Project Manual
Volume 2 of 3

LUHRS MARRIOTT COURTYARD / RESIDENCE INN

132 S. Central Avenue
Phoenix, AZ

Final Bidding

Final for Construction
June 05, 2015

Developed for:
Awbrey Cook Rogers McGill Architects
San Diego, CA

AWBREY
COOK
MCGILL
architects

Project Manual
Volume 2 of 3

LUHRS MARRIOTT COURTYARD / RESIDENCE INN

132 S. Central Avenue
Phoenix, AZ

Final Bidding

Final for Construction
June 05, 2015

Developed for:
Awbrey Cook Rogers McGill Architects
San Diego, CA

AWBREY COOK MCGILL architects

- SECTION 00005 –

PROJECT DIRECTORY

OWNER

LUHRS CM, LLC
631 West Katella Ave.
Fifth Floor
Anaheim, CA 92802
Contact: John Bissell
Primary: johnb@hansji.com
Secondary: (714) 399-0152

(SEAL)

ARCHITECT

AWBREY COOK ROGERS MCGILL ARCHITECTS
1045 14th Street, Suite 100
San Diego, CA 92101
Contact: Leonard Brinkers, Project Manager
Scot McGill, Principal-in-Charge
(619) 398-3480
(619) 398-3488 fax

(SEAL)

STRUCTURAL ENGINEER

CTS ENGINEERS
(CARUSO TURLEY SCOTT CONSULTING STRUCTURAL ENGINEERS)
1215 W. Rio Salado Parkway, suite 200
Tempe, AZ 85281
Contact: Tom Morris, Engineer of Record
Brady Notbohm, Project Manager
(480) 774-1700
(480) 774-1701 fax

(SEAL)

MECHANICAL / PLUMBING ENGINEER

LSW PHOENIX
2333 West Northern Ave, Suite 9
Phoenix, AZ 85021
Contact: Russ Betz
(602) 249-1320
(602) 336-3276 fax

(SEAL)

ELECTRICAL ENGINEER

LSW PHOENIX
2333 West Northern Ave, Suite 9
Phoenix, AZ 85021
Contact: Mark Ralston
(602) 249-1320
(602) 336-3276 fax

(SEAL)

CIVIL ENGINEER

HUBBARD ENGINEERING
1840 S. Stapley Drive, Suite 137
Mesa, AZ 85204
Contact: Brent Steffenhagen
(480) 892-3313
(480) 892-7051 fax

(SEAL)

LANDSCAPE ARCHITECT

GILLESPIE MOODY PATTERSON
4125 Sorrento Valley Blvd. Suite D
San Diego, CA 92121
Contact: Rob Streza
John Patterson
(858) 558-8977

(SEAL)

TELECOMMUNICATIONS & AV- LOW VOLTAGE
ULTIMATE COMMUNICATION SYSTEMS
2579 West Woodland Drive
Anaheim, CA 92801
Contact: Robert Bohan
(714) 484-3101 ext 25
(714) 484-3102 fax

(SEAL)

LIFE SAFETY / ADA / CODE REVIEW / SMOKE CONTROL

AON ENGINEERING
11770 Bernardo Plaza Court
Suite 116
San Diego, CA 92128
Contact: Mark Verrochi
(858) 673-5845
(858) 673-5849 fax

FAÇADE ACCESS CONSULTING (WINDOW WASHING/DAVIT)

OLYMPIQUE
26232 Enterprise Ct
Lake Forest, CA 92630
Contact: Christane de Magalhaes Tonn, Project Manager
David Ortiz
(949) 309-2820
(949) 243-0699 fax

DOOR HARDWARE

OPENING CONSULTANTS
1401 North El Camino, Ste 202
San Clemente, CA 92672
Contact: Missy Fry, Project Manager
Mike Rice
(949) 388-6751

POOL AND SPA

AQUA DESIGN INTERNATIONAL
7534 North La Cholla Blvd.
Tucson, AZ 85741
Contact: David Acklin
Ken Paulson
(520) 219-8929

INTERIOR DESIGNER

DEGEN & DEGEN
1402 Third Avenue, Suite 1100
Seattle, WA 98101
Contact: Anita Degen, Principal
(206) 623-6368

GEOTECHNICAL ENGINEER

SPEEDIE & ASSOCIATES
3331 East Wood Street
Phoenix, AZ 85040
Contact: Gregg Creaser
(602) 997-6391
(602) 943-5508 fax

SHORING DESIGN

AMEC ENVIRONMENT & INFRASTRUCTURE, INC.
4600 East Washington Street, Suite 600
Phoenix, AZ 85034
Contact: Daniel N. Frechette
Senior Associate Geotechnical Engineer
(602) 733-6000

INTERIOR SIGNAGE

GRAPHIC SYSTEMS, INC.
313 IDA
Wichita, KS 67211
Contact: Amy Scheer
Rodney Frey, Wayfinder
(316) 267-4171
(316) 267-6883 fax

FOOD SERVICE & LAUNDRY

MIKE STORY
22899 Byron Road
PO Box 6682
Crestline, CA 92325
Contact: Mike Story
(909) 338-0223

ACOUSTICAL ANALYSIS

MESTRE GREVE ASSOCIATES
Division of Landrum & Brown
19700 Fairchild Road, Suite 230
Irvine, CA 92612
(949) 349-0671
Contact: Eric Seavey
Fred Greve, PE

BUILDING ENVELOPE / SPECIFICATIONS

DTR CONSULTING SERVICES, INC.
1221 Pleasant Grove Blvd, Ste 120
Roseville, CA 95678
Contact: James L. Engler, Associate in Firm
(916) 772-3600
jengler@dtrcs.com
John Guill, Principal in Firm
(707) 578-3600

- DOCUMENT 00 0010 -

TABLE OF CONTENTS

Introductory Documents:

Bidding Documents:

Volume 1 of 3

Specifications:

- END OF TABLE OF CONTENTS –
- (VOLUME 1 OF 3)

VOLUME 2 OF 3

- END OF TABLE OF CONTENTS –
- (VOLUME 2 OF 3)

- VOLUME 3 OF 3

- END OF TABLE OF CONTENTS –
- (VOLUME 3 OF 3)

DIVISION 10 – SPECIALTIES

TABLE OF CONTENTS

- SECTION 10 1100 -

VISUAL DISPLAY SURFACES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Decorative Merchandising Slotted Display Wall.

1.3 RELATED REQUIREMENTS

A. Pertinent Sections specifying Volatile Organic Compound (VOC) Content Restrictions.

B. Section 01 6116 “Volatile Organic Compound (VOC) Restrictions”.

C. Section 09 2216 “Non-Structural Metal Framing”.

D. Section 09 2900 “Gypsum Board”.

1.4 REFERENCES

A. “Phoenix Building Construction Code”, International Building Code 2006, with City of Phoenix administrative provisions and amendments.

1.5 SUBMITTALS

A. General: Submit in accordance with Section 01 3300.

B. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

C. Product Data: For each type of product indicated, demonstrate compliance with specified attributes.

D. VOC Submittals:

1. Product Data – VOC Limits: For adhesives sealants, fillers and primers, documentation including printed statement of VOC contents, comply with limits specified in Section 01 6116.

E. Submit "Letter of Conformance" in accordance with Section 01 3300 with the following supporting data:
   1. Submit product data which shall include physical dimensions, operational features, color and finish, anchorage details, rough-in measurements, location, and details.
   2. Submit manufacturer's installation instructions.

1.6 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements of Section 01 6000.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Limits for adhesives sealants, fillers and primers. Comply with limits specified in Section 01 6116.

2.2 MANUFACTURERS

A. Avendra, LLC Preferred Manufacturers:
   1. None.

B. Approved Manufacturers:
   1. "MegaWall Aluminum Slatwall"; MegaWall, Inc. (616-647-4190)
   2. Approved Substitution.

2.3 DISPLAY WALL

A. 1-sided Aluminum Panel Color: Powdercoated finish, custom color as shown on Drawings.

B. Panel Groove Insert Color: Color as shown on Drawings.

C. Overall Panel Dimension: As shown on Drawings.

D. Groove Spacing: 1-inch on centers.

E. Installation Method: Hidden Fastener system.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install unit level on wall. Secure rigidly in place in accordance with manufacturer's instructions.

- END OF SECTION -

- SECTION 10 1400.01 -

INTERIOR SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Interior Graphic Plaques, Characters and Accessories.
a. Furnished by Owner, installed by Contractor:
1) Directional Signage
2) Identification Signage
3) Projection Mounted Signage
4) Stair and Elevator Signage
5) Informational Signage
6) Letters and Graphics
7) Parking Lot Signage
8) Key Card Signage
9) Guest Room Signage
10) Exercise Room Signage
11) Pool Signage
12) Fire Pit Emergency Shutoff Signage
13) Fire Pit Warning Plaque Signage

1.3 RELATED REQUIREMENTS

A. Section 05 5100 “Pre-Fabricated Metal Stairs” for Intumescent marking on and at metal stairs.

B. Section 10 1400.01a “Sign Manual-Interior Graphics Package (Courtyard)”

C. Section 10 1400.01b “Sign Manual-Interior Graphics Package (Residence Inn)”

D. Section 10 1400.02 “Exterior Signage”

E. Section 10 1400.02a “Sign Manual-Exterior Graphics Package (Courtyard)”

F. Section 10 1400.02b "Sign Manual-Exterior Graphics Package (Residence Inn)"

G. Section 10 3100 "Manufactured Fireplaces" for Emergency Shut Off and Warning Plaque signage installed at Fire Pit.

H. Section 14 2100 "Electric Traction Elevators" for code required elevator signage.

I. Section 26 5100 "Interior Lighting Fixtures and Lamps" for Exit Lighting.

J. Division 26 Sections for electrical service and connections for illuminated signs.

1.4 REFERENCES

A. "Phoenix Building Construction Code", International Building Code 2006, with City of Phoenix administrative provisions and amendments.

B. American National Standards Institute, Inc.(ANSI) Publications:
1. A117.1 "American National Standard for Buildings and Facilities Providing Accessibility and Usability for Physically Handicapped People"

C. Americans with Disabilities Act Accessibility Guidelines (ADAAG)
1. 36 CFR 1191 - Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities; Final Rule; Federal Register, July 26, 1991; updated 2010.

D. ASTM International (ASTM) Publications:
1. B117 "Standard Practice for Operating Salt Spray (Fog) Apparatus"
2. D1735 "Standard Practice for Testing Water Resistance of Coatings Using Water Fog Apparatus"

E. American Welding Society (AWS)

1.5 SUBMITTALS

A. General: Submit in accordance with Section 01 3300.

B. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

C. Product Data: For each type of product indicated, demonstrate compliance with specified attributes.

D. VOC Submittals:
1. Product Data – VOC Limits: For adhesives sealants, fillers and primers, documentation including printed statement of VOC contents, comply with limits specified in Section 01 6116.

E. Submit "Letter of Conformance" in accordance with Section 01 33 00 (01330) indicating specified items selected for use in project with the following supporting data.
1. A copy of the manufacturer's printed installation manual shall accompany Bid for review and approval by the Owner's Representative.

2. Shop Drawings showing sign layout, lettering style, materials, and other pertinent information.
   a. Post and panel/pylon signage: Include plans, elevations, sections, details, and attachments to other work.
   b. Show locations of electrical service connections.

1.6 QUALITY ASSURANCE

A. Graphic signs, including materials, fabrication, mounting and installation, shall conform to state and local code regulations and requirements.

B. All items shall utilize the highest standards of professional workmanship and practices.

1.7 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements of Section 01 6000.

B. Coordinate delivery of materials comprising the complete graphics package. Store materials upon approval of Owner. Take precautions to protect materials and be responsible for same until installed, inspected and accepted in writing by Owner.

1.8 PROJECT CONDITIONS

A. Coordinate work with all trades affected by Contractor's work and be fully cognizant of their requirements as pertaining to Contractor's work.

1.9 WARRANTY

A. Special Warranty: All materials, finishes and workmanship shall be warranted for a period of two (2) years after final acceptance of the work. If during the warranty period, any defects or faulty materials are found, the Contractor shall immediately proceed at his own expense to replace and/or repair same at not cost to Owner.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Limits for adhesives sealants, fillers and primers. Comply with limits specified in Section 01 6116.

2.2 INTERIOR SIGNAGE MANUFACTURER/FABRICATOR

A. Avendra, LLC Preferred Manufacturers:
   1. None

B. Approved Manufacturers:
   1. Graphic Systems Inc.; (316-267-4171)

a. Contact: Jackie Diffenbaugh

2. Cornelius Brand signage, a Forms + Surfaces Company, (800-553-7722).
   a. Contact: Jessica Nagoda (800-451-0410 x 5532), Jessica.nagoda@forms-surfaces.com
3. Approved Substitution by Marriott International.

2.3 MATERIALS – INTERIOR SIGNAGE

A. Basis of Design: Refer to the following for sign types, designs, and graphic information.
   1. Section 10 1400.01a Sign Manual-Interior Graphics Package (Courtyard)
   2. Section 10 1400.01b Sign Manual-Interior Graphics Package (Residence Inn)

B. Acrylic: Produced by Rohm and Haas or approved substitution. Acrylic shall be cut straight and true, free of saw marks, burrs, scratches or other imperfections.

C. Vinyl: Pressure sensitive adhesive backed vinyl with integral color as manufactured by one of the following:
   1. Avendra, LLC Preferred Manufacturers:
      a. None
   2. Approved Manufacturers:
      a. 3M (888-364-3577)
      b. Approved substitution

D. Polycarbonate Sheet: Manufactured by extrusion process, coated on both surfaces with abrasion-resistant coating.

E. Finishes:
   1. Signs: Produced by photographic silk-screen stencils unless otherwise noted. Hand-cut, frisketed, or die-cut images will not be accepted.
   2. Silk-screening inks: As manufactured by one of the following:
      a. Avendra, LLC Preferred Manufacturers:
         1) None
      b. Approved Manufacturers:
         1) Naz-Dar Company (800-767-9942)
         2) Approved substitution
   3. Ink and paint: Mixed in sufficient quantities to assure consistent coloration throughout project.

F. Adhesive: Colorless adhesive used in strict accordance with manufacturer's recommendations for conformance to the manufacturer's product warranty, as manufactured by one of the following:
   1. Avendra, LLC Preferred Manufacturers:
      a. None
   2. Approved Manufacturers:
      a. General Electric
      b. Dow Corning, Inc. (800-248-2481)
      c. Approved substitution

G. Fasteners: Non-corrosive, physically compatible with material fastened. Size, shape and type as recommended by the fabricator. Owner maintains the right to review fastening techniques to assure aesthetic conformance to design drawings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examination:

1. Examine areas for conditions detrimental to completion of the delivery and installation work. Report findings to the Architect immediately. Do not proceed with work until unsatisfactory conditions have been corrected or until advised in writing by the Owner.
2. Starting work constitutes acceptance of conditions under which the work is to be performed. After such acceptance Contractor shall, at his own expense, be responsible for correcting all unsatisfactory and defective work resulting from such unsatisfactory conditions.

3.2 INSTALLATION

A. Perform all cutting and fitting necessary for installation and completion of the work while accommodating the work of other trades. Immediately repair damage to existing surfaces or finishes caused by work of this Contractor at no cost to Owner.

B. Site Verification of Conditions: Verify installation conditions previously established under other sections are acceptable for product installation in accordance with manufacturer's instructions

C. General: Locate sign units and accessories where indicated, using mounting methods of the type described and in compliance with the manufacturer's instructions.

1. Install signs level, plumb, and at the height indicated, with sign surfaces free from distortion or other defects in appearance.

D. Interior Signage:

1. Install at locations as directed by Owner's Representative.
2. Install in strict accordance to manufacturer's recommended procedures.
3. Signs indicated to be door mounted shall use a combination of vinyl tape and silastic adhesive for a permanent bond.
4. Signs indicated to be installed on the wall adjacent to the latch side of the door shall have a mounting height of 60 -inch above finished floor to centerline of sign. Mounting location shall be so that a person may approach within 3 -inch of signage without encountering protruding objects or standing within the swing of a door.
5. Insure level installation.

3.3 CLEANING AND PROTECTION

A. After installation, clean soiled sign surfaces according to the manufacturer's instructions. Protect units from damage until acceptance by the Owner.

B. Provide cleanup and removal of debris resulting from the installation work.

- END OF SECTION -

GRAPHICSSYSTEMS INC

ARCHITECTURAL SIGN SYSTEMS

COURTYARD 2008
INTERIOR SIGNAGE PACKAGE

Featuring attractive ADA compliant signage, Guest Room Area signs consist of a Chemetal backer in Treefrog-Black Oak with a satin aluminum face and a colored accent insert of PMS 144, Golden Orange. Public Area signs are satin aluminum. Room identification signs have raised copy with Grade II Braille, and all signs have Gotham Rounded Med. copy in Romark® 311-803 Dark Brown, or Screenprint Ink to match.

We Make Ordering Easy!

WAYFINDING

Send Graphics Systems, Inc. your hotel's floorplan and let us assist with your signage order. Our experienced wayfinding staff will determine your property's specific requirements and provide you with a detailed plan that includes a graphic of each sign, signtype, quantity, price and location, all in an easy to read format.

NO DESIGN FEES

Our talented design team will create any additional signage you require, including state and local code signage, free of charge.

NO MAP CHARGES

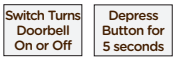
Our professional artists will draw your fire evacuation maps free of charge. Just send us your floorplans and we'll do the rest.

Guest Room Signage

5" x 3"
RMN 0503 COU
Guest Room Number

3" diameter
SHP33/SHV33
Sprinkler Warning
Lexan™ or Decal
available

3" x 3"
HI 33 COU / AC 33 COU
Hearing Impaired/Accessible
Informationals

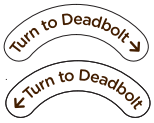


3-1/4" x 2-1/8"
INF 0302 COU
Hearing Impaired
Informationals

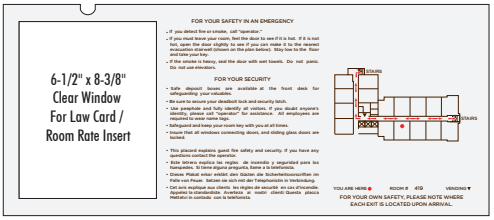
15" x 9-9/16"
FEP 1509 COU
Guest Room Evacuation Plan

6" x 3"
WLD 63 COU
Warning Decal

1-1/4" x 1-1/4
AC11 COU
Accessible Decal



3" x 5/8"
DBV 31 COU
Deadbolt Decal



23" x 10"
FEP 2310 COU
Guest Room Evacuation Plan w/ Window

6-3/4" x 9"
FEP 0709 COU
Rate Card / State Lodging Laws
for Guest Room Evacuation Plan

Directional Signage

11" x 4-1/4"
DIR 1104 COU
Directional, 1-2 line

11" x 7"
DIR 1107 COU
Directional, 3-4 line

13" x 5-3/4"
DIR 1306 COU
Directional, 1-2 line

13" x 8-1/2"
DIR 1309 COU
Directional, 3-4 line

313 Ida ▪ Wichita, KS 67211 ▪ (316) 267-4171 ▪ (316) 267-6883 fax ▪ www.graphicssystems.net

Rev. 07-14-10

FINAL FOR CONSTRUCTION

Directional Signage continued

13" x 11-1/4"
DIR 1311 COU
Directional, 5-6 line

13" x 14"
DIR 1314 COU
Directional, 7-8 line

13" x 16-3/4"
DIR 1317 COU
Directional, 9-10 line

13" x 19-1/2"
DIR 1320 COU (not shown)
Directional, 11-12 line

13" x 22-1/4"
DIR 1322 COU (not shown)
Directional, 13-14 line

13" x 25"
DIR 1325 COU (not shown)
Directional, 15-16 line

Identification Signage

9" x 6"
ID 0906 COU
1-2 Line Identification
ID 0906 COU EXT (exterior)

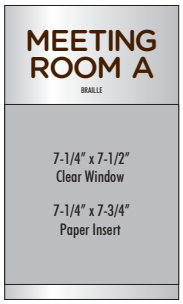
11" x 6"
ID 1106 COU
1-2 Line Identification, Large

7-3/4" x 7-3/4"
RES 0808 COU
Restroom Identification

7-3/4" x 7-3/4"
HR 0808 COU
1-2 Line Identification with
Hours Information
HR 0808 COU EXT (exterior)

9" x 8"
ID 0908 COU
3-4 Line Identification

12" x 11"
TDD 1211 COU
TDD Identification, Exterior



7-1/4" x 12-1/4"
MRID 0712 COU
Meeting Room Identification

9-1/2" x 6"
ID 1006 COU
The Market Identification -
For Renovations Only,
If Required To Meet ADA

Projection Mounted Signage

8-1/2" x 4"
PRO 0804 COU
Projection Mounted Informational,
Double Sided

8-1/2" x 8"
PRO 0808 COU
Projection Mounted Informational,
Double Sided

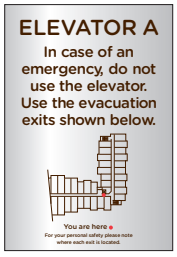
GRAPHICSSYSTEMS INC

ARCHITECTURAL SIGN SYSTEMS

Stair & Elevator Signage

7" x 10-1/4"
FEP0710A COU
Ground Floor
Elevator Evacuation

7" x 10-1/4"
FEP0710B COU
Floors 2 and Up
Elevator Evacuation



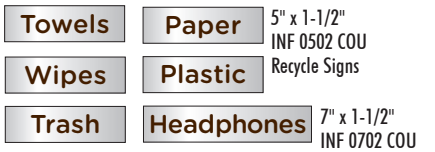
7" x 10-1/4"
FEP0710C COU
Ground Floor
Elevator Evacuation with
Elevator Designation

7" x 10-1/4"
FEP0710D COU
Floors 2 and Up
Elevator Evacuation with
Elevator Designation

12" x 12-1/4"
STR 1212 COU
Stairwell Level Identification for 4 Floors

12" x 16-5/8"
STR1217A CFRST (not shown)
Stairwell Level Identification for 5 Floors & Up
and Where Exit Discharge Information
Is Required

2-3/4" x 3-1/2"
ELJ 0304 COU
Elevator Door Jam



5" x 1-1/2"
INF 0502 COU
Recycle Signs

7" x 1-1/2"
INF 0702 COU
Headphone Sign

Informational Signage

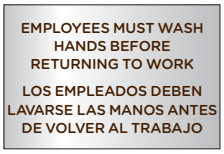
9" x 6"
INF 0906 COU
Informational

9" x 6"
ACC 0906 COU
Accessible Informational

9" x 8"
INF 0908 COU
Informational

8" x 2"
INF 0802 COU
Recycle Signs for
Coffee Area & Bistro

9" x 6"
INF 0906 COU
Informational



9" x 6"
INF 0906 COU
Informational

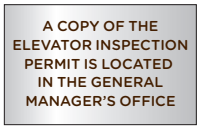
7" x 5"
INF 0705 COU
Informational for
Business Center

8" x 10"
OP 0810 COU
Owner/Operator

9" x 6"
INF 0906 COU
Informational

9" x 6"
INF 0906 COU
1-2 Line Informational, Exterior
INF 0906 COU EXT (exterior)

9" x 6"
MO 0906 COU
Maximum Occupancy



8" x 5"
INF 0805 COU
Elevator Inspection Informational

313 Ida ▪ Wichita, KS 67211 ▪ (316) 267-4171 ▪ (316) 267-6883 fax ▪ www.graphicssystems.net

GRAPHICSSYSTEMS INC

ARCHITECTURAL SIGN SYSTEMS

Letters and Graphics

Boarding Pass

34" x 10-3/16"
MFA 3410 COU
Cut Out Metal Faced Acrylic Letters and Graphic

Quick Print

25-1/2" x 10"
PRT 2610 COU
Cut Out Metal Faced Acrylic Letters and Graphic
(Alternate Option To MFA 3410 COU)

the market

24-1/2" x 7-11/16"
MFA 2508 COU
Cut Out Metal Faced Acrylic Letters

8" x 8"
CUP -0808 COU
Double Sided Graphic

11-1/4" x 10-15/16"
CUP 1111 COU
Double Sided Graphic

Parking Lot Signage

NOTICE

You are parking and leaving your vehicle at your own risk. Please lock all doors and windows after removing any property or valuables from the vehicle. The hotel will not, in any event, be liable for loss or damage to your vehicle or property.

16" x 16"
PRK 1616 COU
"NOTICE" Parking Informational

Key Card Signage

Please use your Guest Room Key Card for entry or ring the bell for service
Thank you

10" x 7"
KC 1007 COU
Key Card Informational

COURTYARD

10" x 7"
LOGO 1007 COU
Logo Informational
(to fit on back of Key Card Informational)

Use Guest Room Key Card

3-1/4" x 2-1/2"
KC 0302 COU
Key Card Informational

Portico Signage

Clearance 10'-10"

60" x 10"
CL 6010 COU
Clearance Sign

313 Ida ▪ Wichita, KS 67211 ▪ (316) 267-4171 ▪ (316) 267-6883 fax ▪ www.graphicssystems.net

GRAPHICSSYSTEMS INC

ARCHITECTURAL SIGN SYSTEMS

Health Club Signage

Whirlpool Spa Use

For your safety, it is required that you observe the following:

- Registered guests only.
- Individuals utilizing this facility do so at their own risk.
- WARNING - No consumption of alcoholic beverages or food is permitted in pool area.
- It is highly recommended that the following individuals not use the whirlpool spa:
  a) persons with present or prior heart disease, high blood pressure, or any chronic health problems.
  b) persons under the influence of alcohol, stimulants or depressants.
  c) pregnant women. d) elderly persons. e) children under the age of 10.
  f) unsupervised children under the age of 15.
- Should you need any assistance, please contact management.
- WARNING: Chemical and PH levels are in accordance with local codes and measured regularly.
- However, high heat and chemical in this spa may cause fading and/or damage to certain fabrics. • Always practice water safety and courtesy to others.
- Report any unsafe conditions to the management.
- All persons shall bathe with warm water and soap before entering spa.
- Any persons known or suspected of having a communicable disease shall not use the spa.
- Spitting or blowing the nose in the spa is prohibited. • Do not use alone.
- Observe a reasonable time limit, (preferably not longer than 15 minutes), then shower, cool down and if you wish, return for another brief stay. Long exposures may result in nausea, dizziness or fainting.
- Food and glass objects are not permitted in spa area.
- Maximum temperature 104° Fahrenheit.

MAXIMUM BATHING LOAD

9

Thank you for your attention and cooperation.

24" x 19"
WR2419 CFRST
Whirlpool Spa Rules

Pool Area Use

For your safety, it is required that you observe the following:

- Registered guests only.
- All children under 14 must be with an adult.
- Running and horseplay are prohibited.
- Appropriate swim wear required.
- Diving strictly prohibited.
- Shirts and shoes required in the hotel lobby.
- Glassware is not permitted within the pool area.
- Only flexible swim-aids are permitted.
- Be aware of depth markings at all times.
- Report any unsafe conditions or violations to the management immediately.
- Individuals assume the risk for any injuries sustained while using pool facilities.
- Always practice water safety and courtesy.
- Shower before entering pool.
- Children who are not toilet trained must wear swim diapers with rubber pants over them.

Thank you for your attention and cooperation.

23" x 23"
PR 2323 COU
Pool Rules

Fitness Center Rules

For your safety, it is required that you observe the following:

- Registered guests only.
- Individuals utilizing this facility do so at their own risk.
- Individuals should not undertake exercise routines unless physically qualified and have a physician's approval to do so.
- It is highly recommended that the following individuals not use the exercise equipment:
  -persons under the influence of alcohol, stimulants or depressants
  -unsupervised children under the age of 16
  -children under the age of 14
- Should you need any assistance please contact the Front Desk.
- Equipment should be used in the presence of others.
- Shoes and appropriate exercising attire are necessary.
- Smoking is prohibited.
- Always practice safety and courtesy to others.
- Report any unsafe conditions to the management.

Thank you for your attention and cooperation.

20" x 19"
FIT 2019 COU
Fitness Center Rules

MOUTH-TO-MOUTH RESUSCITATION

A - AIRWAY
1. Clear the mouth.
2. Push or pull jaw into a jutting out position.

B - BREATHING
3. Pinch nose SHUT.
4. Cover victim's mouth with your mouth. BLOW until chest rises: for BABIES; cover mouth and nose.
5. Remove your mouth. Listen for return air. Repeat 12 to 15 times per minute.

CAUTION: If a neck injury sign appears, move the lower jaw forward without tilting the head to open the airway. Rest your elbow without tilting the head to open the airway. Rest your elbow on the surface which the victim is laying. Move the lower jaw forward with both hands, one on each side.

20" x 20"
MM 2020 COU
Mouth-to-Mouth
Resuscitation

WARNING: THIS FACILITY IS UNATTENDED AND IS NOT CONTINUOUSLY MONITORED. THIS FACILITY IS PROVIDED TO OUR GUESTS AS AN AMENITY AND SHOULD NOT BE CONSIDERED A FULL-SERVICE FITNESS FACILITY.

GUESTS SHOULD ONLY USE THIS FACILITY AFTER THEY HAVE CONSULTED A PHYSICIAN TO DETERMINE IF THE USE OF THE EQUIPMENT IN THIS FACILITY IS APPROPRIATE.

AN AUTOMATED EXTERNAL DEFIBRILLATOR HAS BEEN PROVIDED, IN CASE OF AN EMERGENCY.

AS WITH ANY MEDICAL EMERGENCY, 9-1-1 SHOULD BE NOTIFIED PRIOR TO THE RENDERING OF ANY FIRST AID ASSISTANCE.

10" x 10"
AED W1 COU
Automated External Defibrillator
For Unattended Fitness Center

WARNING: THIS FACILITY IS ATTENDED ONLY DURING THE HOURS OF _____. THIS FACILITY IS NOT ATTENDED AT TIMES OUTSIDE OF THESE HOURS. THIS FACILITY IS PROVIDED TO OUR GUESTS AS AN AMENITY AND SHOULD NOT BE CONSIDERED A FULL-SERVICE FITNESS FACILITY.

GUESTS SHOULD ONLY USE THIS FACILITY AFTER THEY HAVE CONSULTED A PHYSICIAN TO DETERMINE IF THE USE OF THE EQUIPMENT IN THIS FACILITY IS APPROPRIATE.

AN AUTOMATED EXTERNAL DEFIBRILLATOR HAS BEEN PROVIDED, IN CASE OF AN EMERGENCY.

AS WITH ANY MEDICAL EMERGENCY, 9-1-1 SHOULD BE NOTIFIED PRIOR TO THE RENDERING OF ANY FIRST AID ASSISTANCE.

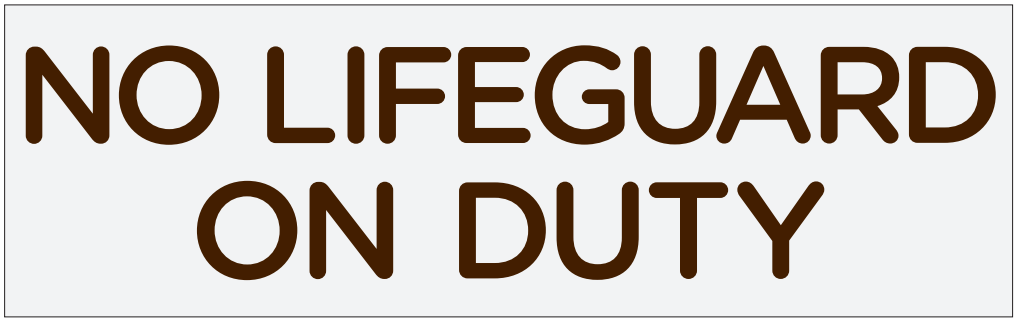
10" x 10"
AED W1 COU
Automated External Defibrillator
For Attended Fitness Center

313 Ida ▪ Wichita, KS 67211 ▪ (316) 267-4171 ▪ (316) 267-6883 fax ▪ www.graphicssystems.net

GRAPHICSSYSTEMS INC

ARCHITECTURAL SIGN SYSTEMS

Health Club Signage



42" x 13"
NLG 4213 COU
No Lifeguard On Duty

5-1/2" x 4"
ESS 0604 COU
Emergency Shutoff Switch

4" x 6"
ST 0406 COU
Spa Timer

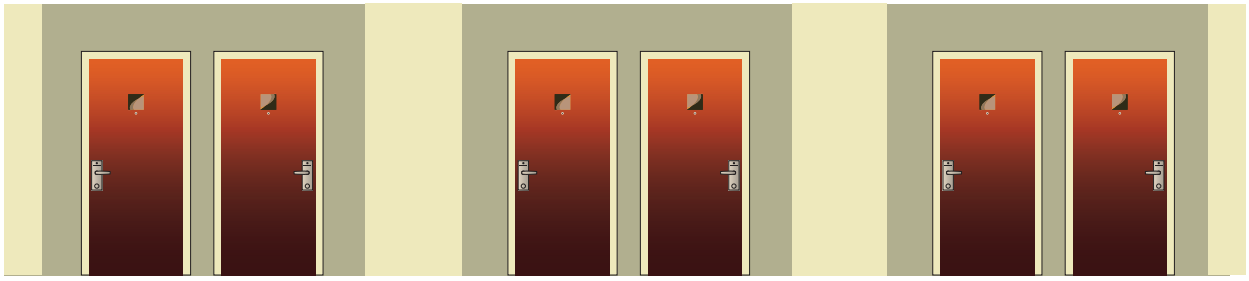
14" x 14"
WND 1414 COU
Warning! No Diving

31" x 7"
ND 3107 COU
No Diving

6" x 4"
PIT 0604 COU
Fire Pit Informational

6" x 4"
PIT 0604B COU
Fire Pit Informational

6" x 6"
RDP 0606 COU
Guest Room Retrofit
These signs must be installed in alternating order.
Please note that the sign is the same, just rotated 180 degrees.



313 Ida ▪ Wichita, KS 67211 ▪ (316) 267-4171 ▪ (316) 267-6883 fax ▪ www.graphicssystems.net

FINAL FOR CONSTRUCTION

GRAPHICSSYSTEMS INC

INSTALLATION

SIGNAGE MOUNTING, CLEANING INSTRUCTIONS AND WARRANTY INFORMATION ON REVERSE SIDE

Do NOT Lose
Give to Installer

ARCHITECTURAL SIGN SYSTEMS

COURTYARD Marriott

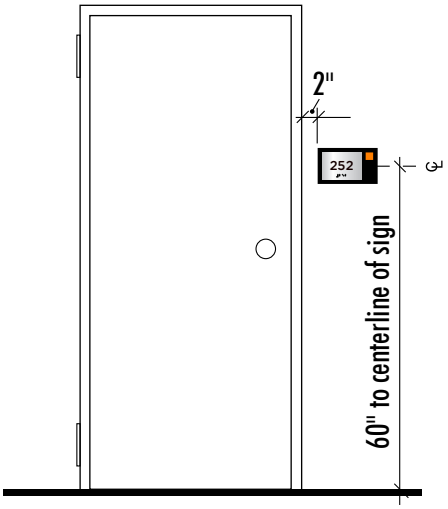
GUEST ROOM NUMBER AND ROOM IDENTIFICATION INSTALLATION

The preferred location for ADA compliancy is on the wall adjacent to the latch side of the door followed by nearest adjacent wall. A sign should NOT be mounted on the door except as a last resort.

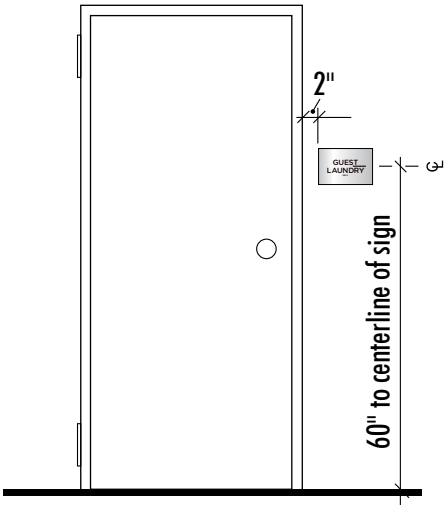
Guest room numbers and room identification signage as well as informational and directional signage should be mounted 60" from the finished floor to the centerline of the sign.

PEEPHOLES NOTE:
Center sign vertically between peepholes if room is accessible. If room is not accessible mount Evacuation Plan 2" below peephole

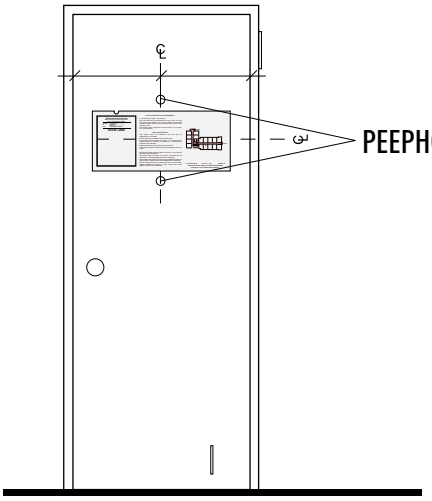
CALIFORNIA EVACS (guest room) are to be mounted no higher than 48" to the bottom of the sign, above finished floor



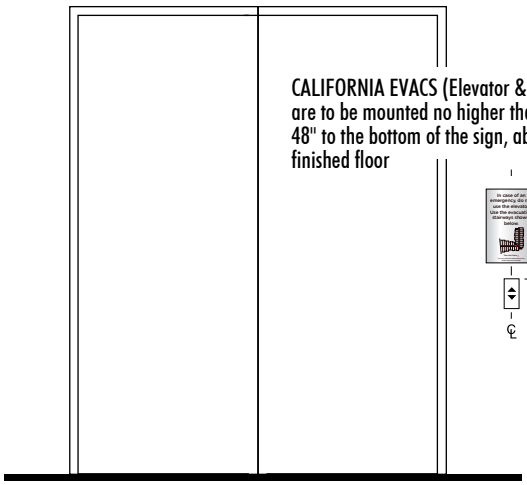
GUESTROOM NUMBER - CORRIDOR SIDE ELEVATION
(NOT TO SCALE)



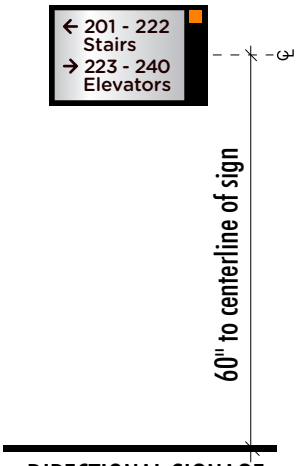
ROOM IDENTIFICATION
(NOT TO SCALE)



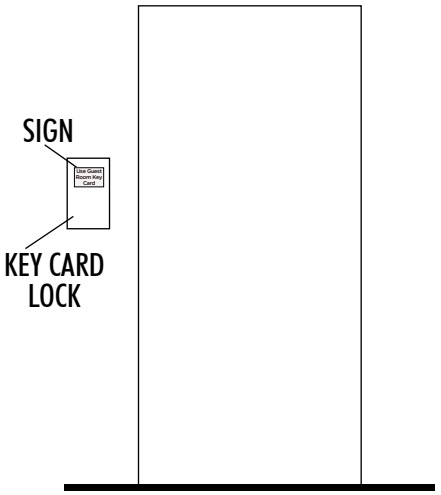
GUESTROOM EVACUATION (INTERIOR)
(NOT TO SCALE)



ELEVATOR EVACUATION - CORRIDOR SIDE ELEVATION
(NOT TO SCALE)

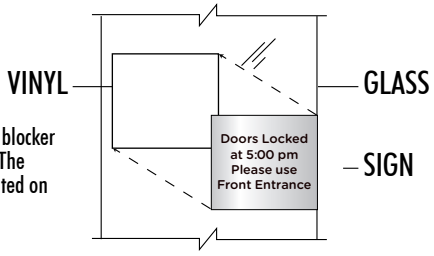


DIRECTIONAL SIGNAGE
(NOT TO SCALE)



KEY CARD - CORRIDOR SIDE ELEVATION
(NOT TO SCALE)

VINYL BLOCKER FOR GLASS MOUNTING
Signage that will be mounted on glass will require a vinyl blocker to hide the signage mounting tape and silicone adhesive. The vinyl blocker is mounted to the glass. The signage is mounted on top of the vinyl blocker.



313 Ida ▪ Wichita, KS 67211 ▪ (316) 267-4171 ▪ (316) 267-6883 fax ▪ www.graphicssystems.net

FINAL FOR CONSTRUCTION

GRAPHICSSYSTEMS INC

ARCHITECTURAL SIGN SYSTEMS

MOUNTING-CLEANING-WARRANTY

SIGNAGE INSTALLATION ON REVERSE SIDE

Do NOT Lose
Give to Installer

Signage Mounting Instructions

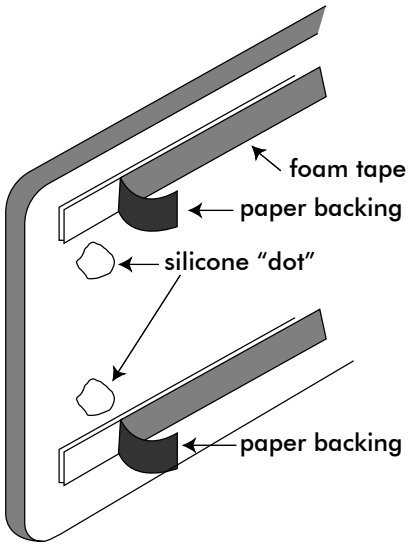
1. Installation surface must be CLEAN and DUST FREE.
2. Place a small "dot" of silicone in each corner of the sign. The "dot" should be 1/4" to 3/8" in diameter.

   WARNING! FOR PRODUCTS WITH METALLIC CONTENT (brass, aluminum, silver, gold, copper, etc.) USE ONLY NON-CORROSIVE SILICONE FOR PRODUCT INSTALLATION! We recommend Silicone XL by M-D (Macklanburg-Duncan) which is regarded as non-corrosive to metals. USE OF REGULAR SILICONE OR OTHER LIQUID ADHESIVES WILL VOID ANY/ALL EXPRESSED OR IMPLIED PRODUCT WARRANTIES REGARDING OXIDATION OF THE METALLIC CONTENT.

3. Remove paper backing from foam tape.
4. Position sign in desired location and apply enough pressure to ensure the foam tape sticks to the mounting surface. The foam tape will hold the sign in place until the silicone adhesive cures.
5. If removal is required, slide a putty knife gently behind the sign and "cut" through the silicone adhesive and the foam tape.

Signs MUST be Mounted with Foam Tape AND Silicone

Tape Holds Sign Until Silicone Dries



If you have any questions concerning these instructions or problems with signage installation, call 316-267-4171 for assistance.

Signage Cleaning Instructions

Do NOT clean unless signage appears soiled.

Do NOT use solvents or ammonia based cleaners. Use of such cleaners will void all warranties.

Use a clean, damp, non-abrasive, lint free cloth to wipe the sign surface.

Do NOT immerse sign. Excess water will damage interior grade Braille signage.

When the soil has been removed, wipe the sign with a clean, dry, non-abrasive, lint free cloth.

If you have any questions concerning these instructions, call your account executive at 316-267-4171 for assistance.

Signage Warranty

Graphics Systems, Inc. guarantees that the materials used for graphics shall be free from defects in materials, design and workmanship for a period of one (1) year from the date of acceptance (delivery).

Upon receipt of notice of failure of any part of these materials during the warranty period, new replacement parts and materials shall be furnished promptly by Graphics Systems, Inc. at no additional cost.

Graphics Systems, Inc. does not warranty abuse, vandalism or wear that occurs in daily use. Graphics Systems, Inc. does not cover damage that occurs in removal of signs.

313 Ida ▪ Wichita, KS 67211 ▪ (316) 267-4171 ▪ (316) 267-6883 fax ▪ www.graphicssystems.net

GRAPHICSSYSTEMS INC

ARCHITECTURAL SIGN SYSTEMS

Residence Inn Marriott

RESIDENCE INN 2009 INTERIOR SIGNAGE PACKAGE

Featuring attractive ADA compliant signage, signs consist of a painted acrylic backer in Turkish Coffee-Sherwin Williams 6076 with a Chemetal Pewter Vine accent. The face of the signs is Metallic Grey-Matthews MP18249, with Frutiger copy and border in White. Guest room numbers and other permanent room identification are created using a photopolymer process which produces raised integral tactile images and Grade II Braille.

We Make Ordering Easy!

WAYFINDING

Send Graphics Systems, Inc. your hotel's floorplan and let us assist with your signage order. Our experienced wayfinding staff will determine your property's specific requirements and provide you with a detailed plan that includes a graphic of each sign, signtype, quantity, price and location, all in an easy to read format.

NO DESIGN FEES

Our talented design team will create any additional signage you require, including state and local code signage, free of charge.

NO MAP CHARGES

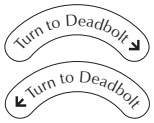
Our professional artists will draw your fire evacuation maps free of charge. Just send us your floorplans and we'll do the rest.

Guest Room Signage

5-3/4" x 3-1/2"
RMN 0604 RES 09
Guest Room Number

3" x 3"
AC33/HI33 RES 09
Accessible /
Hearing Impaired Symbols

6" x 3"
WLD 0603 RES 09
Warning Decal



3" x 5/8"
DBV 31 RES 09
Deadbolt Decal

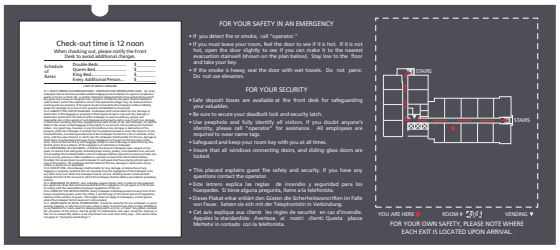
3" diameter
SHP33/SHV33
Sprinkler Warning
Lexan™ or Decal
available

3-1/2" x 2"
INF 0402 RES 09
Hearing Impaired
Informational

5" x 12-1/4"
FEP 0512 RES 09
Standard
Guest Room
Evacuation Plan

5" x 12-1/4"
LAW 0512 INS RES 09
Law/Rate Card Holder

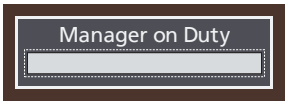
4-3/8" x 11-3/4"
INS 0512 RES 09
Law/Rate Card Insert



23" x 10"
FEP 2310 RES 09
Guest Room
Evacuation Plan w/ Window for flat doors

6-3/4" x 9"
FEP 0709 RES 09
Guest Room Evacuation
Room Rate/State Law Insert

Front Desk Signage

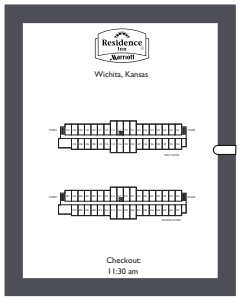


11-3/4" x 4"
MOD 1204 RES 09
Manager On Duty Insert

10" x 1-1/8"
MOD 1103 INSERT RES 09
Manager On Duty Insert

8-1/4" x 4"
INF 0804 RES 09
1-2 Line Informational,
Interior or Exterior

8-1/4" x 8"
OWN 0808 RES 09
Owner/Operator



8-1/2" x 11"
FDM 0911 RES 09
Front Desk Map on Disk

9-5/8" x 12-1/8"
FDM HOLDER RES 09
Front Desk Map Holder

313 Ida ▪ Wichita, KS 67211 ▪ (316) 267-4171 ▪ (316) 267-6883 fax ▪ www.graphicssystems.net

04-11-12

GRAPHICSSYSTEMS INC

ARCHITECTURAL SIGN SYSTEMS

Identification Signage

6-1/2" x 4"
ID 0704 EXT/BH RES 09
1-2 Line Small Identification

8-1/4" x 4"
ID 0804 RES 09
1-2 Line Large Identification

8-1/4" x 6-1/2"
ID 0807 RES 09
3-4 Line Large Identification

8" x 11-1/2"
MR 0812 RES 09
Meeting Room Identification

6-1/2" x 9"
RES 0709 RES 09
Restroom Identification

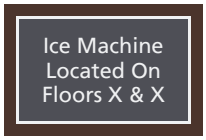
Market Signage

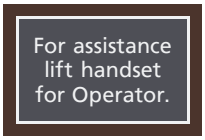
24-1/2" x 7-11/16"
MFA 2508 RES
The Market Metal Face
Cut Out Acrylic Logo

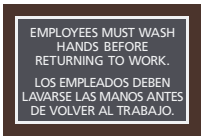
9-1/2" x 6"
ID 1006 RES 09 MARKET
Market ID Sign

Informational Signage

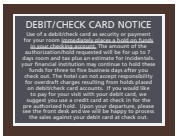
8-1/4" x 5-1/2"
INF 0806 RES 09
Informational,
Interior or Exterior







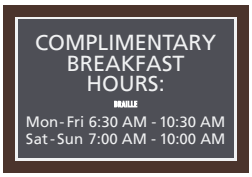
13-1/4" x 12"
TDD 1312 RES 09
Informational



8-1/2" x 6-1/2"
BNT 0907 RES 09
Debit & Check Sign

6-1/4" x 4-1/4"
INF 0604 RES 09
Telephone Informational

8-1/4" x 5-1/2"
MAX 0806 RES 09
Informational



10-1/4" x 7"
HR 1007 RES 09
Informational

9-1/4" x 7"
ACC 0907 RES 09
Accessible Informational, Exterior

313 Ida ▪ Wichita, KS 67211 ▪ (316) 267-4171 ▪ (316) 267-6883 fax ▪ www.graphicssystems.net

GRAPHICSSYSTEMS INC

ARCHITECTURAL SIGN SYSTEMS

Parking Lot Signage

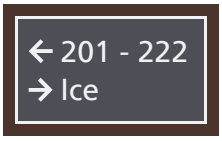
15" x 15"
PLW 1515 RES 09
"NOTICE" Parking Informational

12" x 18"
PRK 1218 RES 09
Parking Informational

Projection Mounted Signage

14-7/8" x 12"
PRO 1412 RES 09
Double-Sided,
Wall Projected
Restroom Informational

Directional Signage



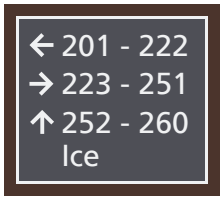
9" x 5-1/2"
DIR 0906 RES 09
1-2 Line, Small Directional

13-1/4" x 5-1/2"
DIR 1306 RES 09
1-2 Line, Large Directional

13-1/4" x 10-1/2"
DIR 1311 RES 09
5-6 Line, Large Directional

13-1/4" x 13"
DIR 1313 RES 09
7-8 Line, Large Directional (not shown)

13-1/4" x 15-1/2"
DIR 1316 RES 09
9-10 Line, Large Directional (not shown)



9" x 8"
DIR 0908 RES 09
3-4 Line, Small Directional

13-1/4" x 8"
DIR 1308 RES 09
3-4 Line, Large Directional

Stair & Elevator Signage

8-1/4" x 9-1/4"
FBH 0809A RES 09
Ground Floor
Elevator Evacuation

8-1/4" x 9-1/4"
FBH 0809B RES 09
Floors 2 & Up
Elevator Evacuation

12" x 12-1/4"
STR 1212 RES 09
Stairwell Level Identification for 4 Floors

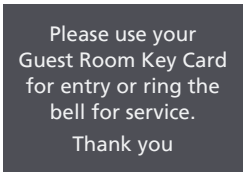
12" x 16-5/8"
STR 1217 RES 09
Stairwell Level Identification for 5 Floors & Up

2-3/4" x 3-1/2"
ELJ 0304 RES 09
Elevator Door Jam

6" x 6"
STR 0606 RES 09
Interior Stairwell Information
Acceptable in some areas
check w/ Local Fire Marshal

8-7/8" x 4"
PRO 0904 RES 09
Double-Sided,
Wall Projected Informational

Key Card Signage



10" x 7"
INF 1007 EXT RES 09
Key Card Informational

3-1/2" x 2"
INF 0402 RES 09
Guest Room Key Card
Informational

313 Ida ▪ Wichita, KS 67211 ▪ (316) 267-4171 ▪ (316) 267-6883 fax ▪ www.graphicssystems.net

GRAPHICSSYSTEMS INC

ARCHITECTURAL SIGN SYSTEMS

Health Club Signage

Pool Area Use

For your safety, it is required that you observe the following:

- Registered guests only.
- All children under 14 must be with an adult.
- Running and horseplay are prohibited.
- Appropriate swim wear required.
- Diving strictly prohibited.
- Shirts and shoes required in the hotel lobby.
- Glassware is not permitted within the pool area.
- Only flexible swim-aids are permitted.
- Be aware of depth markings at all times.
- Report any unsafe conditions or violations to the management immediately.
- Individuals assume the risk for any injuries sustained while using pool facilities.
- Always practice water safety and courtesy.
- Shower before entering pool.
- Children who are not toilet trained must wear swim diapers with rubber pants over them.

Thank you for your attention and cooperation.

23" x 23"
PR 2323 RES 09
Pool Rules

Whirlpool Spa Use

For your safety, it is required that you observe the following:

· Registered guests only.
· Individuals utilizing this facility do so at their own risk.
· WARNING - No consumption of alcoholic beverages or food is permitted in pool area.
· It is highly recommended that the following individuals not use the whirlpool spa:
a) persons with present or prior heart disease, high blood pressure, or any chronic health problems.
b) persons under the influence of alcohol, stimulants or depressants.
c) pregnant women. d) elderly persons. e) children under the age of 10.
f) unsupervised children under the age of 15.
· Should you need any assistance, please contact management.
· WARNING: Chemical and PH levels are in accordance with local codes and measured regularly.
· However, high heat and chemical in this spa may cause fading and/or damage to certain fabrics. • Always practice water safety and courtesy to others.
· Report any unsafe conditions to the management.
· All persons shall bathe with warm water and soap before entering spa.
· Any persons known or suspected of having a communicable disease shall not use the spa.
· Spitting or blowing the nose in the spa is prohibited. • Do not use alone.
· Observe a reasonable time limit, (preferably not longer than 15 minutes), then shower, cool down and if you wish, return for another brief stay. Long exposures may result in nausea, dizziness or fainting.
· Food and glass objects are not permitted in spa area.
· Maximum temperature 104° Fahrenheit.

MAXIMUM BATHING LOAD

9

Thank you for your attention and cooperation.

23" x 23"
WR 2323 RES 09
Whirlpool Spa Rules

SPA TIMER SWITCH
TURN DIAL TO OPERATE
15 MINUTE MAXIMUM

4" x 6"
ST 46 RES 09
Spa Timer Informational

SPORT COURT USE

FOR YOUR SAFETY IT IS REQUIRED THAT YOU OBSERVE THE FOLLOWING:

· Registered guests only.
· Court hours: 9:00 AM to 10:00 PM.
· Individuals utilizing this facility do so at their own risk.
· Individuals should not undertake exercise routines unless physically qualified and have a physicians approval to do so.
· It is highly recommended that persons under the influence of alcohol, stimulants or depressants not use the exercise area.
· Minors should be supervised by parent or guardian.
· Should you need assistance, please contact management.
· Exercise only in the presence of others.
· Shoes and appropriate exercising attire are necessary.
· Always practice safety and courtesy to others.
· Report any unsafe conditions to the management.

Thank you for your attention and cooperation.

14" x 14"
SCU 1414 RES 09
Sport Court Use

MOUTH-TO-MOUTH RESUSCITATION

A - AIRWAY
1. Clear the mouth.
2. Push or pull jaw into a jutting out position.

B - BREATHING
3. Pinch nose SHUT.
4. Cover victim's mouth with your mouth. BLOW until chest rises: for BABIES; cover mouth and nose.
5. Remove your mouth. Listen for return air. Repeat 12 to 15 times per minute.

CAUTION: If a neck injury sign appears, move the lower jaw forward without tilting the head to open the airway. Rest your elbow without tilting the head to open the airway. Rest your elbow on the surface which the victim is laying. Move the lower jaw forward with both hands, one on each side.

20" x 20"
MM 2020 RES 09
Mouth-to-Mouth Resuscitation

Exercise Room Use

For your safety, it is required that you observe the following:

- Registered guests only.
- Individuals utilizing this facility do so at their own risk.
- Individuals should not undertake exercise routines unless physically qualified and have a physician's approval to do so.
- It is highly recommended that the following individuals not use the exercise equipment:
  -persons under the influence of alcohol, stimulants or depressants
  -unsupervised children under the age of 16
  -children under the age of 14
- Should you need any assistance please contact the Front Desk.
- Equipment should be used in the presence of others.
- Shoes and appropriate exercising attire are necessary.
- Smoking is prohibited.
- Always practice safety and courtesy to others.
- Report any unsafe conditions to the management.

Thank you for your attention and cooperation.

20" x 20"
EXR 2020 RES 09
Exercise Rules

WARNING! NO DIVING SHALLOW WATER

CRIPPLING INJURIES MAY RESULT

14" x 14"
WND 1414 RES 09
No Diving

WARNING: THIS FACILITY IS UNATTENDED AND IS NOT CONTINUOUSLY MONITORED. THIS FACILITY IS PROVIDED TO OUR GUESTS AS AN AMENITY AND SHOULD NOT BE CONSIDERED A FULL-SERVICE FITNESS FACILITY.

GUESTS SHOULD ONLY USE THIS FACILITY AFTER THEY HAVE CONSULTED A PHYSICIAN TO DETERMINE IF THE USE OF THE EQUIPMENT IN THIS FACILITY IS APPROPRIATE.

AN AUTOMATED EXTERNAL DEFIBRILLATOR HAS BEEN PROVIDED, IN CASE OF AN EMERGENCY.

AS WITH ANY MEDICAL EMERGENCY, 9-1-1 SHOULD BE NOTIFIED PRIOR TO THE RENDERING OF ANY FIRST AID ASSISTANCE.

10" x 10"
AED W1 RES
Automated External Defibrillator
For Unattended Fitness Center

WARNING: THIS FACILITY IS ATTENDED ONLY DURING THE HOURS OF _____. THIS FACILITY IS NOT ATTENDED AT TIMES OUTSIDE OF THESE HOURS. THIS FACILITY IS PROVIDED TO OUR GUESTS AS AN AMENITY AND SHOULD NOT BE CONSIDERED A FULL-SERVICE FITNESS FACILITY.

GUESTS SHOULD ONLY USE THIS FACILITY AFTER THEY HAVE CONSULTED A PHYSICIAN TO DETERMINE IF THE USE OF THE EQUIPMENT IN THIS FACILITY IS APPROPRIATE.

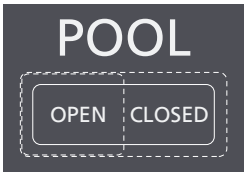
AN AUTOMATED EXTERNAL DEFIBRILLATOR HAS BEEN PROVIDED, IN CASE OF AN EMERGENCY.

AS WITH ANY MEDICAL EMERGENCY, 9-1-1 SHOULD BE NOTIFIED PRIOR TO THE RENDERING OF ANY FIRST AID ASSISTANCE.

10" x 10"
AED W1 RES
Automated External Defibrillator
For Attended Fitness Center

313 Ida ▪ Wichita, KS 67211 ▪ (316) 267-4171 ▪ (316) 267-6883 fax ▪ www.graphicssystems.net

Health Club Signage continued



10" x 7"
PS 1007 RES 09
Informational/Slider Sign

36" x 8"
ND 3608 RES 09
No Diving

36" x 15"
NLG 3615 RES 09
No Lifeguard On Duty

Grill Use Signage

11" x 8"
GU 1108 RES 09
Grill Use

6" x 4"
PIT 0604 RES 09
Fire Pit Informational

6" x 4"
PIT 0604B RES 09
Fire Pit Informational

Portico Signage

60" x 10"
CL 6010 RES 09
Clearance Sign

GRAPHICSSYSTEMS INC

INSTALLATION

SIGNAGE MOUNTING & CLEANING INSTRUCTIONS ON REVERSE SIDE

Do NOT Lose / Give to Installer

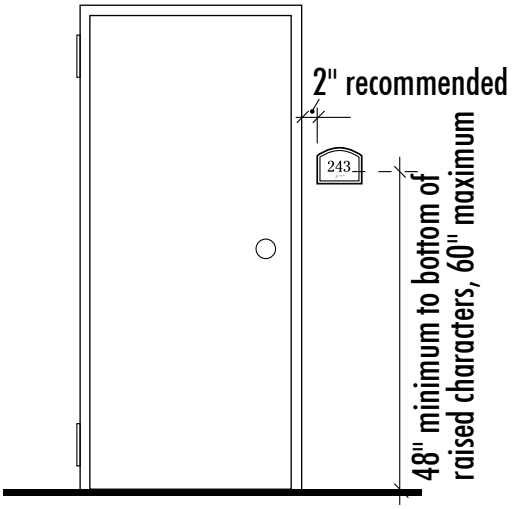
ARCHITECTURAL SIGN SYSTEMS

GUEST ROOM NUMBER AND ROOM IDENTIFICATION INSTALLATION

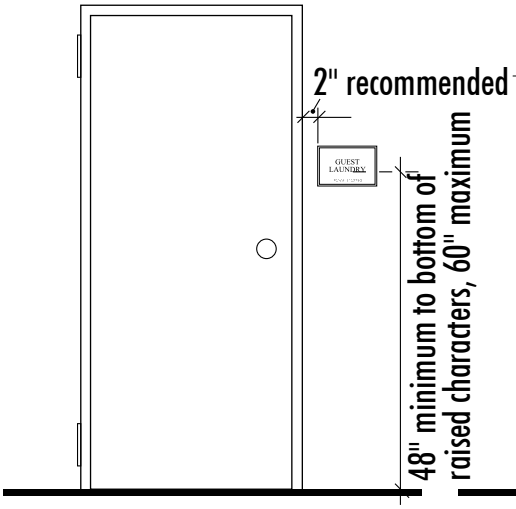
The preferred location for ADA compliancy is on the wall adjacent to the latch side of the door followed by nearest adjacent wall.
If double doors are present (both active), the sign should be located on the right hand side of the right door.
If only one door is active, the sign should be located on the other door. Signs with tactile characters shall be permitted on the push side of doors with closers and without hold-open devices (i.e. - Restrooms, Guest rooms).

PEEPHOLES NOTE:
Center sign vertically between peepholes if room is accessible.
If room is not accessible mount Evacuation Plan 2" below peephole

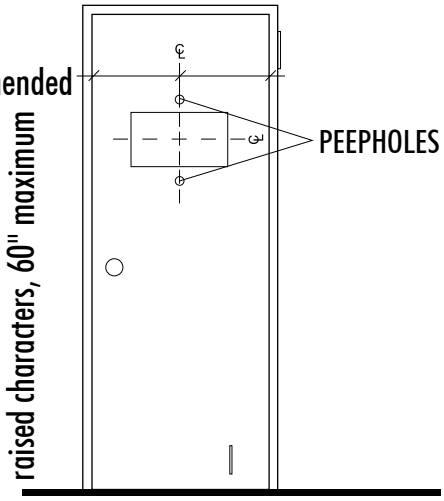
CALIFORNIA EVACS (guest room) are to be mounted no higher than 48" to the bottom of the sign, above finished floor



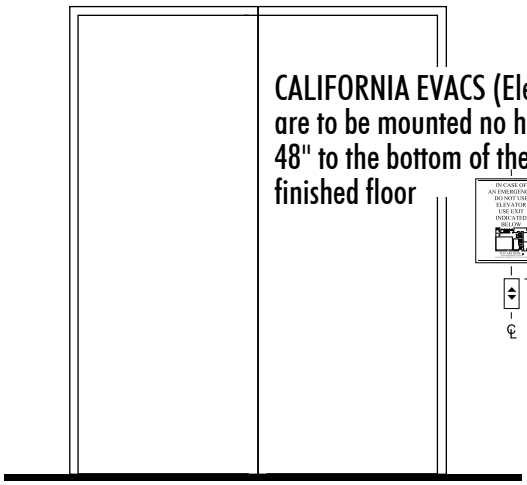
GUESTROOM NUMBER - CORRIDOR SIDE ELEVATION
(NOT TO SCALE)



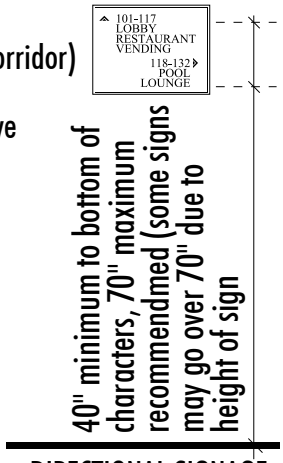
ROOM IDENTIFICATION
(NOT TO SCALE)



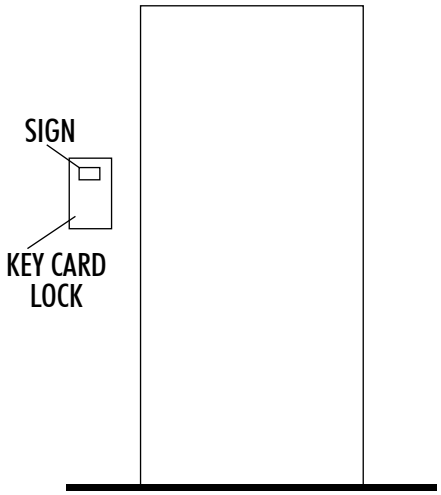
GUESTROOM EVACUATION (INTERIOR)
(NOT TO SCALE)



ELEVATOR EVACUATION - CORRIDOR SIDE ELEVATION
(NOT TO SCALE)



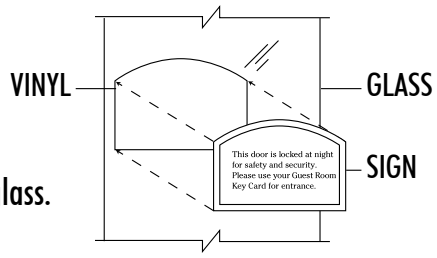
DIRECTIONAL SIGNAGE
(NOT TO SCALE)



KEY CARD - CORRIDOR SIDE ELEVATION
(NOT TO SCALE)

VINYL BLOCKER FOR GLASS MOUNTING

Signage that will be mounted on glass will require a vinyl blocker to hide the signage mounting tape and silicone adhesive. The vinyl blocker is mounted to the glass. The signage is mounted on top of the vinyl blocker.



313 Ida ▪ Wichita, KS 67211 ▪ (316) 267-4171 ▪ (316) 267-6883 fax ▪ www.graphicssystems.net

Signage Mounting Instructions

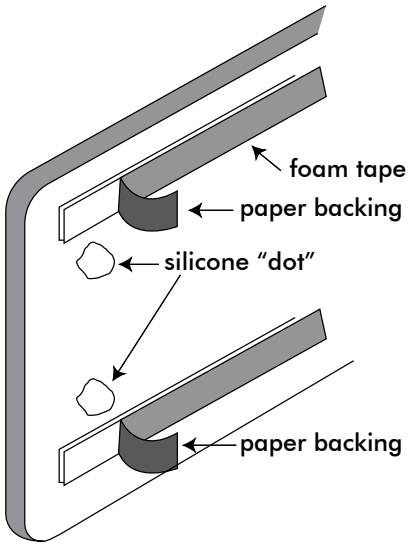
1. Installation surface must be CLEAN and DUST FREE.
2. Place a small "dot" of silicone in each corner of the sign. The "dot" should be 1/4" to 3/8" in diameter.

   WARNING! FOR PRODUCTS WITH METALLIC CONTENT (brass, aluminum, silver, gold, copper, etc.) USE ONLY NON-CORROSIVE SILICONE FOR PRODUCT INSTALLATION! We recommend Silicone XL by M-D (Macklanburg-Duncan) which is regarded as non-corrosive to metals. USE OF REGULAR SILICONE OR OTHER LIQUID ADHESIVES WILL VOID ANY/ALL EXPRESSED OR IMPLIED PRODUCT WARRANTIES REGARDING OXIDATION OF THE METALLIC CONTENT.

3. Remove paper backing from foam tape.
4. Position sign in desired location and apply enough pressure to ensure the foam tape sticks to the mounting surface. The foam tape will hold the sign in place until the silicone adhesive cures.
5. If removal is required, slide a putty knife gently behind the sign and "cut" through the silicone adhesive and the foam tape.

Signs MUST be Mounted with Foam Tape AND Silicone

Tape Holds Sign Until Silicone Dries



If you have any questions concerning these instructions or problems with signage installation, call 316-267-4171 for assistance.

Signage Cleaning Instructions

Do NOT clean unless signage appears soiled.

Do NOT use solvents or ammonia based cleaners. Use of such cleaners will void all warranties.

Use a clean, damp, non-abrasive, lint free cloth to wipe the sign surface.

Do NOT immerse sign. Excess water will damage interior grade Braille signage.

When the soil has been removed, wipe the sign with a clean, dry, non-abrasive, lint free cloth.

If you have any questions concerning these instructions, call your account executive at 316-267-4171 for assistance.

- SECTION 10 1400.02 -

EXTERIOR SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Exterior graphic plaques, characters and accessories.

B. Exterior Signs:
   1. Furnished by Owner, installed by Contractor:
      a. Channel letter signs.
      b. Single-faced, wall mounted signs.
      c. Monument signs.
      d. Pylon signs.
   2. Mounting devices and fittings.
   3. Preparation of camera-ready artwork needed to produce the complete graphics package, unless otherwise noted.

1.3 RELATED REQUIREMENTS

A. Section 10 1400.01 “Interior Signage”.

B. Section 10 1400.01a “Sign Manual-Interior Graphics Package (Courtyard)”.

C. Section 10 1400.01b “Sign Manual-Interior Graphics Package (Residence Inn)”.

D. Section 10 1400.02a “Sign Manual-Exterior Graphics Package (Courtyard)”.

E. Section 10 1400.02b “Sign Manual-Exterior Graphics Package (Residence Inn)”.

F. Section 10 3100 “Manufactured Fireplaces” for Emergency Shut Off and Warning Plaque signage installed at Fire Pit.

G. Division 26 Sections for electrical service and connections for illuminated signs.

1.4 REFERENCES

A. "Phoenix Building Construction Code", International Building Code 2006, with City of Phoenix administrative provisions and amendments.

B. American National Standards Institute, Inc.(ANSI) Publications:
   1. A117.1 "American National Standard for Buildings and Facilities Providing Accessibility and Usability for Physically Handicapped People"

C. Americans with Disabilities Act Accessibility Guidelines (ADAAG)
   1. 36 CFR 1191 - Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities; Final Rule; Federal Register, July 26, 1991; updated 2010.

D. ASTM International (ASTM) Publications:
   1. B117 "Standard Practice for Operating Salt Spray (Fog) Apparatus"
   2. D1735 "Standard Practice for Testing Water Resistance of Coatings Using Water Fog Apparatus"

E. American Welding Society (AWS)

1.5 SUBMITTALS

A. General: Submit in accordance with Section 01 3300.

B. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

C. Product Data: For each type of product indicated, demonstrate compliance with specified attributes.

D. VOC Submittals:
   1. Product Data – VOC Limits: For adhesives sealants, fillers and primers, documentation including printed statement of VOC contents, comply with limits specified in Section 01 6116.

E. Submit "Letter of Conformance" in accordance with Section 01 33 00 (01330) indicating specified items selected for use in project with the following supporting data.
   1. A copy of the manufacturer's printed installation manual shall accompany Bid for review and approval by the Owner's Representative.
   2. Shop Drawings showing sign layout, lettering style, materials, and other pertinent information.
      a. Post and panel/pylon signage: Include plans, elevations, sections, details, and attachments to other work.
      b. Show locations of electrical service connections.

1.6 QUALITY ASSURANCE

A. Graphic signs, including materials, fabrication, mounting and installation, shall conform to state and local code regulations and requirements.

B. All items shall utilize the highest standards of professional workmanship and practices.

1.7 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements of Section 01 6000.

B. Coordinate delivery of materials comprising the complete graphics package. Store materials upon approval of Owner. Take precautions to protect materials and be responsible for same until installed, inspected and accepted in writing by Owner.

1.8 PROJECT CONDITIONS

A. Coordinate work with all trades affected by Contractor's work and be fully cognizant of their requirements as pertaining to Contractor's work.

1.9 WARRANTY

A. Special Warranty: All materials, finishes and workmanship shall be warranted for a period of two (2) years after final acceptance of the work. If during the warranty period, any defects or faulty materials are found, the Contractor shall immediately proceed at his own expense to replace and/or repair same at not cost to Owner.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Limits for adhesives sealants, fillers and primers. Comply with limits specified in Section 01 6116.

2.2 EXTERIOR BUILDING, MONUMENT AND PYLON SIGNS MANUFACTURER/FABRICATOR

A. Avendra, LLC Preferred Manufacturers:
   1. None

B. Approved Manufacturers:
   1. Chandler Signs (214-902-2000)
      a. Dallas, TX
      b. Contact: Bill Teel or Sara Sproull
   2. Persona Inc. (800-843-9888)
      a. Watertown, SD
      b. Contact: Melissa Nash or Mike Peterson
   3. Visual Products Corp. dba Transworld Signs (888-808-8030)
      a. US or Canadian Sales Contact: Scott Gabrisch (281-812-4978)
   4. Coast Sign Inc. (714-520-9144)
      a. Anaheim, CA
      b. Contact: Steve Frazier

5. Philadelphia Sign Co. (856-829-1460)
   a. Palmyra, NJ
   b. Contact: George Braker
6. Cummings Signs (800-239-2655)
   a. Dothan, AL
   b. Contact: Lewis King
7. Pattison Sign Group (800-268-6536 x 2651)
   a. Toronto, Ontario
   b. Contact: John Jeppesen

2.3 MATERIALS – EXTERIOR SIGNAGE

A. Basis of Design: Refer to the following for sign types, designs, and graphic information.
   1. Section 10 1400.02a Sign Manual-Exterior Graphics Package (Courtyard).
   2. Section 10 1400.02b Sign Manual-Exterior Graphics Package (Residence Inn).

B. Standard approved signage. Coordinate mounting with building construction and site layout.

2.4 EXTERIOR ADA PARKING SIGNS

A. Provide exterior ADA Parking signs where indicated on the Drawings.

B. Steel Posts: Type II round post shall be manufactured from cold rolled steel, welded and have a minimum yield strength of 50,000 psi given corrosion protection by an exterior triple coating consisting on zinc-applied before of after welding, chromate conversion and a clear polymer overcoat.
   1. The inside surface shall be given corrosion protection. The internal coating shall be applied before or after welding and shall protect the metal from corrosion when subjected to the following:

	ASTM	Exposure Time	End Point
Salt spray (fog)	B117	300 hours	5% Red Rust

   2. The external coating shall meet the following requirements.

	ASTM	Exposure Time	End Point
Salt spray (fog)	B117	12,000 hours	5% Red Rust
Water (fog)	D1735	500 hours	1st Red Rust

   3. Each steel post shall have an ornamental top of galvanized steel or aluminum alloy designed to fit snugly over the post to exclude moisture. The top shall have a method of securing it to the post to prevent easy removal.

C. Drive Posts: Drive posts shall meet Local DOT requirements, post size No. 3.

D. Sign Type: Accessible Parking: Shall meet Local DOT requirements.

E. Mixes:
   1. Concrete for Foundations: meet Local DOT requirements.
   2. Quantity: Provide ADA signs in locations as shown on the Drawings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examination:

1. Examine areas for conditions detrimental to completion of the delivery and installation work. Report findings to the Architect immediately. Do not proceed with work until unsatisfactory conditions have been corrected or until advised in writing by the Owner.
2. Starting work constitutes acceptance of conditions under which the work is to be performed. After such acceptance Contractor shall, at his own expense, be responsible for correcting all unsatisfactory and defective work resulting from such unsatisfactory conditions.

3.2 INSTALLATION

A. Perform all cutting and fitting necessary for installation and completion of the work while accommodating the work of other trades. Immediately repair damage to existing surfaces or finishes caused by work of this Contractor at no cost to Owner.

B. Site Verification of Conditions: Verify installation conditions previously established under other sections are acceptable for product installation in accordance with manufacturer's instructions

C. General: Locate sign units and accessories where indicated, using mounting methods of the type described and in compliance with the manufacturer's instructions.

1. Install signs level, plumb, and at the height indicated, with sign surfaces free from distortion or other defects in appearance.

D. Exterior Signage:

1. Install exterior signage and cabinet as indicated on Drawings.
2. Install Accessible Parking signs as indicated on the Drawings. Locations and heights to meet ADA.

3.3 CLEANING AND PROTECTION

A. After installation, clean soiled sign surfaces according to the manufacturer's instructions. Protect units from damage until acceptance by the Owner.

B. Provide cleanup and removal of debris resulting from the installation work.

- END OF SECTION -

DESIGN GUIDE

COURTYARD SIGN MANUAL

August 22nd, 2007

Introduction

The Sign Manual provides the general criteria for selection, sizing and placement of the Exterior Signs on the CFRST prototypical buildings. Sign selection, sizing and placement for custom buildings, conversions, and retrofitting existing buildings should be coordinated through one of Marriott's approved exterior sign vendors or Marriott's Lodging Engineering Department.

The manual is a guideline for franchise owners and/ or their architects and contractors and contains enough information for rendering building elevations for the permitting process. The Sign Manual is not intended for actual fabrication of signs. Contact one of the Marriott's approved exterior sign vendors or Marriott's Lodging Engineering Department for procurement and installation information.

Table of Contents

CFRST Sign Use Guideline Summary

Channel Letter Signs

Channel letter size relative to the space available

- Generally, for retrofits, channel letters are not required to be replaced. There will be exceptions for each brand (For example: currently non-illuminated channel letters, Residence Inn Gatehouse.
- Design intent was to spread the letters out, soften the fonts and improve the face material which increased legibility so that they could be read from a greater distance. Note that these changes will make it possible to use a smaller letter than existing to achieve even greater visibility.
- New build designs will be modified as required to allow for signs to fit.
- Regarding raceways; They remain an undesirable method for wiring and should only be used in cases where absolutely necessary. If used, smallest/thinnnest conduit to match the building color.
- Appropriate wall space should be allowed around the channel letters (see guidelines).
- There is a maximum size limitation relative to the situation (see guidelines).

Size & Placement of the word "Marriott"

- The current "Marriott" pill will always need to be replaced with the larger individual LED letters.
- Proportion size is included in the current usage guidelines.
- Placement of the word should be below the brand name, exceptions may be necessary in some retrofit sitations based on available space below or above the existing sign.

Channel Letter Color

- Normally the sign letters are the brand color by day, white at night (dual-color film). Where the building color is medium to dark toned, white face letters by day & night should be used..

Single-faced, wall-mounted Signs

- Channel letters only on the front of the buildings. The preference is always to use channel letters where possible. Where space, local code, or visability prohibits channel letters, a single-faced, wall-mounted sign may be used on the sides or rears of a building.

Monument Signs

- CY & RI monument signs between 30 and 50 sq. ft. in total size shall be three-dimensional. Flat-faced signs are acceptable in certain locations (i.e., tertiary markets, high vandalism areas, etc.).
- SHS, FFI & TPS monument signs shall be flat-faced for all sizes. Three-dimensional signs are acceptable in certain locations (i.e., custom or urban markets).
- Monument signs in excess of 10 ft. in height or 50 sq. ft. in total size shall be flat-faced or vaccuum-formed.
- Unless required by code or authorized by Marriott, primary signage structure shall not include non-Marriott brands or electronic display.
- When multiple Marriott brands are located on the same primary sign structure, higher transient brands should be located in the optimum visibility area (Highest transient brands to lowest are: FFI, CY, SHS, RI, TPS).
- All directional monument signs (entrance, arrows, etc.) are considered part of the new sign package and should comply with design standards.

Mid-rise Pylon

- CY & RI mid-rise pylon signs between 50 and 80 sq. ft. in total size shall be vaccuum-formed. Flat-faced signs are acceptable in certain locations (i.e., tertiary markets, high vandalism areas, etc.).
- SHS, FFI & TPS mid-rise pylon signs shall be flat-faced for all sizes. Vaccum-formed signs are acceptable in certain locations (i.e., custom or urban markets).
- Unless required by code or authorized by Marriott, primary sign structure shall not include non-Marriott brands or electronic display.
- When multiple Marriott brands are located on the same primary sign structure, higher transient brands should be located in the optimum visibility area (Highest transient brands to lowest are: FFI, CY, SHS, RI, TPS).

High-rise Pylon

- Due to current trends in planning and zoning, verify local jurisdictionnal requirements.
- By keeping the same square footage and location you may meet grandfathering provisions and therefore avoid the need for variance approval.
- Unless required by code or authorized by Marriott, primary sign structure shall not include non-Marriott brands or electronic display.
- When multiple Marriott brands are located on the same primary sign structure, higher transient brands should be located in the optimum visibility area (Highest transient brands to lowest are: FFI, CY, SHS, RI, TPS).

Typical Channel Letter Signs

Preferred Option

COLORS

- Letter faces: white Acrysteel
- Returns and trimcap: painted gold PMS #872C, satin finish.

Marriott

- Letter faces: red vinyl #VT11331.
- Returns and trimcap: painted gold PMS #872C, satin finish.

MATERIALS

- 8" depth aluminum returns, painted gold.
- Letter backs from computer cut aluminum.
- 3/16" thk Acrysteel faces, pigmented white #2447
- 1" gold Jewelite trimcap.
- 15mm 6500 white neon CL Designer

Marriott

- 5" depth aluminum returns, painted gold.
- Letter backs from computer cut aluminum.
- 3/16" thk Acrysteel faces, pigmented white #2447, vinyl graphic applied on first surface by cold transfer.
- 1" gold Jewelite trimcap.
- Red LED lighting system

ELECTRICAL REQUIREMENTS

- CY Ch 24 (1 line): 120 volts, X amps, X circuits.
- CY Ch 30 (1 line): 120 volts, X amps, X circuits.
- CY Ch 36 (1 line): 120 volts, X amps, X circuits.
- CY Ch 48 (1 line): 120 volts, X amps, X circuits.

	A	B	C	D
CY Channel 24	4'- 4"	19'- 7"	24"	19"
CY Channel 30	5'- 5"	24'- 6"	30"	24"
CY Channel 36	6'- 6"	29'- 5"	36"	29"
CY Channel 48	8'- 8"	36'- 19"	48"	39"

FINAL FOR CONSTRUCTION

Single-faced, wall-mounted Signs

COLORS

- Filler and retainer: painted green #MP14975, red #MP08937 from Matthews, and gold PMS #872C, satin finish.
- Background green #VT5272 and red #VT11331.
- Border and trees gold #VDN11780 over a layer of #VTV9679.
- All other copy is white.

MATERIALS

Panaflex Option

- Aluminum extrusion filler and retainer, 12"depth (18" High Rise application) , painted green, red and gold
- Face from flexible material "Panaflex", vinyl graphic applied on first surface by cold transfer.
- 24 ga metal sheet background, prepainted white on one side.
- Illuminated by fluorescent lamps, H/O.

Acrysteel Option

- Aluminum sheet filler and retainer .081 thk and .125 thk, 5" depth, painted gold and red.
- 3/16" thk Acrysteel face, pigmented white, panned and molded, vinyl graphic applied on first surface by cold transfer.
- 24 ga metal sheet background, prepainted white on one side.
- Illuminated by fluorescent lamps, H/O.

ELECTRICAL REQUIREMENTS

- CY WM 50: 120 volts, 7.2 amps, 1 circuit.
- CY WM 80: 120 volts, 8.9 amps, 1 circuit.
- CY WM 100: 120 volts, 12.3 amps, 1 circuit.
- CY WM 120: 120 volts, 12.4 amps, 1 circuit.

	Panaflex	Acrysteel
CY WM 50	5'- 8" X 9'- 0"	5'- 11" X 9'- 3"
CY WM 80	7'- 1" X 11'- 3"	7'- 4" X 11'- 6"
CY WM 100	7'- 10" X 12'- 6"	
CY WM 120	8'- 8" X 13'- 9"	

Panaflex Option

Acrysteel Option

FINAL FOR CONSTRUCTION

Directional Signs

COLORS

- Filler, retainer and trimcap: painted green #MP14975, red #MP08937 from Matthews, and gold PMS #872C, satin finish.
- Background green #VT5272 and red #VT11331.
- Border and trees gold #VDN11780 over a layer of #VTV9679.
- All other copy is white.
- Cladding painted grey #MP20140, Matthews, gloss finish.

MATERIALS

- .081 thk aluminum filler, 8" overall depth, painted green and red.
- 3/16" thk Lexan faces, pigmented white #7328, vinyl graphic applied on first surface by cold transfer.
- 1" Jewelite trimcap, cimented to Lexan faces and painted gold and red.
- Illuminated by fluorescent lamps, H/O.
- .081 thk aluminum cladding painted grey.

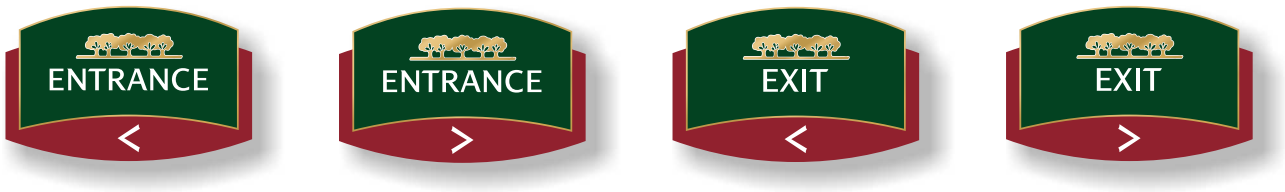
ELECTRICAL REQUIREMENTS

- CY Dir 5: 120 volts, 1.9 amps, 1 circuit.
- CY Dir 10: 120 volts, 1.5 amps, 1 circuit.

CY Dir 5

CY Dir 5	1'- 9" X 2'- 10"	3'- 6" Overall Height
CY Dir 10	2'- 6" X 4'- 1"	3'- 6" Overall Height

CY Dir 10



Message Options

Monument Signs

COLORS

- Filler, retainer and trimcap: painted green #MP14975, red #MP08937 from Matthews, and gold PMS #872C, satin finish.
- Background green #VT11679 and red #VT11331 (#MP08937 Matthews, satin finish).
- Border and trees gold #VDN11780 over a layer of #VTV9679.
- All other copy is white.
- Cladding painted grey #MP20140, Matthews, gloss finish.

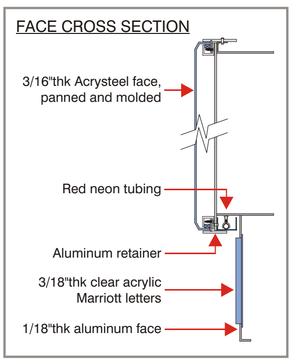
MATERIALS

CY Monument 10 and CY Monument 20

- .081 thk aluminum filler, 8" overall depth, painted green and red.
- 3/16" thk Lexan faces, pigmented white #7328, vinyl graphic applied on first surface by cold transfer.
- 1" Jewelite trimcap, cimented to Lexan faces and painted gold and red.
- Illuminated by fluorescent lamps, H/O.
- .081 thk aluminum cladding painted grey.

CY Monument 30 and CY Monument 50

- Courtyard section: .081 thk aluminum filler and retainer, 20 1/2" overall depth, painted green and gold.
- 3/16" thk Acrysteel faces, pigmented white #7328, panned and molded, vinyl graphic applied on first surface by cold transfer.
- Marriott section: .125 thk aluminum filler, retainer and faces painted red.
- Copy routed-out from aluminum faces and infilled with 3/8" thk clear acrylic cutted-out letters with white translucent vinyl applied on first surface by cold transfer.
- Illuminated by fluorescent lamps, H/O.
- 15mm red neon tubing (on 3 sides).
- .081 thk aluminum cladding painted grey.



CY Monument 80

- .051 thk aluminum filler and retainer, 16" overall depth, painted gold and red.
- 3/16" thk Acrysteel faces, pigmented white #7328, panned and molded, vinyl graphic applied on first surface by cold transfer.
- Illuminated by fluorescent lamps, H/O.
- .081 thk aluminum cladding painted grey.

ELECTRICAL REQUIREMENTS

- CY Monument 10: 120 volts, 1.5 amps, 1 circuit.
- CY Monument 20: 120 volts, 2.8 amps, 1 circuit.
- CY Monument 30: 120 volts, 5.2 amps, 1 circuit.
- CY Monument 50: 120 volts, 8.3 amps, 1 circuit.
- CY Monument 80: 120 volts, 13.3 amps, 1 circuit.

		Overall Height
CY Monument 10	2'- 6" X 4'- 1"	3'- 6"
CY Monument 20	3'- 7" X 5'- 8"	5'- 0"
CY Monument 30	4'- 3" X 6'- 9"	6'- 0" to 12'- 0"
CY Monument 50	5'- 8" X 9'- 0"	8'- 0" to 12'- 0"
CY Monument 80	7'- 4" X 11'- 6"	15'- 0"

CY Monument 10 CY Monument 20

CY Monument 30 CY Monument 50

CY Monument 80

FINAL FOR CONSTRUCTION

Pylon Signs

COLORS

- Filler and retainer: painted green #MP14975, red #MP08937 from Matthews, and gold PMS #872C, satin finish.
- Background green #VT5272 and red #VT11331.
- Border and trees gold #VDN11780 over a layer of #VTV9679.
- All other copy is white.
- Cladding and posts painted grey #MP20140, Matthews, gloss finish.

MATERIALS

- .064 thk aluminum filler, 36" overall depth, painted green and red.
- Aluminum extrusion retainer (Alumiflex) frameless, painted green, red and gold.
- Faces from flexible material "Panaflex", vinyl graphic applied on first surface by cold transfer.
- Illuminated by 6500 metal halide lamps.
- .081 thk aluminum cladding painted grey (CY Pylon 140 only).
- Steel post painted grey.

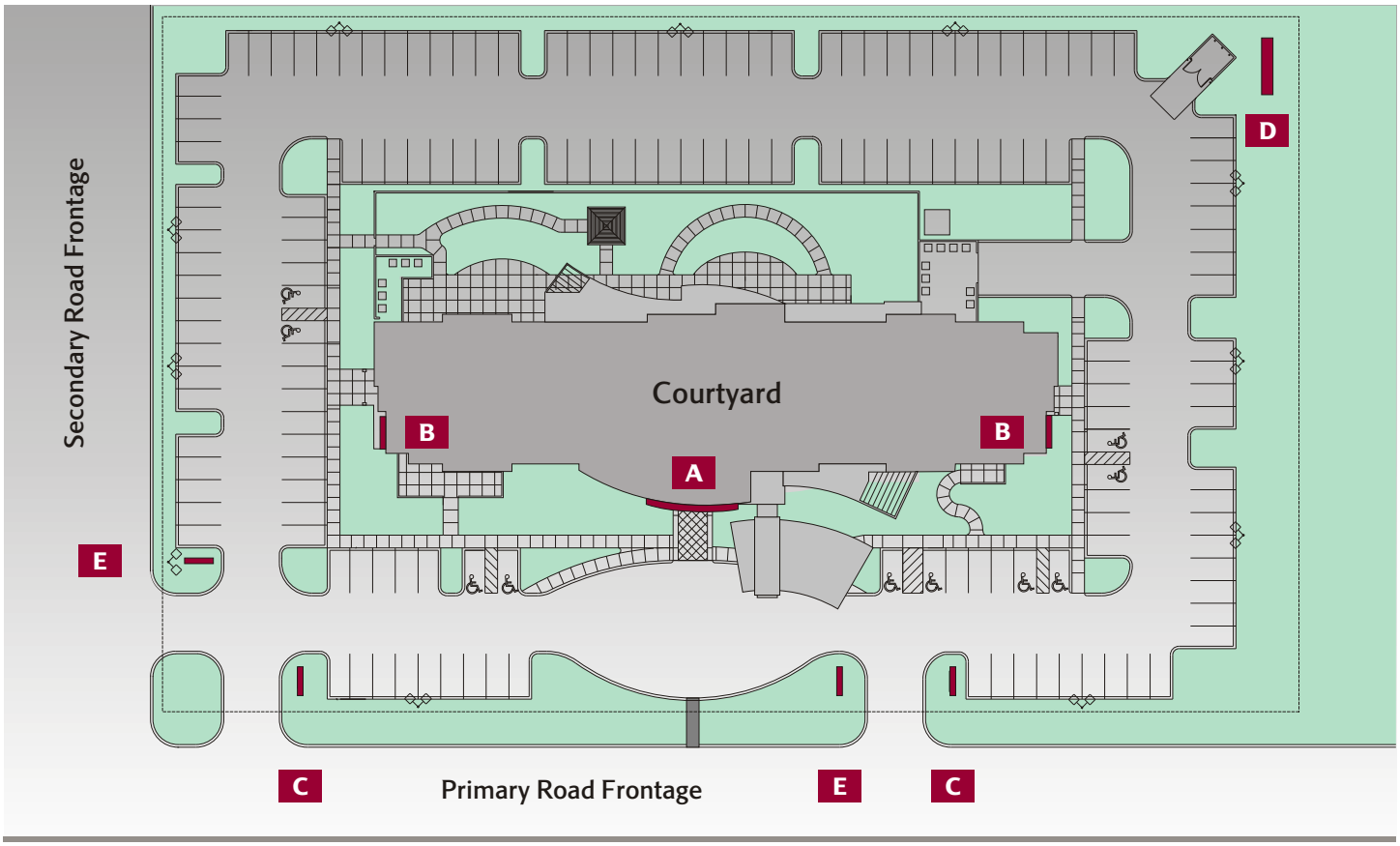
ELECTRICAL REQUIREMENTS

- CY Pylon 140: 120 volts, 33.28 amps, 3 circuits.
- CY Pylon 200: 120 volts, 45.83 amps, 4 circuits.
- CY Pylon 300: 120 volts, 62.40 amps, 6 circuits.
- CY Pylon 400: 120 volts, 83.20 amps, 7 circuits.

		Overall Height
CY Pylon 140	9'- 4" X 14'- 10"	35'- 0"
CY Pylon 200	11'- 3" X 17'- 10"	To be determined
CY Pylon 300	13'- 9" X 21'- 9"	80'- 0"
CY Pylon 400	15'- 11" X 25'- 2"	100'- 0"

CY Pylon 140 | CY Pylon 200 | CY Pylon 300 | CY Pylon 400

Exterior Sign Locator



A **Typical Channel Letter Signs**

B **Single-faced, wall -mounted Signs**

C **Monument Signs**

D **Pylon Signs**

E **Directional Signs**

The Exterior Sign Locator is a diagrammatic representation of the prototypical site providing for the potential placement of exterior signs. Final location and sizing of exterior signs are dependent on jurisdictional review and approval. Refer to the actual Site Plans in the Design Guideline Drawings for specific site and landscape information.

10 1400.02b Sign Manual-Exterior Graphics Package (Residence Inn)

FINAL FOR CONSTRUCTION

Residence Inn
Sign Guidelines

Marriott

Residence Inn
Sign Guidelines
March 9, 2010

Contents:

PERSONA
Sign Makers / Image Builders

MR. MICHAEL PETERSON

700 21st STREET SOUTHWEST

PO BOX 210

WATERTOWN, SD 57201-0210

Ph.: 1.800.843.9888

Fax: 1.800.843.9890

Email: mpeterson@persona-inc.com

Introduction

The Sign Manual provides the general criteria for selection, sizing and placement of the Exterior Signs on the Residence Inn prototypical buildings. Sign selection, sizing and placement for custom buildings, conversions, and retrofitting existing buildings should be coordinated through one of Marriott's approved exterior sign vendors or Marriott's Lodging Engineering Department.

Alternate colors and materials should never be substituted on the signage products shown in these guidelines. Any requests for deviations must be submitted to Marriott's Lodging Engineering Department.

The manual is a guideline for franchise owners and/or their architects and contractors and contains enough information for rendering building elevations for the permitting process. The Sign Manual is not intended for actual fabrication of signs. Contact one of Marriott's approved exterior sign vendors or Marriott's Lodging Engineering Department for procurement and installation information.

Overview

Six major types of property signs are available for Residence Inn properties:

- Channel Letters
- Wall Signs
- Directional Signs
- Monument Signs
- Mid-Rise Signs
- Hi-Rise Signs

The selection of colors, materials and formats for Residence Inn property signage reflect the stature associated with Residence Inn. The colors, Residence Inn burgundy and Residence Inn gold, are utilized on the signs to reflect the significance of the brand.

Channel Letters

Channel letter size relative to the space available -

- Design intent is to increase legibility so that they will be read from a greater distance.
- New build designs will be modified as required to allow for signs to fit.
- Raceways remain an undesirable method for wiring. Raceways should only be used in cases where absolutely necessary and approval must be obtained from Marriott's Lodging Engineering Department. If used, the raceways should be painted to match the building background color.
- Appropriate wall space should be allowed around the channel letters (see guidelines).
- There is a maximum size limitation relative to the situation (see guidelines).

FINAL FOR CONSTRUCTION

Channel Letter Color -

- Normally the sign letters are the brand color by day (burgundy), white at night (dual color film). Where the building color is medium to dark toned, white face letters by day and night should be used. "Marriott" should maintain red face by day and night.
- Alternate colors and materials should never be substituted on the illuminated channel letters shown in these guidelines.

Size & Placement of the word "Marriott"

- Proportion size is included in the current usage guildelines.
- Placement of the word should be below the brand name, exceptions may be necessary in some situations based on available space below or above the existing sign. Any exceptions must be approved by Marriott's Lodging Engineering Department.

Daytime View | Letters appear burgundy and red during the daylight

Nighttime View | Letters illuminate white and red at night

FINAL FOR CONSTRUCTION

Marriott

Project: Residence Inn Sign Guidelines
Page: 4
Scale: Not to scale
Notes: Shown here are the standard channel letters for light colored buildings in daylight and at night.

Channel Letters

PERSONA
Sign Makers / Image Builders

Marriott

Project: Residence Inn Sign Guidelines
Page: 5
Scale: Not to scale
Notes: Shown here are the standard channel letters for dark colored buildings in daylight and at night.

Channel Letters

FINAL FOR CONSTRUCTION

Daytime View | Letters appear white (Residence Inn) and red (Marriott) both day and night.

Nighttime View | Letters illuminate white and red at night

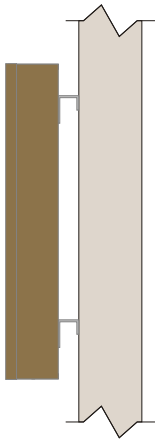
PERSONA
Sign Makers / Image Builders

	A	B	C	D	E
RI Channel 24	6'-0 13/16"	13'-10 1/8"	24"	14 7/16"	20"
RI Channel 30	7'-7"	17'-3 5/8"	30"	18"	25"
RI Channel 36	9'-1 3/16"	20'-9 1/8"	36"	21 5/8"	30"
RI Channel 48	12'-1 5/8"	27'-8 3/16"	48"	28 13/16"	40"

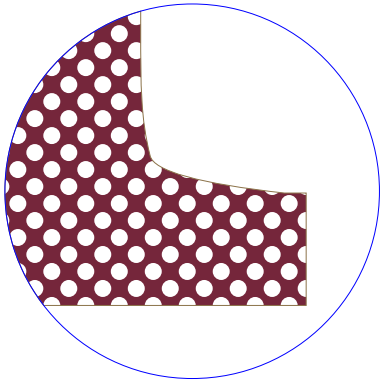
FINAL FOR CONSTRUCTION

Day Appearance

Night Appearance



Side Profile



Detail F

Substrate is 2447 white acrylic with 3M 3635-2079 burgundy dual-color vinyl applied to 1st surface.

Light colored buildings:

Channel Letters to use 2447 white acrylic with 3635-2079 burgundy perforated vinyl applied 1st surface. Channel letters to appear green during the day and light white at night.

Marriott

Project: Residence Inn Sign Guidelines
Page: 6
Scale: Not to scale
Notes: Shown here are the standard 3-line channel letters for light colored building applications.

Channel Letters

Residence Inn Specifications:
.050" aluminum construction with .063" aluminum letter backs. 2" J-clips used to keep letters 2" from wall surface. 1" trim cap painted to match PMS 872 gold.

Faces: 3/16" 2447 white acrylic with 3635-2079 burgundy perforated vinyl applied 1st surface.

Illumination: White LED's as required.

Marriott Specifications:
.050" aluminum construction with .063" aluminum letter backs. 2" J-clips used to keep letters 2" from wall surface. 1" trim cap painted to match PMS 872 gold.

Faces: 3/16" 2447 white acrylic with 3630-2382 red vinyl applied to 1st surface..

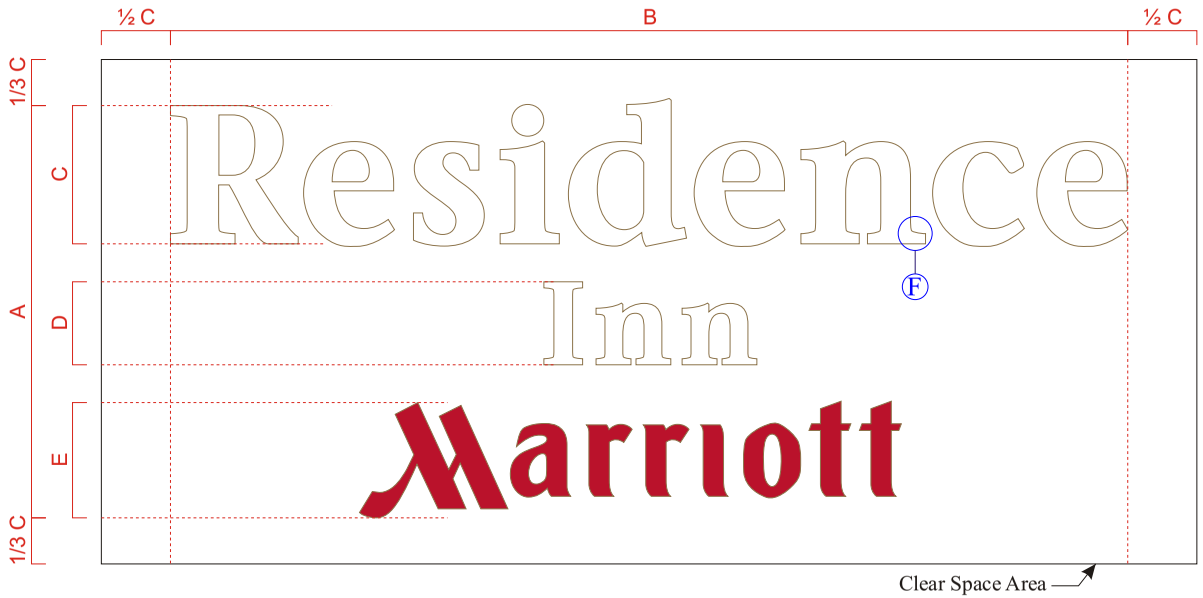
Illumination: Red LED's as required.

Color:

Letter Exteriors:
PMS 872 gold

Faces:
3M 3635-2079 burgundy perforated vinyl (1st surface) (Residence Inn)
3M 3630-2382 red vinyl (1st surface) (Marriott)
2447 white acrylic

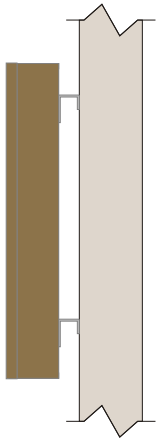
PERSONA
Sign Makers / Image Builders



	A	B	C	D	E
RI Channel 24	6'-0 13/16"	13'-10 1/8"	24"	14 7/16"	20"
RI Channel 30	7'-7"	17'-3 5/8"	30"	18"	25"
RI Channel 36	9'-1 3/16"	20'-9 1/8"	36"	21 5/8"	30"
RI Channel 48	12'-1 5/8"	27'-8 3/16"	48"	28 13/16"	40"

Day Appearance

Night Appearance



Side Profile

FINAL FOR CONSTRUCTION

Marriott

Project: Residence Inn Sign Guidelines
Page: 7
Scale: Not to scale
Notes: Shown here are the standard 3-line channel letters for dark colored building applications.

Channel Letters

Residence Inn Specifications:
.050" aluminum construction with .063" aluminum letter backs. 2" J-clips used to keep letters 2" from wall surface. 1" trim cap painted to match PMS 872 gold.

Faces: 3/16" 7328 white acrylic faces.

Illumination: White LED's as required.

Marriott Specifications:
.050" aluminum construction with .063" aluminum letter backs. 2" J-clips used to keep letters 2" from wall surface. 1" trim cap painted to match PMS 872 gold.

Faces: 3/16" 2447 white acrylic with 3630-2382 red vinyl applied to 1st surface..

Illumination: Red LED's as required.

Color:

Letter Exteriors:
PMS 872 gold

Faces:
7328 white acrylic (Residence Inn)
3M 3630-2382 red vinyl (1st surface) (Marriott)
2447 white acrylic (Marriott)

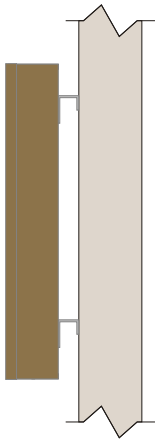
PERSONA
Sign Makers / Image Builders

	A	B	C	D
RI Channel 24	4'-5 1/4"	19'-7"	24"	20"
RI Channel 30	5'-6 9/16"	24'-5 3/4"	30"	25"
RI Channel 36	6'-7 7/8"	29'-4 1/2"	36"	30"
RI Channel 48	8'-10 1/2"	39'-2"	48"	40"

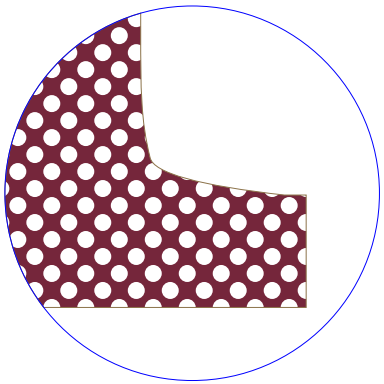
FINAL FOR CONSTRUCTION

Day Appearance

Night Appearance



Side Profile



Detail E

Substrate is 2447 white acrylic with 3M 3635-2079 burgundy dual-color vinyl applied to 1st surface.

Light colored buildings:

Channel Letters to use 2447 white acrylic with 3635-2079 burgundy perforated vinyl applied 1st surface. Channel letters to appear green during the day and light white at night.

Marriott

Project: Residence Inn Sign Guidelines
Page: 8
Scale: Not to scale
Notes: Shown here are the standard 2-line channel letters for light colored building applications.

Channel Letters

Residence Inn Specifications:
.050" aluminum construction with .063" aluminum letter backs. 2" J-clips used to keep letters 2" from wall surface. 1" trim cap painted to match PMS 872 gold.

Faces: 3/16" 2447 white acrylic with 3635-2079 burgundy perforated vinyl applied 1st surface.

Illumination: White LED's as required.

Marriott Specifications:
.050" aluminum construction with .063" aluminum letter backs. 2" J-clips used to keep letters 2" from wall surface. 1" trim cap painted to match PMS 872 gold.

Faces: 3/16" 2447 white acrylic with 3630-2382 red vinyl applied to 1st surface..

Illumination: Red LED's as required.

Color:

Letter Exteriors:
PMS 872 gold

Faces:
3M 3635-2079 burgundy perforated vinyl (1st surface) (Residence Inn)
3M 3630-2382 red vinyl (1st surface) (Marriott)
2447 white acrylic

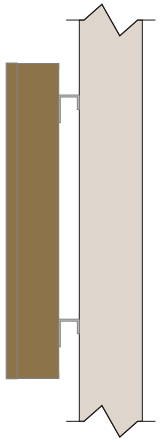
PERSONA
Sign Makers / Image Builders

FINAL FOR CONSTRUCTION

	A	B	C	D
RI Channel 24	4'-5 1/4"	19'-7"	24"	20"
RI Channel 30	5'-6 9/16"	24'-5 3/4"	30"	25"
RI Channel 36	6'-7 7/8"	29'-4 1/2"	36"	30"
RI Channel 48	8'-10 1/2"	39'-2"	48"	40"

Day Appearance

Night Appearance



Side Profile

Marriott

Project: Residence Inn Sign Guidelines
Page: 9
Scale: Not to scale
Notes: Shown here are the standard 2-line channel letters for dark colored building applications.

Channel Letters

Residence Inn Specifications:
.050" aluminum construction with .063" aluminum letter backs. 2" J-clips used to keep letters 2" from wall surface. 1" trim cap painted to match PMS 872 gold.

Faces: 3/16" 7328 white acrylic faces.

Illumination: White LED's as required.

Marriott Specifications:
.050" aluminum construction with .063" aluminum letter backs. 2" J-clips used to keep letters 2" from wall surface. 1" trim cap painted to match PMS 872 gold.

Faces: 3/16" 2447 white acrylic with 3630-2382 red vinyl applied to 1st surface..

Illumination: Red LED's as required.

Color:

Letter Exteriors:
PMS 872 gold

Faces:
7328 white acrylic (Residence Inn)
3M 3630-2382 red vinyl (1st surface) (Marriott)
2447 white acrylic (Marriott)

PERSONA
Sign Makers / Image Builders

Single-faced, Wall-mounted Signs

FINAL FOR CONSTRUCTION

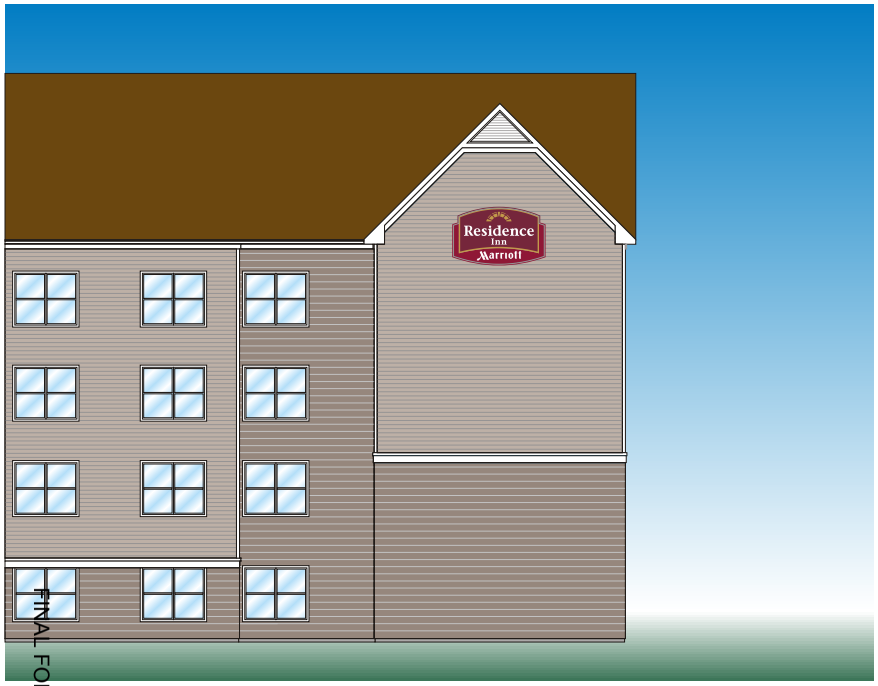
Single-faced, wall-mounted signs -

- (R) Illuminated channel letters are required on the front of buildings.
- (R) The preference is to use channel letters where possible.
- (R) Where scale, local code, or visibility prohibits channel letter use, a single-faced, wall-mounted sign may be used on the sides or rear of a building. Exceptions to channel letters on the front of the buildings must be submitted to Marriott's Lodging Engineering Department for approval.

Marriott

Project: Residence Inn Sign Guidelines
Page: 11
Scale: Not to scale
Notes: Shown here are the standard single-faced, wall-mounted signs during daylight and at night.

Single-faced, Wall-mounted Signs

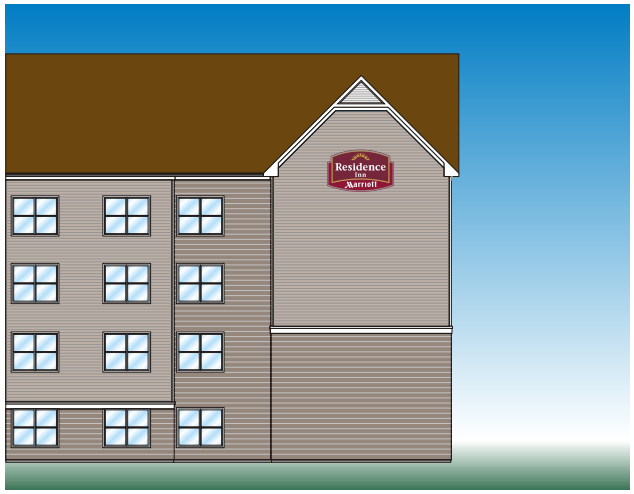


Daytime View

Nighttime View

FINAL FOR CONSTRUCTION

PERSONA
Sign Makers / Image Builders



	Flexible	Rigid
RI WM 50	Not Applicable	5'-8" X 9'-0"
RI WM 80	Not Applicable	7'-1" X 11'-2 3/4"
RI WM 100	8'-0" X 12'-9"	Not Applicable
RI WM 120	8'-8" X 13'-9 5/16"	Not Applicable

Marriott

Project: Residence Inn Sign Guidelines
Page: 12
Scale: Not to scale
Notes: Shown here are the standard single-faced, wall-mounted signs. Both rigid and flexible face options are presented.

Single-faced, Wall-mounted Signs

FINAL FOR CONSTRUCTION

Rigid Option

Front View End View

Rigid Frame Specifications:
Steel angle construction with aluminum cabinet skins. Faces to be secured using aluminum retainer. 24 gauge steel backs to be painted white on one side. Illuminated by H/O fluorescent lamps. .177" 2-step, pan-formed white tuf-glas faces to be decorated with 1st surface vinyl decoration as shown below.

Colors:
Paint (Cabinet)-
- Matthews MP38021 burgundy
- Matthews MP08937 red

Vinyl (Face)-
- 3M 3630-2079 burgundy vinyl applied to 1st surface
- 3M 3630-2382 red vinyl applied to 1st surface
- 3M 3635-25 yellow vinyl applied to 1st surface
- 3M 3630-4048 gold perforated vinyl applied to 1st surface over top of yellow vinyl
- .177" white tuf-glas

Flexible Option

Front View End View

Rigid Frame Specifications:
Steel angle construction with aluminum cabinet skins. Faces to be bleed, showing no visible retainer. 24 gauge steel backs to be painted white on one side. Illuminated by H/O fluorescent lamps. Flexible face material to be decorated with 1st surface vinyl decoration.

Colors:
Paint (Cabinet)-
- Matthews MP38021 burgundy
- Matthews MP08937 red

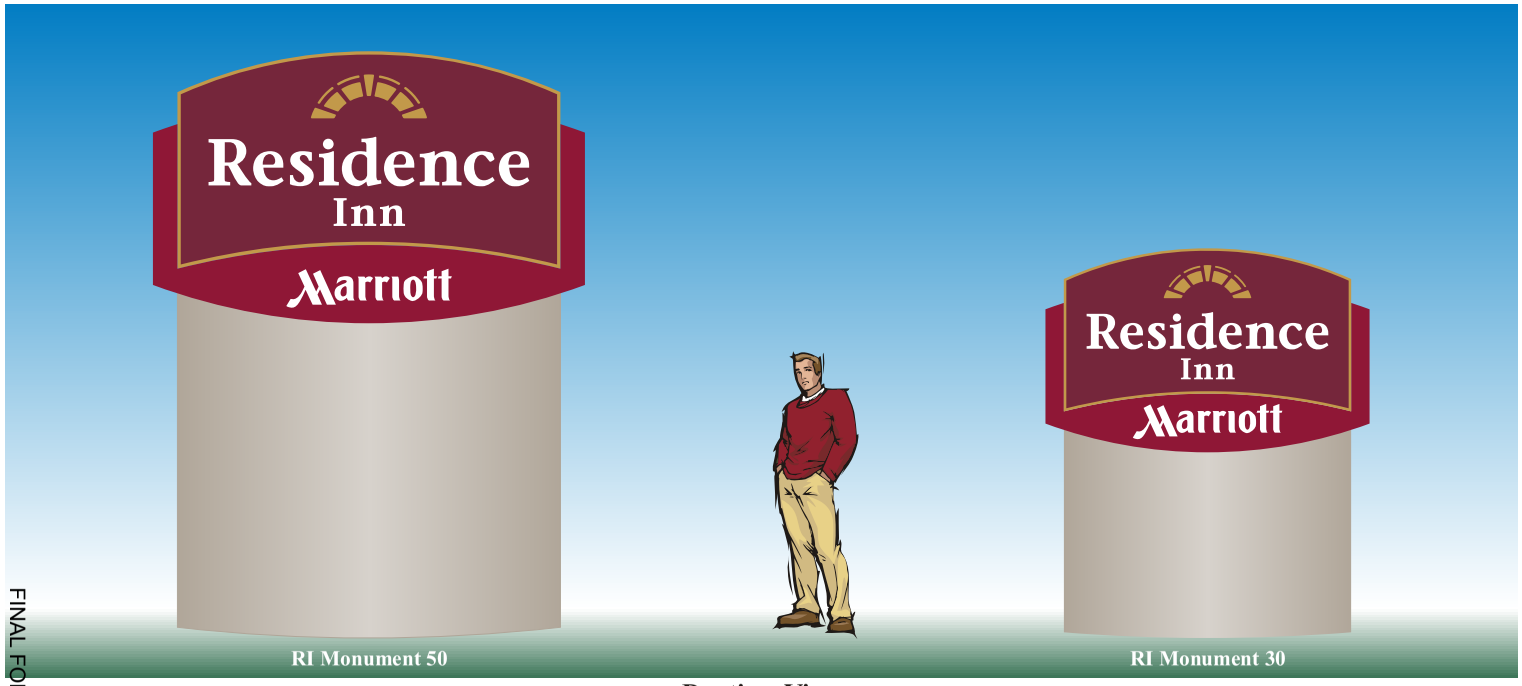
Vinyl (Face)-
- 3M 3630-2079 burgundy vinyl applied to 1st surface
- 3M 3630-2382 red vinyl applied to 1st surface
- 3M 3635-25 yellow vinyl applied to 1st surface
- 3M 3630-4048 gold perforated vinyl applied to 1st surface over top of yellow vinyl
- Flexible face material

PERSONA
Sign Makers / Image Builders

Monument Signs

Monument Signs -

- Residence Inn monument signs between 30 and 50 square feet in total size shall be 3-dimensional Flat-faces signs are acceptable in certain locations (i.e., tertiary markets, high vandalism areas, etc.)
- Monument signs in excess of 10 feet in height or 50 square feet in total size shall be flat-faced or vacuum formed.
- Unless required by code or authorized by Marriott, primary signage structure shall not include non-Marriott brands.
- When multiple Marriott brands are located on the same primary sign structure, higher transient brands should be located in the optimum visibility area. (Highest transient brands to lowest are: Fairfield Inn & Suites, Courtyard, SpringHill Suites, Residence Inn, TownePlace Suites.)
- All directional monument signs (entrance, arrows, etc.) should comply with established design Standards.



Daytime View

Nighttime View

FINAL FOR CONSTRUCTION

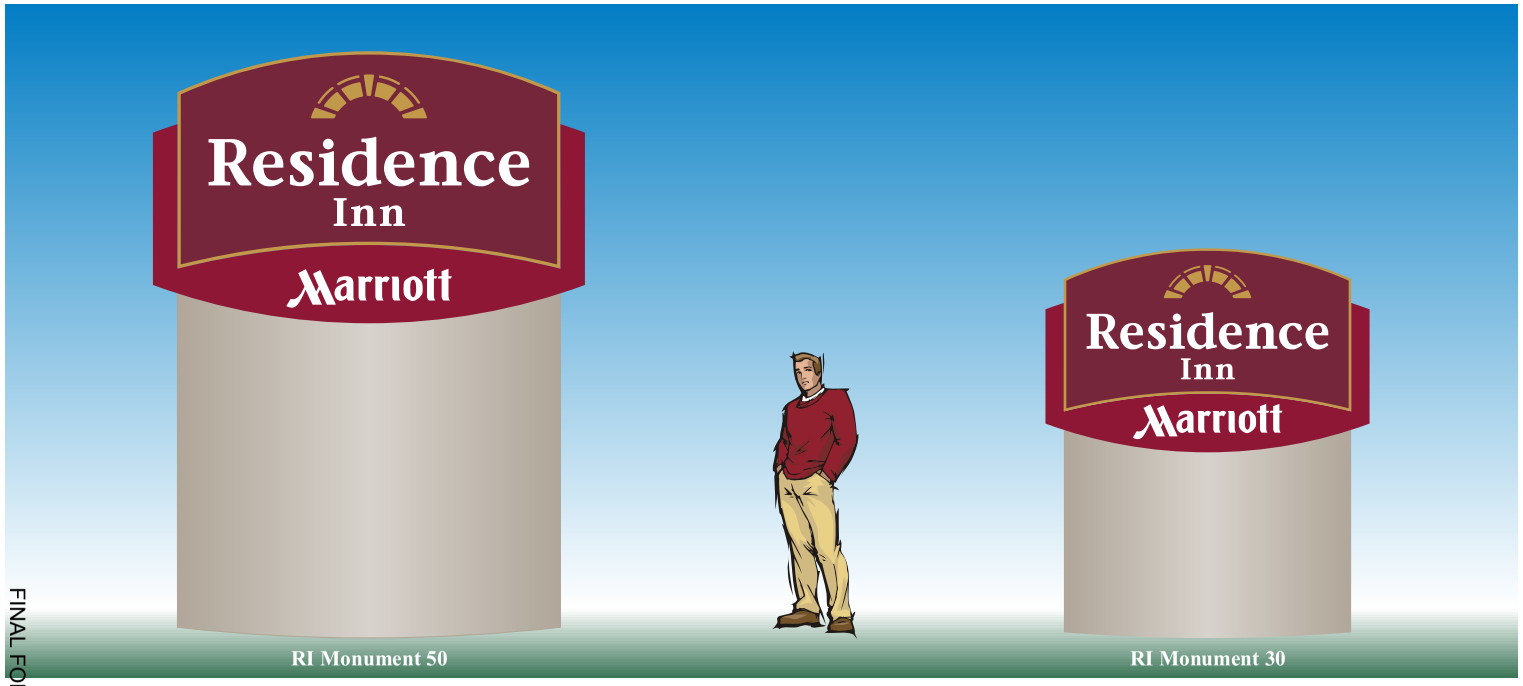
Marriott

Project: Residence Inn Sign Guidelines
Page: 14
Scale: Not to scale
Notes: Shown here are the standard 3-dimensional monument signs in daylight and at night.

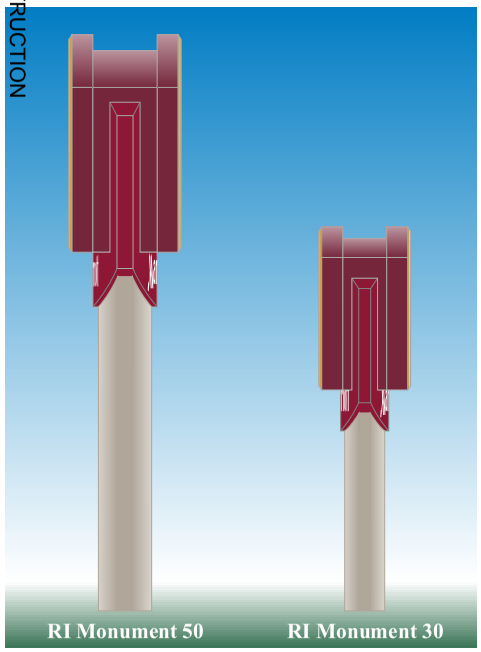
3-D Monument Signs

PERSONA
Sign Makers / Image Builders

FINAL FOR CONSTRUCTION

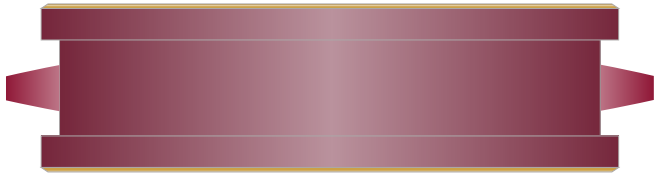


Front View



End View

	Size	Overall Height
RI Monument 30	4'-3" X 6'-9"	6'-0" to 12'-0"
RI Monument 50	5'-8" X 9'-0"	8'-0" to 12'-0"



Top View

Marriott

Project: Residence Inn Sign Guidelines
Page: 15
Scale: Not to scale
Notes: Shown here are the standard 3-dimensional monument signs.

3-D Monument Signs

Specifications:
Aluminum and steel construction with rigid, bleed, pan-formed faces (Residence Inn) and routed aluminum faces (Marriott). 3-D monument signs to include clear red neon border behind sides and bottom of the "Residence Inn" portion of cabinet. Neon should not be visible from front or sides of cabinet. Internal illumination provided by H/O fluorescent lamps.

Color:

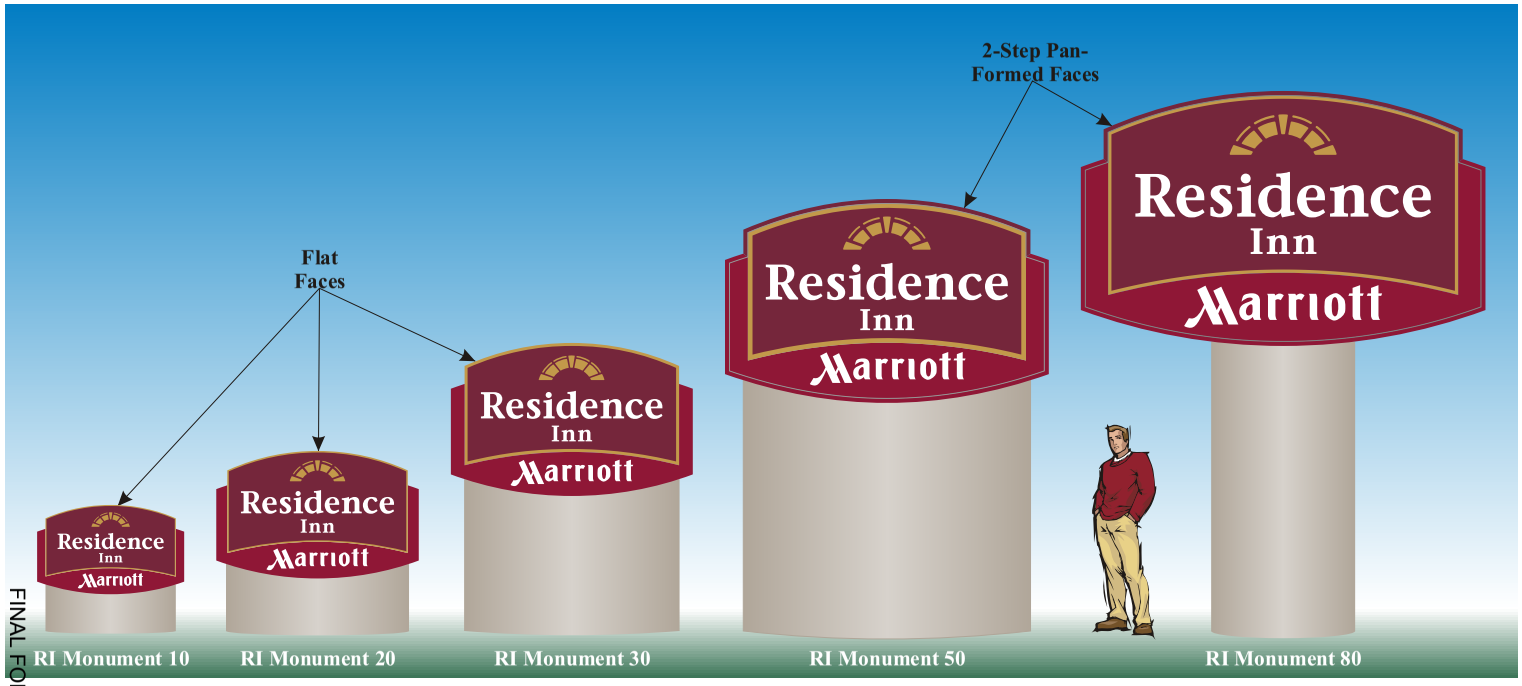
Frame-
- Matthews MP38021 burgundy
- Matthews MP08937 red

Face-
- 3M 3630-2079 burgundy vinyl applied to 1st surface
- 3M 3635-25 yellow vinyl applied to 1st surface
- 3M 3630-4048 gold perforated vinyl applied to 1st surface over top of yellow vinyl
- .177" 7328 white tuf-glas

Marriott copy-
- 3M 3630-20 white vinyl applied to 1st surface of clear push-thru letters

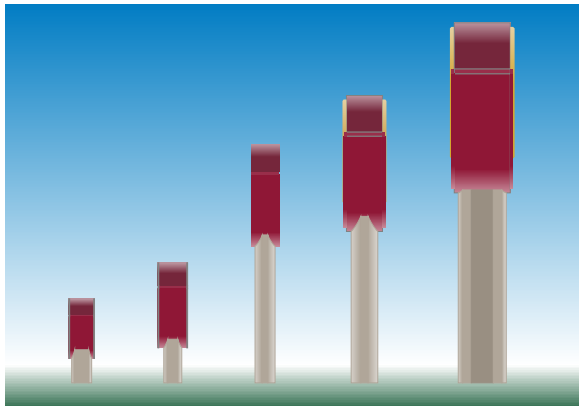
Pole Cover-
- Matthews MP20140 gray, gloss finish
  * Pole covers being painted in-field should be painted to match PMS 402C

PERSONA
Sign Makers / Image Builders



Front View

FINAL FOR CONSTRUCTION



End View

	Size	Overall Height	Face Type
RI Monument 10	2'-5 3/4" X 4'-1"	3'-6"	Flat
RI Monument 20	3'-6 1/2" X 5'-7 1/2"	5'-0"	Flat
RI Monument 30	4'-3" X 6'-8 5/8"	6'-0" to 12'-0"	Flat
RI Monument 50	5'-8" X 9'-0"	8'-0" to 12'-0"	2-Step Pan
RI Monument 80	7'-1" X 11'-2 3/4"	15'-0"	2-Step Pan

Marriott

Project: Residence Inn Sign Guidelines
Page: 16
Scale: Not to scale
Notes: Shown here are the standard monument signs.

Monument Signs

Specifications:
Aluminum and steel construction with rigid faces. Face material is dependent upon the size and type of face being used. Pole covers to be construction of aluminum. All monument signs must have a pole cover. Illumination by H/O fluorescent lamps.

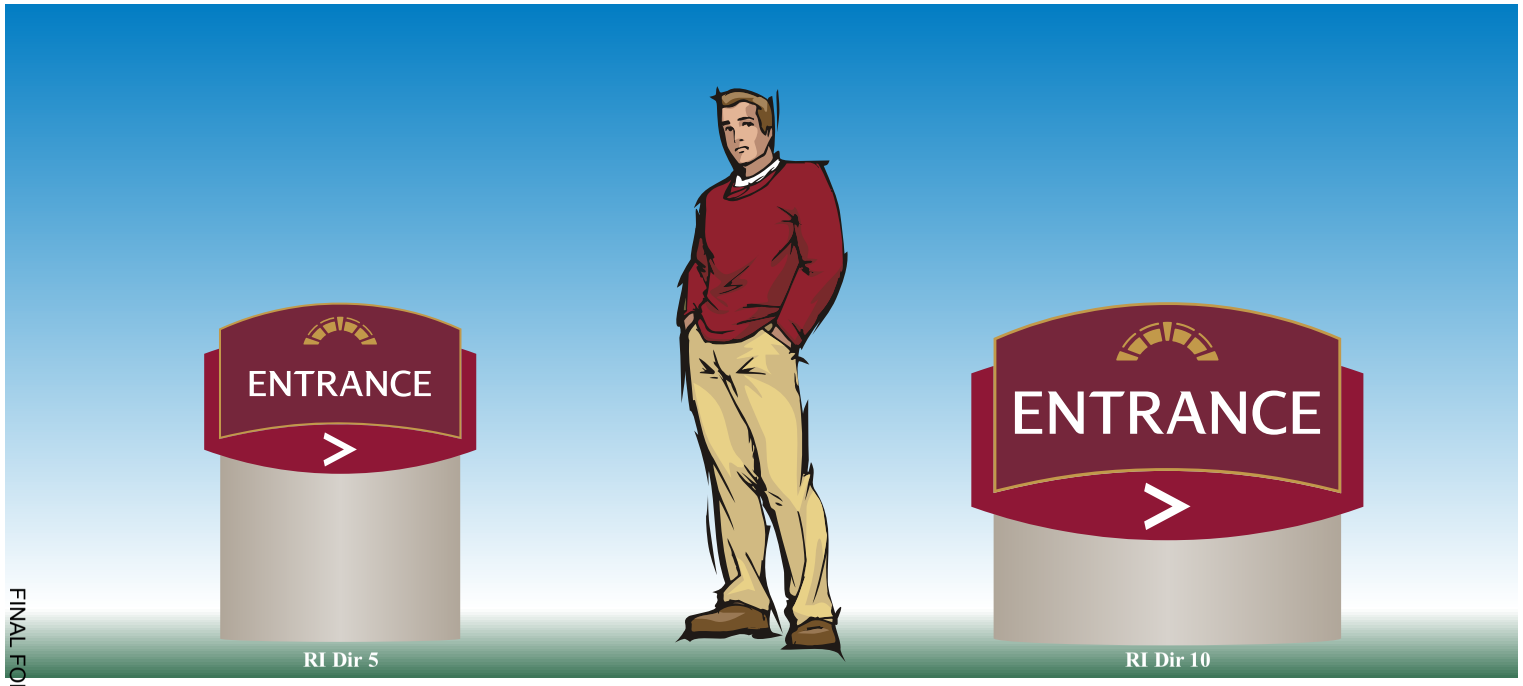
Color:

Frame-
- Matthews MP38021 burgundy
- Matthews MP08937 red

Face-
- 3M 3630-2079 burgundy vinyl applied to 1st surface
- 3M 3630-2382 red vinyl applied to 1st surface
- 3M 3635-25 yellow vinyl applied to 1st surface
- 3M 3630-4048 gold perforated vinyl applied to 1st surface over top of yellow vinyl
- 7328 white tuf-glas

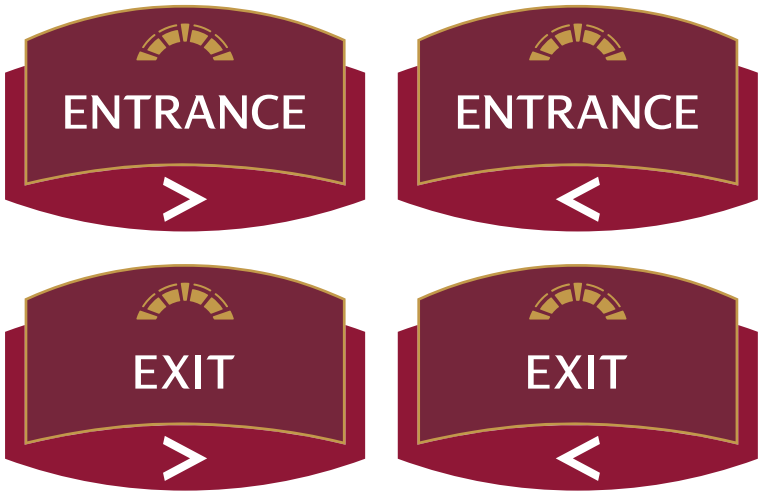
Pole Cover-
- Matthews MP20140 gray, gloss finish
  * Pole covers being painted in-field should be painted to match PMS 402C

PERSONA
Sign Makers / Image Builders

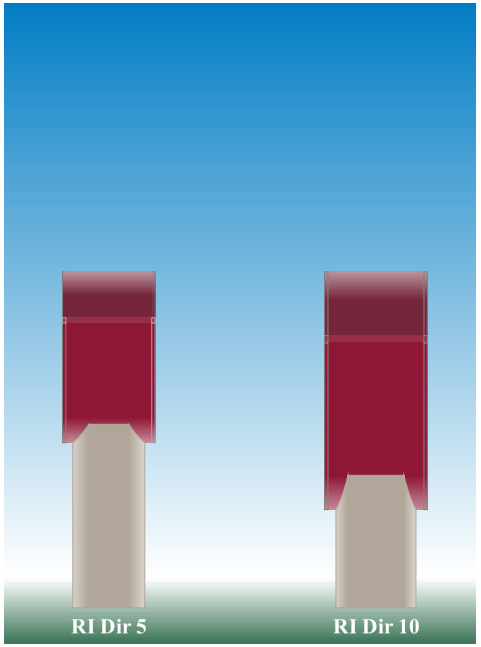


FINAL FOR CONSTRUCTION

	Size	Overall Height
RI Dir 5	1'-9 3/8" X 2'-10"	3'-6"
RI Dir 10	2'-5 3/4" X 4'-1"	3'-6"



Message Options



End View

Marriott

Project: Residence Inn Sign Guidelines
Page: 17
Scale: Not to scale
Notes: Shown here are the standard directional signs.

Directional Signs

Specifications:
Aluminum construction with trim cap faces and aluminum pole cover. Face materials is .150" 7328 white tuf-glas with 1st surface vinyl decoration. Illuminated by H/O fluorescent lamps.

Color:

Frame-
- Matthews MP38021 burgundy
- Matthews MP08937 red

Face-
- 3M 3630-2079 burgundy vinyl applied to 1st surface
- 3M 3630-2382 red vinyl applied to 1st surface
- 3M 3635-25 yellow vinyl applied to 1st surface
- 3M 3630-4048 gold perforated vinyl applied to 1st surface over top of Yellow vinyl
- .150" 7328 white tuf-glas

Pole Cover-
- Matthews MP20140 gray, gloss finish
  * Pole covers being painted in-field should be painted to match PMS 402C

Typeface:
Marriott Bold is the secondary typeface to be used on all directional and informational signs. Text to be in upper-case and centered right to left in cabinet. Arrow to be centered below text in red section of face.

PERSONA
Sign Makers / Image Builders

Mid-Rise Pylons

FINAL FOR CONSTRUCTION

Mid-Rise Pylon -

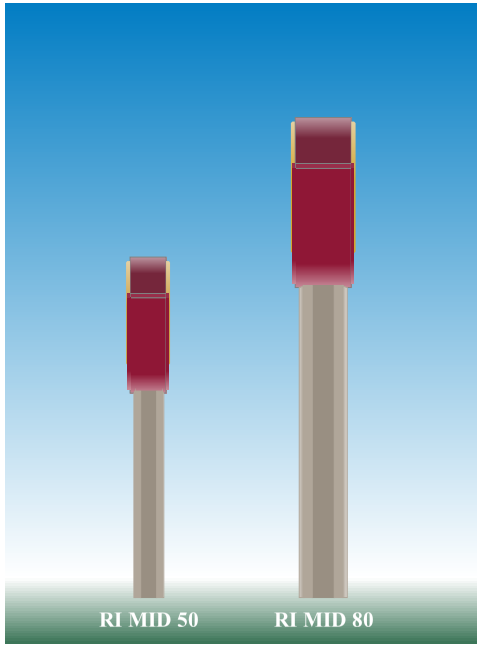
- R Residence Inn mid-rise pylon signs between 50 and 80 square feet in total size shall have vacuum-formed faces. Flat-faced signs are acceptable in certain locations (i.e., tertiary markets, high-vandalism areas, etc.).
- R Mid-rise pylon signs should include a pole cover at least 3 feet wide, painted Matthews MP20140 gray, to hide pole structure.
- R Unless required by code or authorized by Marriott, primary sign structures shall not include non-Marriott brands.
- R When multiple Marriott brands are located on the same primary sign structure, higher transient brands should be located in the optimum visibility area. (highest transient brands to lowest are: Fairfield Inn & Suites, Courtyard, SpringHill Suites, Residence Inn, TownePlace Suites.)

Front View

FINAL FOR CONSTRUCTION

	Size	Overall Height
RI MID 50	5'-8" X 9'-0"	15'-0"
RI MID 80	7'-1" X 11'-2 3/4"	20'-0"

Note: All mid-rise pylon signs are required to have a pole cover at least 3 feet wide.



End View

Marriott

Project: Residence Inn Sign Guidelines
Page: 19
Scale: Not to scale
Notes: Shown here are the standard mid-rise pylon signs.

Mid-Rise Pylons

Specifications:
Aluminum and steel construction with aluminum pole cover. Face materials is .177" 7328 white, 2-step, pan-formed Tuf-glas with 1st surface vinyl decoration. Illuminated by H/O fluorescent lamps. Pole covers are required on all mid-rise pylons and are constructed of aluminum.

Color:

Frame-
- Matthews MP38021 burgundy
- Matthews MP08937 red

Face-
- 3M 3630-2079 burugndy vinyl applied to 1st surface
- 3M 3630-2382 red vinyl applied to 1st surface
- 3M 3635-25 yellow vinyl applied to 1st surface
- 3M 3630-4048 gold perforated vinyl applied to 1st surface over top of yellow vinyl
- .177" 7328 white tuf-glas

Pole Cover-
- Matthews MP20140 gray, gloss finish
  * Pole covers being painted in-field should be painted to match PMS 402C

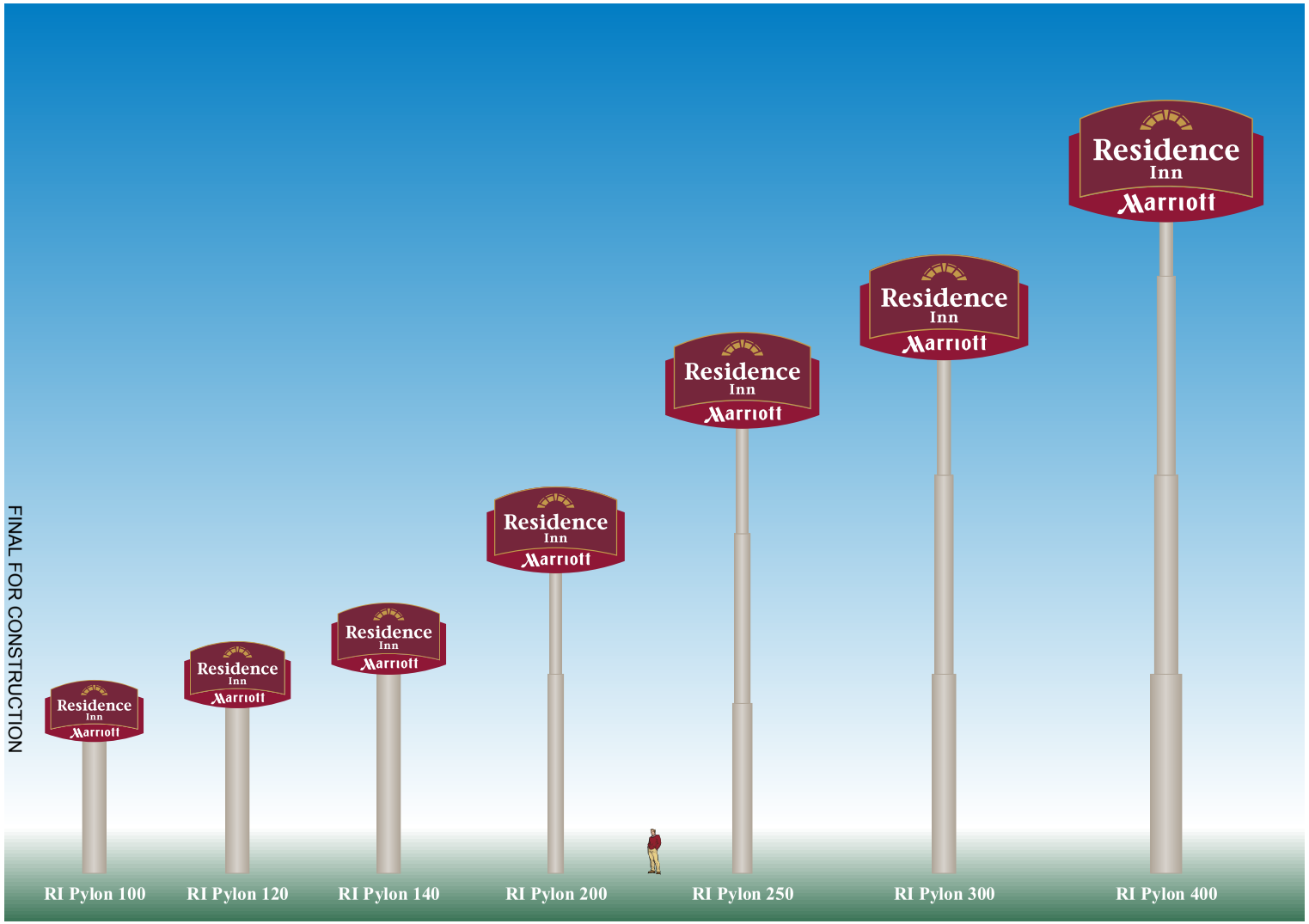
PERSONA
Sign Makers / Image Builders

Hi-Rise Pylons

FINAL FOR CONSTRUCTION

Hi-Rise Pylon -

- Due to current trends in planning and zoning, verify local jurisdictional requirements.
- Unless required by code or authorized by Marriott, primary sign structure shall not include non-Marriott brands.
- When multiple Marriott brands are located on the same primary sign structure, higher transient brands should be located in the optimum visibility area. (Highest transient brands to lowest are: Fairfield Inn & Suites, Courtyard, SpringHill Suites, Residence Inn, TownePlace Suites.)



	Size	Overall Height	Lighting
RI Pylon 100	8'-0 3/8" X 12'-9"	25'-0"	Fluorescent or H.I.D.
RI Pylon 120	8'-8" X 13'-9 5/16"	30'-0"	Fluorescent
RI Pylon 140	9'-4" X 14'-10"	35'-0"	Fluorescent or H.I.D.
RI Pylon 200	11'-2 5/8" X 17'-10"	50'-0"	H.I.D.
RI Pylon 250	12'-6 3/8" X 19'-11"	70'-0"	H.I.D.
RI Pylon 300	13'-8 3/16" X 21'-9"	80'-0"	H.I.D.
RI Pylon 400	15'-10" X 25'-2"	100'-0"	H.I.D.

Note: All hi-rise pylon signs 35'-0" overall height and below are required to have a pole cover at least 3 feet wide.

Marriott

Project: Residence Inn Sign Guidelines
Page: 21
Scale: Not to scale
Notes: Shown here are the standard hi-rise pylon signs.

Hi-Rise Pylons

Specifications:
Aluminum and steel construction with bleed faces. Face to be flexible with 1st surface vinyl decoration. Illuminated by H/O fluorescent lamps or H.I.D. lamps. Pole covers are required on all hi-rise pylons 35'-0" overall height and less. Pole covers to be constructed from aluminum.

Color:

Frame-
- Matthews MP38021 burgundy
- Matthews MP08937 red

Face-
- 3M 3630-2079 burgundy vinyl applied to 1st surface
- 3M 3630-2382 red vinyl applied to 1st surface
- 3M 3635-25 yellow vinyl applied to 1st surface
- 3M 3630-4048 gold perforated vinyl applied to 1st surface over top of yellow vinyl
- Flexible face material

Poles and Pole Covers-
- Matthews MP20140 gray, gloss finish
  * Poles and pole covers being painted in-field should be painted to match PMS 402C

PERSONA
Sign Makers / Image Builders

- SECTION 10 2113 -

TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Extent of toilet partitions is indicated on Drawings.
   2. Styles of toilet compartments include:
      a. Plastic Laminate Finished, Floor-Anchored, Overhead Braced
   3. Styles of Screens include:
      a. Plastic Laminate Finished, Floor-Anchored

1.3 RELATED REQUIREMENTS

A. Pertinent Sections specifying Volatile Organic Compound (VOC) Content Restrictions.

B. Pertinent Sections specifying sealants or referencing this Section for sealant products and Execution Requirements.

C. Section 01 6116 “Volatile Organic Compound (VOC) Restrictions”

D. Section 09 2116 “Gypsum Board Assemblies”.

E. Section 09 3013 “Tiling”.

F. Section 10 2800.01 “Toilet, Bath, and Laundry Accessories” (COURTYARD)

G. Section 10 2800.01a “Toilet and Bath Accessory Matrix” (COURTYARD)

H. Section 10 2800.02 “Toilet, Bath, and Laundry Accessories” (RESIDENCE INN)

I. Section 10 2800.02a “Toilet and Bath Accessory Matrix” (RESIDENCE INN)

1.4 REFERENCES

A. "Phoenix Building Construction Code", International Building Code 2006, with City of Phoenix administrative provisions and amendments.

B. Americans with Disabilities Act (ADA) II Public Accommodations
   1. 36 CFR 1191 - Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities; Final Rule; Federal Register, July 26, 1991; updated 2010.
   2. Americans with Disabilities Act Accessibility Guidelines (ADAAG)

C. ASTM International (ASTM) Publications:
   1. A167 "Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip"

D. National Electrical Manufacturer's Association (NEMA) Standards Publications:
   1. LD 3 - 2000 "High Pressure Decorative Laminates (HPDL)"

1.5 SUBMITTALS

A. General: Submit in accordance with Section 01 3300.

B. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

C. Product Data: For each type of product indicated, demonstrate compliance with specified attributes.

D. VOC Submittals:
   1. Product Data – VOC Limits: For adhesives sealants, fillers and primers, documentation including printed statement of VOC contents, comply with limits specified in Section 01 6116.

E. Submit "Letter of Conformance" in accordance with Section 01 33 00 (01330) indicating specified items selected for use in project with the following supporting data.
   1. Product Data: Submit manufacturer's detailed technical data for materials, fabrication, and installation, including catalog cuts of anchors, hardware, fastenings, and accessories.
   2. Shop Drawings: Submit shop drawings for fabrication and erection of toilet partition assemblies not fully described by product drawings, templates, and instructions for installation of anchorage devices built into other work.

1.6 QUALITY ASSURANCE

A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication where possible, to ensure proper fitting of work. However, allow for adjustments within specified tolerances wherever taking field measurements before fabrication might delay work.

B. Coordination: Furnish inserts and anchorages which must be built into other work for installation of toilet partitions and related work; coordinate delivery with other work to avoid delay.

1.7 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements of Section 01 6000.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Limits for adhesives sealants, fillers and primers. Comply with limits specified in Section 01 6116.

2.2 MANUFACTURERS

A. Avendra, LLC Preferred Manufacturers:
   1. None

B. Approved Manufacturers:
   1. Accurate Partitions Corp. (708-442-6800)
      a. Toilet Comp: “Concord”
      b. Urinal Screens: Floor mounted with post supports.
   2. Knickerbocker Partition Corp. (516-546-0550)
      a. Toilet Comp: “Metropolitan:
      b. Urinal Screens: Floor mounted with post supports.
   3. Metpar Corporation (888-638-7271)
      a. Toilet Compartments: "Corinthian FP-500"
      b. Urinal Screens: Type "PF"
   4. Flush-Metal Partition Corporation (718-784-3380)
      a. Toilet Compartments: "Flushite"
      b. Urinal Screens: "PS-Post Supported"
   5. Bobrick Washroom Equipment (818-764-1000)
      a. Toilet Compartments: No. 1042 Series, Overhead Braced
      b. Urinal Screens: No. 1043 Designer Series: 1541 Classic Series, Floor-Anchored.
   6. Global Steel Products Corporation (516-586-3330)
      a. Toilet Compartments: "Embasy"
      b. Urinal Screens: Floor mounted with Post Support
   7. Sanymetal, a Crane Plumbing Co. (800-832-7994)
      a. Toilet Compartments: "Academy"
      b. Urinal Screens: Type "BX"
   8. Hadrian Manufacturing, Inc. (800-536-1469)
      a. Toilet Compartments: "Headrail Braced"

b. Urinal Screens: Floor mounted with Post Support

2.3 MATERIALS

A. General: Provide materials which have been selected for surface flatness and smoothness. Exposed surfaces which exhibit pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections on finished units are not acceptable.

B. Plastic Laminate: NEMA std. LD-3, minimum 0.050 -inch thick, color and pattern as indicated in Interior Finish Index.

C. Core Material for Plastic Laminate: Manufacturer's standard plywood or particleboard in thickness to provide normal dimension of 1 inch minimum for all components.

D. Concealed Anchorage Reinforcement: Minimum 12 gauge galvanized steel sheet.

E. Concealed Tapping Reinforcement: Minimum 14 gauge galvanized steel sheet.

F. Pilaster Shoes: ASTM A167, Type 304 stainless steel, not less than 3 -inch high, 20-gauge, finished to match hardware.

G. Stirrup Brackets: Manufacturer's standard design for attaching panels to walls and pilasters, either chromium-plated non-ferrous cast alloy ("Zamac") or anodized aluminum.

H. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories of stainless steel.

1. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match hardware, with theft-resistant type heads and nuts. For concealed anchors, use hot-dip galvanized, cadmium-plated, or other rust-resistant protective-coated steel.

I. Overhead Bracing: Continuous extruded aluminum, antigrip profile, with clear anodized finish.

2.4 FABRICATION

A. General: Furnish standard doors, panels, and pilasters fabricated for partition system, unless otherwise indicated. Furnish units with cutouts, drilled holes, and internal reinforcement to receive partition-mounted hardware, accessories, and grab bars, as indicated. Fabricate to fit dimensions shown on Drawings.

B. Door Dimensions: Unless otherwise indicated, furnish 24 -inch wide in swinging doors for standard toilet compartments and 36 -inch wide (32 -inch clear opening) outswinging doors at stalls equipped for compartments shown as wheelchair accessible.

1. Provide 34 -inch (32 -inch clear opening) wide out-swinging doors for compartments shown as ambulatory compartments.

C. Plastic Laminate Compartments and Screens: Pressure-laminate one-piece face sheets to core material with no splices or joints and with edges straight and sealed. Seal exposed core material at cutouts to protect against moisture.

D. Overhead-Braced Compartments: Furnish galvanized steel supports and leveling bolts at pilasters as recommended by manufacturer to suit floor conditions. Make provisions for setting and securing continuous, extruded, aluminum, antigrip, overhead bracing at top of each pilaster.

1. Furnish galvanized steel anchorage devices complete with threaded rods, lock washers, and leveling adjustment nuts at pilasters to permit structural connection at floor. Provide shoe at each pilaster to conceal anchorage.

E. Hardware: Furnish hardware for each compartment in partition system, as follows:

1. Hinges: Cutout inset type, adjustable to hold door open at any angle up to 90 degrees. Provide gravity type, spring-action cam type, or concealed torsion rod type, to suit manufacturer's standards.
2. Latch and Keeper: Manufacturer's standard surface-mounted latch unit, designed for emergency access, with combination rubber-faced door strike and keeper.
3. Coat Hook: Manufacturer's standard unit, combination hook and rubber-tipped bumper, sized to prevent door hitting mounted accessories.
4. Door Pull: Manufacturer's standard unit for out-swing doors. Provide pulls on both faces of handicap compartment doors. Design shall be in conformance with ADA requirements.

2.5 FINISHES

A. Color: As indicated in Interior Finish Index.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's recommended procedures and installation sequence. Install partitions rigid, straight, plumb, and level. Provide clearances of not more than 1/2 -inch between pilasters and panels, and not more than 1 -inch between panels and walls. Secure panels to walls with not less than two stirrup brackets attached near top and bottom of panel. Locate wall brackets so that holes for wall anchorages occur in masonry or tile joints. Secure panels to pilasters with not less than two stirrup brackets located to align with stirrup brackets at wall. Secure panels in position with manufacturer's recommended anchoring devices.

B. Floor Supported Partitions and Screens: Set pilaster units with anchorages having not less than 2-inch penetration into structural floor, unless otherwise recommended by partition manufacturer. Level, plumb, and tighten installation with devices furnished. Hang doors and adjust so that tops of doors are level with tops of pilasters when doors are in closed position.

C. Overhead Braced Compartments: Secure overhead brace to each pilaster with not less than two stirrup brackets. Hang doors and adjust so that top of doors are parallel with overhead brace when doors are in closed position.

D. Screens: Attach with anchoring devices as recommended by manufacturer to suit supporting structure set units to provide support and to resist lateral impact.

3.2 ADJUST AND CLEAN

A. Hardware Adjustment: Adjust and lubricate hardware for proper operation. Set hinges on inswinging doors to hold open approximately 30 degrees from closed position when unlatched. Set hinges on outswinging doors (and entrance swing doors) to return to fully closed position.

B. Clean exposed surfaces of partition systems using materials and methods recommended by manufacturer, and provide protection as necessary to prevent damage during remainder of construction period.

- END OF SECTION -

- SECTION 10 2238 -

OPERABLE PANEL PARTITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Manually operated, acoustical panel partitions with pocket for stacking panels.
2. Pocket Doors.

1.3 RELATED REQUIREMENTS

A. Pertinent Sections specifying Volatile Organic Compound (VOC) Content Restrictions.

B. Section 01 6116 “Volatile Organic Compound (VOC) Restrictions”.

C. Section 05 4000 “Cold-Formed Metal Framing”.

D. Section 05 5000 "Metal Fabrications" for supports that attach supporting tracks to overhead structural system.

E. Section 09 2216 “Non-Structural Metal Framing”.

F. Section 09 2226 “Gypsum Board Ceiling Suspension Systems”.

G. Section 09 2900 "Gypsum Board" for fire-rated assemblies and sound barrier construction above the ceiling at track.

H. Section 09 5123 “Acoustical Tile Ceilings”.

I. Division 26 for lighting controls.

1.4 REFERENCES

A. “Phoenix Building Construction Code”, International Building Code 2006, with City of Phoenix administrative provisions and amendments.

1.5 DEFINITIONS

A. ADA-ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."

B. NIC: Noise Isolation Class.

C. NRC: Noise Reduction Coefficient.

D. STC: Sound Transmission Class.

1.6 SUBMITTALS

A. General: Submit in accordance with Section 01 3300.

B. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

C. Product Data: For each type of product indicated, demonstrate compliance with specified attributes.

D. VOC Submittals:
1. Product Data – VOC Limits: For adhesives sealants, fillers and primers, documentation including printed statement of VOC contents, comply with limits specified in Section 01 6116.

E. Shop Drawings: For operable panel partitions.
1. Include plans, elevations, sections, details, numbered panel installation sequence, and attachments to other work.
2. Indicate stacking and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.
3. For installed products indicated to comply with design loads, include structural analysis data for attachments, signed and sealed by the qualified professional engineer responsible for their preparation.
4. Indicate storage and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.

F. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Partition track, track supports and bracing, switches, turning space, and storage layout.
   a. Stacking type.
2. Suspended ceiling components.
3. Structural members to which suspension systems are attached.
4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including the following:
   a. Lighting fixtures.
   b. HVAC ductwork, outlets, and inlets.

c. Speakers.
d. Sprinklers.
e. Smoke detectors.
f. Access panels.

6. Plenum acoustical barriers.

G. Setting Drawings: For embedded items and cutouts required in other work, including support-beam, mounting-hole template.

H. Samples for Initial Selection: For each type of exposed material, finish, covering, or facing.
1. Include Samples of accessories involving color selection.

I. Samples for Verification: For each type of exposed material, finish, covering, or facing, prepared on Samples of size indicated below:
1. Textile Facing Material: Full width by not less than 36 -inch (914 mm-) long section of fabricfrom dye lot to be used for the Work, with specified treatments applied. Show complete pattern repeat.
2. Panel Facing Material: Manufacturer's standard-size unit, not less than 3 -inches (75 mm) square.
3. Panel Edge Material: Not less than 3 -inches (75 mm) long.
4. Chair Rail: Manufacturer's standard-size unit, 6 -inches (150 mm) long.
5. Glass: Units 12 -inches (300 mm) square.
6. Hardware: One of each exposed door-operating device.

1.7 INFORMATIONAL SUBMITTALS

A. Delegated-Design Submittal: For operable panel partitions indicated to comply with performance requirements, including analysis data and calculations signed and sealed by the qualified professional engineer responsible for their preparation.
1. Design Calculations: Calculate requirements for seismic restraints.
2. Include design calculations for seismic restraints.

B. Qualification Data: For qualified Installer and manufacturer .

C. Seismic Qualification Certificates: For operable panel partitions, tracks, accessories, and components, from manufacturer. Include seismic capacity of partition assemblies to remain in vertical position during a seismic event and the following:
1. Basis for Certification: Indicate whether certification is based on analysis, testing, or experience data, according to ASCE/SEI 7.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of partition anchorage devices on which the certification is based and their installation requirements.

D. Product Certificates: For each type of operable panel partition.
1. Include approval letter signed by manufacturer acknowledging Owner-furnished panel facing material complies with requirements.

E. Product Test Reports: For each operable panel partition, for tests performed by a qualified testing agency.

F. Field quality-control reports.

G. Operation and Maintenance Data: For operable panel partitions to include in maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:

1. Panel finish facings and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
2. Seals, hardware, track, carriers, and other operating components.

H. Sample Warranty: For manufacturer's special warranty.

I. Closeout Submittals:

1. Operation and Maintenance Data: For operable panel partitions to include in maintenance manuals.
    a. In addition to items specified in Section 01 7823 "Operation and Maintenance Data," include the following:
        1) Panel finish facings and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
        2) Seals, hardware, track, track switches, carriers, and other operating components.

J. Maintenance Material Submittals:

1. Furnish extra materials, from the same production run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
    a. Panel Finish-Facing Material: Furnish full width in quantity to cover both sides of two panels when installed.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Fire-Test-Response Characteristics: Provide panels with finishes meeting one of the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Surface-Burning Characteristics: As determined by testing per ASTM E 84.
    a. Flame-Spread Index: As herein specified.
    b. Smoke-Developed Index: As herein specified.
2. Fire Growth Contribution: Meeting acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265.

C. Preinstallation Conference: Conduct conference at Project site.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of Section 01 6000.

B. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels.

1.10 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of operable panel partition openings by field measurements before fabrication.

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of operable panel partitions that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Faulty operation of operable panel partitions.
      b. Deterioration of metals, metal finishes, and other materials beyond normal use.
   2. Warranty Period: Two (2) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Limits for adhesives sealants, fillers and primers. Comply with limits specified in Section 01 6116.

B. Delegated Design: Design operable panel partitions, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Seismic Performance: Operable panel partitions shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "the partition panels will remain in place without separation of any parts from the system when subjected to the seismic forces specified."

D. Acoustical Performance: Provide operable panel partitions tested by a qualified testing agency for the following acoustical properties according to test methods indicated:
   1. Sound-Transmission Requirements: Operable panel partition assembly tested for laboratory sound-transmission loss performance according to ASTM E 90, determined by ASTM E 413, and rated for not less than the STC indicated.
   2. Noise-Reduction Requirements: Operable panel partition assembly, identical to partition tested for STC, tested for sound-absorption performance according to ASTM C 423, and rated for not less than the NRC indicated.

3. Noise-Isolation Requirements: Installed operable panel partition assembly, identical to partition tested for STC, tested for NIC according to ASTM E 336, determined by ASTM E 413, and rated for 10 dB less than STC value indicated .

E. Fire-Test-Response Characteristics: Provide panels with finishes complying with one of the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Surface-Burning Characteristics: Class “A”, comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   a. Flame-Spread Index: 25 or less.
   b. Smoke-Developed Index: 450 or less.
2. Fire Growth Contribution: Complying with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 Method B Protocol - Standard Methods of Fire Tests for Evaluating Room Fire Growth Contribution of Textile or Expanded Vinyl Wall Coverings on Full Height Panels and Walls] .

2.2 MATERIALS

A. Steel Frame: Steel sheet, 0.0641-inch (1.6-mm) nominal minimum thickness for uncoated steel.

B. Steel Face/Liner Sheets: Tension-leveled steel sheet, 0.0478-inch (1.2-mm) nominal minimum thickness for uncoated steel.

C. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use, corrosion resistance, and finish indicated; ASTM B 221 (ASTM B 221M) for extrusions; manufacturer's standard strengths and thicknesses for type of use.
1. Frame Reinforcement: Manufacturer's standard steel or aluminum.

D. Particleboard: ANSI A208.1.

E. Medium-Density Fiberboard: ANSI A208.2 made with binder containing no urea formaldehyde.

2.3 OPERABLE ACOUSTICAL PANELS

A. Operable Acoustical Panels: Partition system, including storage pocket doors, panels, seals, finish facing, suspension system, operators, and accessories.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide ACOUSTI-SEAL 941 series, Single panel system by Modernfold, Inc. with pocket doors; a DORMA Group company or comparable product by one of the following:
   a. Advanced Equipment Corporation.
   b. Hufcor, Inc.
   c. Panelfold Inc

B. Panel Operation: Manually operated, individual (single) panels.

C. Panel storage pocket stacking:

1. Refer to Drawings

D. Panel Construction: As required to support panel from suspension components and with reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.

E. Dimensions: Fabricate operable acoustical panel partitions to form an assembled system of dimensions indicated and verified by field measurements.
1. Panel Width: Equal widths .

F. STC: Not less than 55
1. Higher STC if indicated on Drawings.

G. Panel Weight:
1. Manufacturers required weight to meet required STC value

H. Panel Thickness: Not less than 4 -inches (102 mm) unless indicated otherwise in Drawings.

I. Panel Closure: Manufacturer's standard unless otherwise indicated.
1. Initial Closure: Flexible, resilient PVC, bulb-shaped acoustical seal .
a. Fixed jamb where indicated in drawings.
2. Final Closure: Constant-force, lever-operated mechanical closure expanding from panel edge to create a constant-pressure acoustical seal

J. Hardware: Manufacturer's standard as required to operate operable panel partition and accessories; with decorative, protective finish.
1. Hinges:Concealed (invisible)

2.4 SEALS

A. General: Provide seals that produce operable panel partitions complying with performance requirements and the following:
1. Manufacturer's standard seals unless otherwise indicated.
2. Seals made from materials and in profiles that minimize sound leakage.
3. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable panel partition perimeter and adjacent surfaces, when operable panel partition is extended and closed.

B. Vertical Seals: Deep-nesting, interlocking steel astragals mounted on each edge of panel, with continuous PVC acoustical seal.

C. Horizontal Top Seals:
1. Continuous-contact, extruded-PVC seal exerting uniform constant pressure on track or PVC-faced, mechanical, retractable, constant-force-contact seal exerting uniform constant pressure on track when extended.

D. Horizontal Bottom Seals: PVC-faced, mechanical, retractable, constant-force-contact seal exerting uniform constant pressure on floor when extended, ensuring horizontal and vertical sealing and resisting panel movement.
   1. Automatically Operated for Acoustical Panels: Extension and retraction of bottom seal automatically operated by movement of partition, with operating range not less than 1-1/2 inches (38 mm) between retracted seal and floor finish.

2.5 PANEL FINISH FACINGS

A. General: Provide finish facings for panels that comply with indicated fire-test-response characteristics and that are factory applied to operable panel partitions with appropriate backing, using mildew-resistant nonstaining adhesive as recommended by facing manufacturer's written instructions.
   1. Apply facings free of air bubbles, wrinkles, blisters, and other defects, with edges tightly butted, and with invisible seams complying with Shop Drawings for location, and with no gaps or overlaps.
      a. Horizontal butted edges and seams are not permitted.
      b. Tightly secure and conceal raw and selvage edges of facing for finished appearance.
   2. Where facings with directional or repeating patterns or directional weave [directional, repeating, or matching grain are indicated, mark facing top and attach facing in same direction.
   3. Match facing pattern 72 -inches (1830 mm) above finished floor.

B. Facing Materials:
   1. Schedule:
      a. Vinyl-Coated Fabric Wall Covering: Manufacturer's standard, mildew-resistant, washable, vinyl-coated fabric wall covering; complying with CFFA-W-101-D for type indicated; Class A.
         1) Antimicrobial Treatment: Additives capable of inhibiting growth of bacteria, fungi, and yeasts.
      b. Carpet Wall Covering: Manufacturer's standard nonwoven, needle-punched carpet with fibers fused to backing, from same dye lot, treated to resist stains.
      c. Fabric Wall Covering: from same dye lot, treated to resist stains.
      d. High-Pressure Decorative Laminate: NEMA LD 3, Horizontal grade.

C. Cap-Trimmed Edges: Protective perimeter-edge trim with tight hairline joints concealing edges of panel and finish facing, finished as follows:
   1. Steel, Painted: Finished with manufacturer's color as selected by Architect from manufacturer's full range.

D. Trimless Edges: Fabricate exposed panel edges so finish facing wraps uninterrupted around panel, covering edge and resulting in an installed partition with facing visible on vertical panel edges, without trim, for minimal sightlines at panel-to-panel joints.

2.6 SUSPENSION SYSTEMS

A. Tracks: Steel or aluminum mounted directly to overhead structural support, with adjustable steel hanger rods for overhead support**,** designed for operation, size, and weight of operable panel partition indicated. Size track to support partition operation and storage without damage to suspension system, operable panel partitions, or adjacent construction. Limit track deflection to no more than 0.10 -inch between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.

1. Panel Guide: Aluminum guide on both sides of the track to facilitate straightening of the panels; finished with factory-applied, decorative, protective finish.
2. Head Closure Trim: As required for acoustical performance; with factory-applied, decorative, protective finish .

B. Carriers: Trolley system as required for configuration type, size, and weight of partition and for easy operation; with ball-bearing wheels.

1. Multidirectional Carriers: Capable of negotiating 90-degree L, T, and X intersections without track switches.
2. Multidirectional Switches: Adjustable switch configuring track into L, T, or X intersections and allowing panels to be moved in all pass-through, 90-degree change, and cross-over travel direction combinations.
3. Center carrier stop.

C. Aluminum Finish: Mill finish or manufacturer's standard, factory-applied, decorative finish unless otherwise indicated.

D. Steel Finish: Manufacturer's standard, factory-applied, corrosion-resistant, protective coating unless otherwise indicated.

E. Track Intersections, Switches, and Accessories: As required for operation, storage, track configuration, and layout indicated for operable panel partitions, and compatible with partition assembly specified. Fabricate track intersections and switches from steel or aluminum.

1. L Intersections: Allow panels to change 90 degrees in direction of travel.
2. T Intersections: Allow panels to pass through or change 90 degrees to another direction of travel.

F. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop operable panel partition at fully extended and fully stacked positions.

G. Emergency Release Mechanism: Quick disconnect-release of electric-motor drive system, permitting manual operation in event of operating failure.

H. Electric Interlock: Equip each motorized operable panel partition with electric interlocks at locations indicated, to prevent operation of operable panel partition under the following conditions:

1. On storage pocket door, to prevent operation if door is not in fully open position.
2. On partitions at location of convergence by another partition, to prevent operation if merging partitions are in place.

2.7 ACCESSORIES

A. Storage Pocket Door: Full height at end of partition runs to conceal stacked partition; of same materials, finish, construction, thickness, and acoustical qualities as panels; complete with operating hardware and acoustical seals at soffit, floor, and jambs. Hinges in finish to match other exposed hardware.
   1. Manufacturer's standard method to secure storage pocket door in closed position.

B. Work Surfaces: Quantities, placement, and size indicated.
   1. Surface: Porcelain steel marker/projection surface .
      a. Location each side of panel assembly as directed by Architect.
   2. Surface Color: As selected by Architect from manufacturer's full range .
   3. Size: As indicated on Drawings.
   4. Trim: Aluminum slip-on or snap-on trim with no visible screws or exposed joints and with corners mitered to a neat, hairline joint.

C. Chair Rails: Surface mounted in locations indicated on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable panel partitions.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with ASTM E 557 except as otherwise required by operable panel partition manufacturer's written installation instructions.

B. Install operable panel partitions and accessories after other finishing operations, including painting, have been completed in area of partition installation.

C. Install panels from marked packages in numbered sequence indicated on Shop Drawings.

D. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.

E. Broken, cracked, deformed, or unmatched gasketing or gasketing with gaps at butted ends is not acceptable.

F. Light-Leakage Test: Illuminate one side of partition installation and observe vertical joints and top and bottom seals for voids. Adjust partitions for alignment and full closure of vertical joints and full closure along top and bottom seals.

3.3 FIELD QUALITY CONTROL

B. An operable panel partition installation will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust operable panel partitions, hardware, and other moving parts to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust storage pocket doors to operate smoothly and easily, without binding or warping.

C. Verify that safety devices are properly functioning.

3.5 MAINTENANCE SERVICE

A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by manufacturer's authorized service representative. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operable-partition operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.6 CLEANING

A. Clean soiled surfaces of operable panel partitions to remove dust, loose fibers, fingerprints, adhesives, and other foreign materials according to manufacturer's written instructions.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable panel partitions.

- END OF SECTION -

- SECTION 10 2600 -

WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Wall protection corner guards.
   2. Crash rails.

1.3 RELATED REQUIREMENTS

A. Pertinent Sections specifying Volatile Organic Compound (VOC) Content Restrictions.

B. Section 01 6116 “Volatile Organic Compound (VOC) Restrictions”

C. Section 08 1113 “Hollow Metal Doors and Frames”

D. Section 08 1400.01 “Wood Doors” (Courtyard)

E. Section 08 1400.02 “Wood Doors” (Residence Inn)

F. Section 09 2216 “Non-Structural Metal Framing”

G. Section 09 2900 “Gypsum Board”

1.4 REFERENCES

A. “Phoenix Building Construction Code”, International Building Code 2006, with City of Phoenix administrative provisions and amendments.

1.5 ACTION SUBMITTALS

A. General: Submit in accordance with Section 01 3300.

B. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

C. Product Data: For each type of product indicated, demonstrate compliance with specified attributes.

D. Shop Drawings: For each impact-resistant wall protection unit showing locations and extent. Include sections, details, and attachments to other work.
   1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

E. VOC Submittals:
   1. Product Data – VOC Limits: For adhesives sealants, fillers and primers, documentation including printed statement of VOC contents, comply with limits specified in Section 01 6116.

F. Samples for Initial Selection: For each type of impact-resistant wall protection unit indicated.
   1. Include similar Samples of accent strips and accessories involving color selection.

G. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below. Include Samples of accent strips to verify color selected where applicable.
   1. Corner Guards: 12 -inches (300 mm) long. Include examples of joinery, corners, end caps, top caps, and field splices.
   2. Wall Guards – Crash Rails: 12 -inches (300 mm) long. Include examples of joinery, corners, end caps, top caps, and field splices.

H. Submit “Letter of Conformance” in accordance with Section 01 3300 indicating specified items selected for use in project with the following supporting data.
   1. Provide manufacturer's technical data, installation instructions, setting drawings, templates, instructions, and directions for installation of anchorage devices in other work.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer .

B. Material Certificates: For each impact-resistant plastic material, from manufacturer.

C. Material Test Reports: For each impact-resistant plastic material.

D. Warranty: Sample of special warranty.

1.7 DEFINITIONS

A. BOH: Back of House.

B. FOH: Front of House.

1.8 CLOSEOUT SUBMITTALS

A. Refer to Section 01 700.

B. Maintenance Data: For each impact-resistant wall protection unit to include in maintenance manuals.

1. Include recommended methods and frequency of maintenance for maintaining optimum condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to plastic finishes and performance.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Source Limitations: Obtain impact-resistant wall protection units from single source from single manufacturer.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of impact-resistant wall protection units and are based on the specific system indicated. Refer to Section 01 4000 "Quality Requirements."

D. Revise subparagraph below to suit Project.

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

E. Surface-Burning Characteristics: Provide impact-resistant, plastic wall protection units with surface-burning characteristics as determined by testing identical products per ASTM E 84, NFPA 255, or UL 723 by UL or another qualified testing agency.

F. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines .

G. Preinstallation Conference: Conduct conference at Project site .

1.10 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of Section 01 6000.

B. Store impact-resistant wall protection units in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1. Maintain room temperature within storage area at not less than 70 deg F (21 deg C) during the period plastic materials are stored.
2. Keep plastic sheet material out of direct sunlight.
3. Store plastic wall protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F (21 deg C).
    a. Store corner-guard covers in a vertical position.
    b. Store wall-guard, bed-locator and handrail covers in a horizontal position.

C. Do not deliver guards to site until rooms in which they are to be installed are ready to receive them.

D. Store packages to prevent physical damage or wetting.

E. Pack all parts individually in a manner to protect finish.

F. Maintain protective covers on all units until final clean-up.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of impact-resistant wall protection units that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures.
      b. Deterioration of plastic and other materials beyond normal use.

B. Work of this Section shall be jointly warrantied by the manufacturer and the installer for a period of (1) one year after final payment.
   1. Any material or workmanship that is judged defective during this period shall be replaced at no cost to the Owner.

C. Product shall be warranted by the manufacturer for a period of (5) five years after final payment.
   1. Any material or workmanship that is judged defective during this period shall be replaced at no cost to the Owner.

1.12 EXTRA MATERIAL

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Corner-Guard Covers: Full-size plastic covers of maximum length equal to 2 percent of each type, color, and texture of units installed, but no fewer than two, 4-foot- (1.2-m-) long units.
   2. Wall-Guard Covers: Full-size plastic covers of maximum length equal to 2 percent of each type, color, and texture of units installed, but no fewer than two, 8-foot (2.4-m-)long units.

B. Include mounting and accessory components. Replacement materials shall be from same production run as installed units.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Limits for adhesives sealants, fillers and primers. Comply with limits specified in Section 01 6116.

B. Structural Performance: Provide handrails capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
2. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
3. Uniform and concentrated loads need not be assumed to act concurrently.

2.2 MATERIALS

A. PVC Plastic: ASTM D 1784, Class 1, textured, chemical- and stain-resistant, high-impact-resistant PVC or acrylic-modified vinyl plastic with integral color throughout; extruded and sheet material, thickness as indicated.

1. Impact Resistance: Minimum 25.4 ft-lbf/in. (1356 J/m) of notch when tested according to ASTM D 256, Test Method A.
2. Chemical and Stain Resistance: Tested according to ASTM D 543 .
3. Self-extinguishing when tested according to ASTM D 635.
4. Flame-Spread Index: 25 or less.
5. Smoke-Developed Index: 450 or less.

B. Polycarbonate Plastic Sheet: ASTM D 6098, S-PC01, Class 1 or 2, abrasion resistant; with a minimum impact-resistance rating of 15 ft-lbf/in. (800 J/m) of notch when tested according to ASTM D 256, Test Method A.

C. Aluminum Extrusions: Alloy and temper recommended by manufacturer for type of use and finish indicated, but with not less than strength and durability properties specified in ASTM B 221 (ASTM B 221M) for Alloy 6063-T5.

D. Stainless-Steel Sheet: ASTM A 240/A 240M.

E. Brass: ASTM B 249/B 249M for extruded shapes and ASTM B 36/B 36 M for sheet.

F. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

G. Adhesive: As recommended by impact-resistant plastic wall protection manufacturer and with Section 01 6116 “Volatile Organic Compound (VOC) Restrictions”.

2.3 MANUFACTURERS

A. Avendra, LLC Preferred Manufacturers:
   1. IPC Door and Wall Protection Systems, Inpro Corp. (800-543-1729)

B. Approved Manufacturers:
   1. Grand Entrance, A Division of Construction Specialties, Inc. (888-424-6287)
   2. Balco, Inc. (800-628-0449)
   3. Korogard Wall Protection Systems, a Division of RJF International Corporation (800-628-0449)

2.4 WALL PROTECTION CORNER GUARDS – COURTYARD & RESIDENCE INN

A. Surface mounted corner guards of various materials. Provide backing in walls for mounting.

B. Corner Guards: "Rigid extruded PVC, 90 degree type"; adhesive applied.
   1. Size:
      a. Guest Rooms: (See all Finish Specification Drawings including ID0.4)
         1) Designation: **CG-1 (**Unless indicated otherwise in Drawings)
         2) Mfgr: IPC Door and Wall Protection Systems, Inpro Corp.
         3) Series: Inpro
         4) Material: Vinyl
         5) Profile: 3/4 -inch by 3/4 –inch.
            a) Height to be from top of base to underside of ceiling
         6) Thickness: 0.080 –inch.
         7) Model: 3496N
         8) Texture: Yes
         9) Color/Pattern: Refer to Interior Finish Schedule / Index Drawings
      b. Guestroom Corridors: (See all Finish Specification Drawings including ID0.4)
         1) Designation: **CG-2 (**Unless indicated otherwise in Drawings)
         2) Mfgr: IPC Door and Wall Protection Systems, Inpro Corp.
         3) Series: Inpro
         4) Material: Vinyl
         5) Profile: 1-1/2 -inch by 1-1/2 –inch.
            a) Height to be from top of base to underside of ceiling
         6) Thickness: 0.080 -inch.
         7) Texture: Yes
         8) Color/Pattern: Refer to Interior Finish Schedule / Index Drawings
      c. Height to be from top of resilient or carpet base to underside of ceiling with no gaps top or bottom.
         1) Where ceiling heights are greater than 8 -feet-0 -inch, provide corner guards in one piece, no joints or seams will be permitted.
   2. Attachment: Adhesive cement as recommended by manufacturer.
      a. Self-Adhesive tape application not permitted.

C. Corner Guards: Stainless Steel Corner Guards 90 degree type with 1/8 -inch radius, surface mounted and adhesive applied, by IPC or approved substitution by listed manufacturer.

1. Locations:
   a. Laundry and Housekeeping
   b. Basement Hallway, B105.
   c. Services Vestibule, B111.
   d. Vestibule B112.
   e. Service Corridor 107
   f. Corridor 207
   g. Service 214
   h. Vestibules serving Elevators.
   i. As indicated on Drawings.
2. Mfgr: IPC Door and Wall Protection Systems, Inpro Corp.
3. Series: Inpro
4. Profile: 3-1/2 -inch by 3-1/2 –inch.
   a. Height to be from top of base to underside of ceiling.
5. Type: 430
6. Model No: 183124C-430
7. Gauge: 16
8. Finish: No. 4, brushed finish
9. Attachment: Adhesive cement as recommended by manufacturer.

D. Corner Guards: Stainless Steel Corner Guards 90 degree type with 1/8 -inch radius, surface mounted and adhesive applied, by IPC or approved substitution by listed manufacturer.

1. Locations:
   a. Kitchens
   b. As indicated on Drawings.
2. Mfgr: IPC Door and Wall Protection Systems, Inpro Corp.
3. Series: Inpro
4. Profile: 3-1/2 -inch by 3-1/2 –inch.
   a. Height to be from top of base to underside of ceiling.
5. Type: 304
6. Model No: 183128C-304
7. Gauge: 16
8. Finish: No. 4, brushed finish
9. Attachment: Adhesive cement as recommended by manufacturer.

2.5 WALL PROTECTION WALL GUARDS (CRASH RAILS)

A. Crash Rail: Heavy-duty assembly consisting of continuous snap-on plastic cover installed over concealed retainer system; designed to withstand impacts.

B. Basis of Design: 5000 Wall Guard manufactured by IPC Corporation, (800) 222-5556; www.inprocorp.com

1. Locations: BOH - Service areas, corridors, as specified and other locations as noted on Drawings.
   a. Basement Hallway B105
   b. Service Vestibule B111
   c. Vestibule B112
   d. Service Corridor 107
   e. Corridor 207
   f. Service 214
   g. Service Vestibules Elevators
2. Cover: Extruded rigid plastic, minimum 0.80 -inch wall thickness; as follows:
   a. Profile: Flat face with faceted edges.
   b. Dimensions: Nominal 4 -inches high by 1 -inch deep (101.6 mm high by 25 mm deep).
   c. Surface: Uniform.
   d. Color and Texture: As selected by Architect from manufacturer's full range.
3. Continuous Retainer: Minimum 0.080 -inch (2.0-mm-) thick, one-piece, continuous aluminum.
4. Internal Impact Bumper: Minimum 0.070 –inch thick, one-piece, continuous aluminum.
5. Bumper: Continuous rubber or vinyl bumper cushion(s) where indicated in Drawings.
6. End Caps and Corners: Prefabricated, injection-molded plastic; matching color cover; field adjustable for close alignment with snap-on cover.
7. Accessories: Concealed splices and mounting hardware.
8. Mounting: Surface mounted directly to wall.

2.6 ACCESSORIES

A. Provide all appropriate mounting systems including all screws, bolts, brackets, end caps, and base plates as required for complete installation.

2.7 FABRICATION

A. Fabricate impact-resistant wall protection units to comply with requirements indicated for design, dimensions, and member sizes, including thicknesses of components.

B. Preform curved semirigid, impact-resistant sheet wall covering in factory for radius and sheet thickness as follows minimum unless thicker material per manufactuers requirements:

1. Sheet Thickness of 0.040 -inch (1.0 mm): 24-inch (610-mm) radius.
2. Sheet Thickness of 0.060 -inch (1.5 mm): 36-inch (914-mm) radius.

C. Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

D. Fabricate components with tight seams and joints with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

E. Miter corners and ends of wood handrails for returns.

2.8 METAL FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
   1. Remove tool and die marks and stretch lines, or blend into finish.
   2. Grind and polish surfaces to produce uniform finish, free of cross scratches.
   3. Run grain of directional finishes with long dimension of each piece.
   4. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

B. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances, fire rating, and other conditions affecting performance of work.

B. Examine walls to which impact-resistant wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
   1. For impact-resistant wall protection units attached with adhesive or foam tape, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Complete finishing operations, including painting, before installing impact-resistant wall protection system components.

B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. General: Install impact-resistant wall protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
   1. Install impact-resistant wall protection units in locations and at mounting heights indicated on Drawings.
   2. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.
      a. Provide anchoring devices to withstand imposed loads.
      b. Where splices occur in horizontal runs of more than 20 -feet (6.1 m), splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 -inches (305 mm).
      c. Adjust end and top caps as required to ensure tight seams.

B. Attach retainers to wall with appropriate anchorage devices furnished by manufacturer. Snap-lock covers onto retainers after paint or wallcoverings have been applied.

C. Install guards, accessories, and items in accordance with manufacturer's printed instructions.

D. Use concealed fastenings wherever possible.

E. Install true, plumb, and level, securely and rigidly anchored to substrate in accordance with manufacturer's instructions for each item and each type of substrate construction.
   1. Attach with manufacturer’s recommended adhesive.

- END OF SECTION -

- SECTION 10 2800 -

TOILET, BATH AND LAUBNDRY ACCESSORIES (COURTYARD)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: **(COURTYARD)**
   1. Typical:
      a. Toilet Accessories
      b. Bath Accessories
      c. Attachment hardware
   2. Frameless Shower Door With Fixed Glass Panel - Curved
   3. Fixed Glass Panel at Tub Seat - Curved

1.3 RELATED REQUIREMENTS

A. Pertinent Sections specifying Volatile Organic Compound (VOC) Content Restrictions.

B. Section 01 6116 “Volatile Organic Compound (VOC) Restrictions”.

C. Section 05 5000 “Metal Fabrications”.

D. Section 08 8300 “Mirrors” for unframed mirrors.

E. Section 09 3013 “Tiling” for coordinating installation of accessories.

F. Section 10 2113 “Toilet Compartments” for coordinating installation of accessories.

G. Section 10 2800.01a “Toilet & Bath Accessory Matrix (Courtyard).

H. Section 10 2800.02a “Toilet & Bath Accessory Matrix (Residence Inn).

1.4 REFERENCES

A. "Phoenix Building Construction Code", International Building Code 2006, with City of Phoenix administrative provisions and amendments.

B. ASTM International Publications:
   1. A167 - "Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip"
   2. A666 "Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar"

C. American National Standards Institute (ANSI)
   1. ICC/ANSI A117.1-2003 , "Accessible and Useable Buildings and Facilities"
   2. 36 CFR 1191 - Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities; Final Rule; Federal Register, July 26, 1991; updated 2010.

D. Americans with Disabilities Act (ADA) II Public Accommodations.

1.5 SUBMITTALS

A. General: Submit in accordance with Section 01 3300.

B. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

C. Product Data: For each type of product indicated, demonstrate compliance with specified attributes.

D. VOC Submittals:
   1. Product Data – VOC Limits: For adhesives sealants, fillers and primers, documentation including printed statement of VOC contents, comply with limits specified in Section 01 6116.

E. Submit "Letter of Conformance" in accordance with Section 01 33 00 indicating specified items selected for use in project with the following supporting data.
   1. Product Data: Mark each copy to identify applicable products, characteristics, models, options and other supplemental data to clearly communicate information specific to this project.

1.6 QUALITY ASSURANCE

A. Provide products of the same manufacturer for each type of accessory unit and for units exposed in the same area.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of Section 01 6000.

B. Do not deliver accessories to site until rooms in which they are to be installed are ready to receive them.

C. Store packages to prevent physical damage or wetting.

D. Pack accessories individually in a manner to protect accessory and its finish.

E. Maintain protective covers on all units until final clean-up.

F. Protection: Protect adjacent or adjoining finished surfaces and work from damage during installation of work of this Section.

1.8 WARRANTY

A. Work of this Section shall be jointly warrantied by the manufacturer and the installer for a period of one year after final payment. Any material or workmanship that is judged defective during this period shall be replaced at no cost to the Owner.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Limits for adhesives sealants, fillers and primers. Comply with limits specified in Section 01 6116.

2.2 DISTRIBUTORS

A. Avendra, LLC Preferred Distributor:
   1. Contract Hardware, Inc. (800-266-3418)
      a. Contact: Mark Tew
   2. Home Depot Supply
      a. Contact: Rajan Batra (703-404-4567)

2.3 MANUFACTURERS

A. See Toilet & Bath Accessory Matrix for list of which Manufacturer's are approved for use on a specific item.

B. Avendra, LLC Preferred Manufacturers:
   1. Franklin Brass, Liberty Hardware Manufacturing Corp., A Masco Company (800-421-3375)
   2. WingIts LLC (877-894-6448)

C. Approved Manufacturers:
   1. American Specialties, Inc. (ASI) (914-476-9000)
   2. Bobrick Washroom Equipment, Inc. (818-503-1630)
   3. C.R. Laurence Company (CRL) (800-421-6144)
   4. Continental Group (614-679-1201)
   5. Gamco, A Bobrick Company (800-421-3375)

6. Hafele America Co. (HEWI) (336-889-2322)
7. ProjectStone by Belstone (877-667-8663)
8. Mincey Marble Manufacturing Co. (800-533-1806)
9. Shower Solutions USA, Inc. (407-314-2176)

MPL Corporation (317-835-9000)

Symmons Industries, Inc. (800-796-6667)

2.4 MATERIALS - TOILET ACCESSORIES

A. 18-8 (Type 302) stainless steel alloy of at least 22 gauge in all elements of cabinet work. Unless shown otherwise, all exposed stainless steel to have a #4 Satin finish or Satin chrome finish where applicable with all elements of a unit to have brushing in one direction.

B. Exposed surfaces to be protected with a factory applied PVC film to be left in place until final clean-up.

C. Mirrors to be 1/4 -inch polished plate glass with 10-year guarantee against silver spoilage.

D. Stainless steel tubing: 18 ga., Type 304, seamless welded.

E. Fasteners, screws, and bolts: Hot dip galvanized. Expansion shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component substrate.

F. Adhesive: Epoxy type contact cement.

2.5 FIXED GLASS PANEL AT SHOWER (452)

A. Avendra, LLC Preferred Manufacturers:
   1. None

B. Approved Manufacturers:
   1. ProjectStone by Belstone

C. Glass Fixed Panel (A): frosted finish to obscure clear view through glass.
   1. 10 MM thick tempered, polished edges. “Model CYFP8540“;ProjectStone by Belstone
   2. Size: Refer to Drawings for width and height.
   3. Profile: Curved unless indicated otherwise on Drawings.

D. U Channels for Fixed Panel (B1): 3/4 -inch deep ‘U’ channel (One side of glass panel):
   1. Finish: Polished Chrome (Bright Anodized)
   2. 3/4 -inch deep: “Model CYUC8540“; ProjectStone by Belstone

E. Stainless Steel Ceiling Clamps for Fixed Panel (B2):
   1. Finish: Polished Stainless Steel
   2. 3-11/16 -inch W x 1-7/8 -inch H, “Model CYCC8540“; ProjectStone by Belstone

F. Stainless Steel Floor Clips for Fixed Panel (B3):

1. Finish: Polished Stainless Steel
2. 1-7/16 -inch W x 1-7/8 -inch H,“Model CYFC8540“; ProjectStone by Belstone

G. Fasteners: All fasteners to be by the manufacturer.

H. Adhesives: Type as per manufacturer’s recommendations.

I. Sealant: Silicone type as per manufacturer’s recommendations

2.6 FRAMELESS SHOWER DOOR WITH ONE FIXED GLASS PANEL (452 OPT)

A. Avendra, LLC Preferred Manufacturers:
1. None

B. Approved Manufacturers:
1. ProjectStone by Belstone

C. Glass Doors and Fixed Panels (A):
1. ProjectStone by Belstone:
   a. “Model 7272/85SL” Sidelight 10 MM thick clear tempered, polished edges.
   b. “Model 7272/85D” Door 10 MM thick clear tempered, polished edges.

D. Glass Fixed Panel and Glass Door (A):
1. ProjectStone by Belstone:
   a. Fixed Panel: 10 MM thick tempered, polished edges. “Model CYFP8540“
   b. Door: 10 MM thick tempered, polished edges. “Model CYGD7232“
2. Size: Refer to Drawings for width and height.
3. Profile: Curved unless indicated otherwise on Drawings.

E. U Channels for Fixed Panel (B1): 3/4” deep ‘U’ channel (One side of glass panel):
1. Finish: Polished Chrome (Bright Anodized)
2. 3/4” deep: “Model CYUC8540“; ProjectStone by Belstone

F. Stainless Steel Ceiling Clamps for Fixed Panel (B2):
1. Finish: Polished Stainless Steel
2. 3-11/16”W x 1-7/8”H, “Model CYCC8540“; ProjectStone by Belstone

G. Stainless Steel Floor Clips for Fixed Panel (B3):
1. Finish: Polished Stainless Steel
2. 1-7/16”W x 1-7/8”H,“Model CYFC8540“; ProjectStone by Belstone

H. Hinges (C): Glass to Wall 90° inward and outward: Self-centering with reversible 5° pivot pin. Adjustable for glass thickness from 3/8” to 1/2".
1. Finish: Polished Stainless Steel
2. “Model “CYWH7232”; ProjectStone by Belstone

I. Back to Back Pull Handles (D): Square Style pull handle, standard plastic washers included to protect against glass-to-metal contact.

1. "Model Number SQ18X18CH"; C.R. Laurence Company
   a. Size: 18" center-to-center hole spacing.
   b. Finish: Polished Chrome.
2. "Model "CYDH7232"; ProjectStone by Belstone
   a. Size: 18" out to out.
   b. Finish: Polished Stainless Steel.
3. "Model Number CD0142-3GMDBLDP-18"; Symmons Industries, Inc
   a. Size: 18" center-to-center hole spacing.
   b. Finish: Polished Chrome.

J. Door Wall Seal and Door Sweep (E):
   1. "Model CYWS7232/CYDS7232"; ProjectStone by Belstone

K. Magnetic Closure Strike (F):
   1. "Model CYMC7232"; ProjectStone by Belstone

L. Polycarbonate or Vinyl Seals: Provide clear polycarbonate or vinyl seals for glass to glass edges, and glass to wall edges per manufacturer's recommendations.

M. Fasteners: All fasteners to be by the manufacturer.

N. Adhesives: Type as per manufacturer's recommendations.

O. Sealant: Silicone type as per manufacturer's recommendations

2.7 FINISHES

A. Guest Rooms: Refer to Toilet & Bath Accessory Matrix for Finishes. Grab bars shall have peened gripping surface with bright polished ends.
   1. Section 10 2800.01 Toilet & Bath Accessory Matrix (Courtyard)
   2. Section 10 2800.02 Toilet & Bath Accessory Matrix (Residence Inn)

B. Employee and Public Toilet Rooms: Refer to Toilet & Bath Accessory Matrix for Finishes. Grab Bars shall have peened gripping surface with satin finish ends.
   1. Section 10 2800.01 Toilet & Bath Accessory Matrix (Courtyard)
   2. Section 10 2800.02 Toilet & Bath Accessory Matrix (Residence Inn

C. Exposed heads of fasteners shall match finish of accessory.

2.8 FABRICATION - TOILET ACCESSORIES

A. Provide steel anchor plates and anchor components for installation on building finishes.

B. Form surfaces flat without distortion. Maintain flat surface without scratches or dents.

C. Back paint components where contact is made with building finishes to prevent electrolysis.

D. Hot dip galvanize ferrous metal anchors and fastening devices.

E. Shop assemble components and package complete with anchors and fittings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Deliver inserts and rough-in frames to job site and in appropriate time for building-in. Provide templates and rough-in measurements as required.

B. Before starting work, notify Owner's Representative in writing of any conflicts detrimental to installation or operation of units.

C. Verify with Owner's Representative exact location of accessories.

3.2 INSTALLATION

A. Install fixtures, accessories, and items in accordance with manufacturer's printed instructions.

B. Use concealed fastenings wherever possible.

C. Install true, plumb, and level, securely and rigidly anchored to substrate in accordance with manufacturer's instructions for each item and each type of substrate construction.
   1. Wood blocking shall be provided at grab bars and fold down shower seats, and as shown on Drawings.
   2. Strap metal may be used for all other areas, as approved by Owner's Representative, unless indicated otherwise.

D. Fasteners for all accessory mounting to be theft-resistant.

PART 4 - ACCESSORY SCHEDULE

4.1 SCHEDULE

A. Refer to;
   1. Section 10 2800.01a Toilet & Bath Accessory Matrix (Courtyard)
   2. Section 10 2800.02a Toilet & Bath Accessory Matrix (Residence Inn)

B. Shelf (Paraphernalia):
   1. Basis-Of-Design:
      a. Type: Fixed
      b. Applications:
         1) Where indicated
         2) Inside Accessible toilet stalls adjacent to toilet paper dispenser
      c. Mfgr: Bradley
      d. Model: 755-8

e. Size: 8 –inches long by 5 –inches deep
f. Material: 18 gauge satin stainless steel
g. Edges: 3/4 -inch return;

2. Alternate manufacturer:
   a. American Specialties: 0692 (5 –inch deed by 12 –inches long)
   b. Bobrick: 295-16 (5 –inch deed by 16 –inches long)

- END OF SECTION -

Toilet & Bath Accessory Matrix — Courtyard by Marriott

Gen 5 - New Build - Transformations or Twilight PS / CYnergy GR

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
120		Toilet Tissue Holder - Double (Heavy Duty)	US32D	American Specialties, Inc.	AS 7305-2B	Gen 5 Transformations or Twilight PS / CYnergy GR	Public	Restroom
			US32D	Bobrick Washroom Equipment, Inc	B-686	Gen 5 Transformations or Twilight PS / CYnergy GR	Public	Restroom
900		Feminine Napkin Vendor (Wall Mtd)	US32D	American Specialties, Inc.	AS 0864	Gen 5 Transformations or Twilight PS / CYnergy GR	Public	Restroom
			US32D	Bobrick Washroom Equipment, Inc	B-2800	Gen 5 Transformations or Twilight PS / CYnergy GR	Public	Restroom
910		Paper Towel Disp / Disposal (Recessed)	US32D	American Specialties, Inc.	AS 0469-BL	Gen 5 Transformations or Twilight PS / CYnergy GR	Public	Restroom
			US32D	Bobrick Washroom Equipment, Inc	B-3944	Gen 5 Transformations or Twilight PS / CYnergy GR	Public	Restroom
			US32D	GAMCO, Inc., A Bobrick Company	GA TW-1-18	Gen 5 Transformations or Twilight PS / CYnergy GR	Public	Restroom

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright (Polished) US32 = Stainless Steel, Bright (Polished) US15 = Satin Nickel WHT =White
US26D = Chrome, Satin US32D = Stainless Steel, Satin

Note 1: Standard finish for Gen 5 Guestroom Bathrooms is Bright (Polished) Chrome (US26) / Polished Stainless Steel (US32).
Note 2: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.

Gen 5 - New Build - Transformations or Twilight PS / CYnergy GR

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
920		Soap Dispenser (Wall Mtd.)	US32D	Bobrick Washroom Equipment, Inc	B-2112	Gen 5 Transformations or Twilight PS / CYnergy GR	Public	Restroom
925		Soap Dispenser (Lavatory-Mtd., Top Load, 6" Spout, 34 oz)	US32D	American Specialties, Inc.	AS 0332D	Gen 5 Transformations or Twilight PS / CYnergy GR	Public	Restroom
			US32D	Bobrick Washroom Equipment, Inc	B-8226	Gen 5 Transformations or Twilight PS / CYnergy GR	Public	Restroom
930		Seat Cover Dispenser (Dual - Partition Mtd.)	US32D	American Specialties, Inc.	AS 0476	Gen 5 Transformations or Twilight PS / CYnergy GR	Public	Restroom
931		Seat Cover Dispenser (Single Recessed)	US32D	American Specialties, Inc.	AS 6477	Gen 5 Transformations or Twilight PS / CYnergy GR	Public	Restroom
			US32D	Bobrick Washroom Equipment, Inc	B-301	Gen 5 Transformations or Twilight PS / CYnergy GR	Public	Restroom
			US32D	GAMCO, Inc., A Bobrick Company	GA TSC-8	Gen 5 Transformations or Twilight PS / CYnergy GR	Public	Restroom

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright (Polished) US32 = Stainless Steel, Bright (Polished) US15 = Satin Nickel WHT =White
US26D = Chrome, Satin US32D = Stainless Steel, Satin

Note 1: Standard finish for Gen 5 Guestroom Bathrooms is Bright (Polished) Chrome (US26) / Polished Stainless Steel (US32).
Note 2: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.

Gen 5 - New Build - Transformations or Twilight PS / CYnergy GR

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
940		Feminine Napkin Disposal (Wall Mtd.)	US32D	American Specialties, Inc.	AS 0473-1	Gen 5 Transformations or Twilight PS / CYnergy GR	Public	Restroom
			US32D	Bobrick Washroom Equipment, Inc	B-353	Gen 5 Transformations or Twilight PS / CYnergy GR	Public	Restroom
			US32D	GAMCO, Inc., A Bobrick Company	GA ND-4	Gen 5 Transformations or Twilight PS / CYnergy GR	Public	Restroom
941		Feminine Napkin Disposal (Partition Mtd.)	US32D	American Specialties, Inc.	AS 0472-1	Gen 5 Transformations or Twilight PS / CYnergy GR	Public	Restroom
			US32D	Bobrick Washroom Equipment, Inc	B-354	Gen 5 Transformations or Twilight PS / CYnergy GR	Public	Restroom
			US32D	GAMCO, Inc., A Bobrick Company	GA ND-6	Gen 5 Transformations or Twilight PS / CYnergy GR	Public	Restroom
710		Mirror (Frameless)	US32D	N/A	(See Section 08 80 00 (08800))	Gen 5 Transformations or Twilight PS / CYnergy GR	Public	Restroom (Accessible Lav)

Finish Codes: US26 = Chrome, Bright (Polished) US32 = Stainless Steel, Bright (Polished) US15 = Satin Nickel WHT =White
US26D = Chrome, Satin US32D = Stainless Steel, Satin

Note 1: Standard finish for Gen 5 Guestroom Bathrooms is Bright (Polished) Chrome (US26) / Polished Stainless Steel (US32).
Note 2: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.

Gen 5 - New Build - Transformations or Twilight PS / CYnergy GR

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
318		Grab Bar 18"	US32D	American Specialties, Inc.	AS 3701-18	Gen 5 Transformations or Twilight PS / CYnergy GR	Public	Restroom (Accessible Stall)
			US32D	Bobrick Washroom Equipment, Inc	B-5806 x 18"	Gen 5 Transformations or Twilight PS / CYnergy GR	Public	Restroom (Accessible Stall)
			US32D	Franklin Brass, a Liberty Hardware Brand, A Masco Company	FB 5718	Gen 5 Transformations or Twilight PS / CYnergy GR	Public	Restroom (Accessible Stall)
			US32D	WingIt Innovations	WGB5SS18	Gen 5 Transformations or Twilight PS / CYnergy GR	Public	Restroom (Accessible Stall)
336		Grab Bar 36"	US32D	American Specialties, Inc.	AS 3701-36	Gen 5 Transformations or Twilight PS / CYnergy GR	Public	Restroom (Accessible Stall)
			US32D	Bobrick Washroom Equipment, Inc	B-5806 x 36"	Gen 5 Transformations or Twilight PS / CYnergy GR	Public	Restroom (Accessible Stall)
			US32D	Franklin Brass, a Liberty Hardware Brand, A Masco Company	FB 5736	Gen 5 Transformations or Twilight PS / CYnergy GR	Public	Restroom (Accessible Stall)

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright (Polished) US32 = Stainless Steel, Bright (Polished) US15 = Satin Nickel WHT =White
US26D = Chrome, Satin US32D = Stainless Steel, Satin

Note 1: Standard finish for Gen 5 Guestroom Bathrooms is Bright (Polished) Chrome (US26) / Polished Stainless Steel (US32).
Note 2: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.

Gen 5 - New Build - Transformations or Twilight PS / CYnergy GR

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
336		Grab Bar 36"	US32D	WingIt Innovations	WGB5SS36	Gen 5 Transformations or Twilight PS / CYnergy GR	Public	Restroom (Accessible Stall)
342		Grab Bar 42"	US32D	American Specialties, Inc.	AS 3701-42	Gen 5 Transformations or Twilight PS / CYnergy GR	Public	Restroom (Accessible Stall)
			US32D	Bobrick Washroom Equipment, Inc	B-5806 x 42"	Gen 5 Transformations or Twilight PS / CYnergy GR	Public	Restroom (Accessible Stall)
			US32D	Franklin Brass, a Liberty Hardware Brand, A Masco Company	FB 5742	Gen 5 Transformations or Twilight PS / CYnergy GR	Public	Restroom (Accessible Stall)
			US32D	WingIt Innovations	WGB5SS42	Gen 5 Transformations or Twilight PS / CYnergy GR	Public	Restroom (Accessible Stall)
212		Towel Bar 12"	US26	Symmons Industries Inc.	353TB-12	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom
224		Towel Bar 24"	US26	Symmons Industries Inc.	353TB-24	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom (King)	Bathroom

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright (Polished) US32 = Stainless Steel, Bright (Polished) US15 = Satin Nickel WHT =White
US26D = Chrome, Satin US32D = Stainless Steel, Satin

Note 1: Standard finish for Gen 5 Guestroom Bathrooms is Bright (Polished) Chrome (US26) / Polished Stainless Steel (US32).
Note 2: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.

Gen 5 - New Build - Transformations or Twilight PS / CYnergy GR

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
271		Robe Hook	US26	Symmons Industries Inc.	353RH	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom
282		Robe Hook - Glass Mounted	US26	Symmons Industries Inc.	CD0142-353GMRH	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Shower
312		Grab Bar 12"	US26	American Specialties, Inc.	AS 3701-12	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Shower
			US26	Bobrick Washroom Equipment, Inc	B-5806 x 12"	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Shower
			US26	Franklin Brass, a Liberty Hardware Brand, A Masco Company	FB 5712SN	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Shower
			US26	WingIt Innovations	WGB5SS12	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Shower
312 (OPT)		Grab Bar 12" - Platinum BANDS Series	US26	WingIt Innovations	WPGB5SN12BAN	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Shower

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright (Polished) US32 = Stainless Steel, Bright (Polished) US15 = Satin Nickel WHT =White
US26D = Chrome, Satin US32D = Stainless Steel, Satin

Note 1: Standard finish for Gen 5 Guestroom Bathrooms is Bright (Polished) Chrome (US26) / Polished Stainless Steel (US32).
Note 2: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.

Gen 5 - New Build - Transformations or Twilight PS / CYnergy GR

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
452		Fixed Glass Panel at Shower including: (A) Glass Fixed Panel (B1) U-Channels (B2) Ceiling Clamps (B3) Floor Clips	Polished Chrome	See Section 10 28 00 for Manufacturer and Components		Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Shower
452 (OPT)		Glass Shower Door w/Fixed Panel including: (A) Glass Fixed Panel (B1) U-Channels (B2) Ceiling Clamps (B3) Floor Clips (C) Hinges (D) Pull Handles/Towel Bar (E) Door Wipe/Drip Rail (F) Polycarbonate Strike	Polished Chrome	See Section 10 28 00 for Manufacturer and Components		Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Shower
520		Soap Dish / Shower Caddy (Corner Surface Mount)	US26	Granite Tech, Inc.	GTI-918-CP	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Shower
			US26	Mincey Marble Manufacturing Company	SD-08	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Shower
550		Shower Foot Rest (Refer to Tub and Shower Surround Product Manual for Surrounds)	#2250 Solid White w/textured finish on top	Mincey Marble Manufacturing Company	FR-03	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Shower

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright (Polished) US32 = Stainless Steel, Bright (Polished) US15 = Satin Nickel WHT =White
US26D = Chrome, Satin US32D = Stainless Steel, Satin

Note 1: Standard finish for Gen 5 Guestroom Bathrooms is Bright (Polished) Chrome (US26) / Polished Stainless Steel (US32).
Note 2: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.

Gen 5 - New Build - Transformations or Twilight PS / CYnergy GR

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
550		Shower Foot Rest (Refer to Tub and Shower Surround Product Manual for Surrounds)	#SC-BW Bright White w/textured finish on top	MPL Corporation	FR-01	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Shower
555		Shower Accessory Ledge (Refer to Tub and Shower Surround Product Manual for Surrounds)	#2250 Solid White	Mincey Marble Manufacturing Company	SS-03	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Shower
			#SC-BW Bright White	MPL Corporation	AS-02	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Shower
560		Amenities Niche *Solid surfacing one-piece construction. *Interior: 12"H x 12"W x 16"D (Refer to Tub and Shower Surround Product Manual for Surrounds)	#2250 Solid White	Mincey Marble Manufacturing Company	AN-05	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Shower
312		Grab Bar 12"	US26	American Specialties, Inc.	AS 3701-12	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Tub
			US26	Bobrick Washroom Equipment, Inc	B-5806 x 12"	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Tub
			US26	Franklin Brass, a Liberty Hardware Brand, A Masco Company	FB 5712SN	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Tub

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright (Polished) US32 = Stainless Steel, Bright (Polished) US15 = Satin Nickel WHT =White
US26D = Chrome, Satin US32D = Stainless Steel, Satin

Note 1: Standard finish for Gen 5 Guestroom Bathrooms is Bright (Polished) Chrome (US26) / Polished Stainless Steel (US32).
Note 2: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.

Toilet & Bath Accessory Matrix — Courtyard by Marriott

Gen 5 - New Build - Transformations or Twilight PS / CYnergy GR

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
312		Grab Bar 12"	US26	WingIt Innovations	WGB5SS12	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Tub
312 (OPT)		Grab Bar 12" - Platinum BANDS Series	US26	WingIt Innovations	WPGB5SN12BAN	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Tub
501		Corner Ceramic Soap Dish	WHT	Mincey Marble Manufacturing Company	SD-07	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Tub
212		Towel Bar 12"	US26	Symmons Industries Inc.	353TB-12	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible
224		Towel Bar 24"	US26	Symmons Industries Inc.	353TB-24	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible
271		Robe Hook	US26	Symmons Industries Inc.	353RH	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible
318W		Grab Bar 18" - Nylon Coated	WHT	Hafele America Co.	HEWI 988.61.199.M	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Roll-In Shower

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright (Polished) US32 = Stainless Steel, Bright (Polished) US15 = Satin Nickel WHT =White
US26D = Chrome, Satin US32D = Stainless Steel, Satin

Note 1: Standard finish for Gen 5 Guestroom Bathrooms is Bright (Polished) Chrome (US26) / Polished Stainless Steel (US32).
Note 2: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.

Gen 5 - New Build - Transformations or Twilight PS / CYnergy GR

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
318W		Grab Bar 18" - Nylon Coated	WHT	WingIt Innovations	WGB5PU18WH	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Roll-In Shower
318W (OPT)		Grab Bar 18" - Polyester Painted (Option)	WHT	WingIt Innovations	WGB5YS18WH	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Roll-In Shower
324S		Grab Bar 24" - Nylon Coated with Sliding Handheld Shower Holder	WHT	Hafele America Co.	HEWI 988.61.299.M / 988.66.799	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Roll-In Shower
324W		Grab Bar 24" - Nylon Coated	WHT	Hafele America Co.	HEWI 988.61.299.M	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Roll-In Shower
			WHT	WingIt Innovations	WGB5PU24WH	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Roll-In Shower
324W (OPT)		Grab Bar 24" - Polyester Painted (Option)	WHT	WingIt Innovations	WGB5YS24WH	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Roll-In Shower
336W		Grab Bar 36" - Nylon Coated	WHT	Hafele America Co.	HEWI 988.61.499.M	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Roll-In Shower

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright (Polished) US32 = Stainless Steel, Bright (Polished) US15 = Satin Nickel WHT =White
US26D = Chrome, Satin US32D = Stainless Steel, Satin

Note 1: Standard finish for Gen 5 Guestroom Bathrooms is Bright (Polished) Chrome (US26) / Polished Stainless Steel (US32).
Note 2: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.

Toilet & Bath Accessory Matrix — Courtyard by Marriott

Gen 5 - New Build - Transformations or Twilight PS / CYnergy GR

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
336W		Grab Bar 36" - Nylon Coated	WHT	WingIt Innovations	WGB5PU36WH	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Roll-In Shower
336W (OPT)		Grab Bar 36" - Polyester Painted (Option)	WHT	WingIt Innovations	WGB5YS36WH	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Roll-In Shower
361		Grab Bar / Slide Bar w/Additional Vertical Grab Bar - Nylon Coated with Sliding Handheld Shower Holder (Alternative Design in lieu of individual Grab Bars)	WHT	Hafele America Co.	HEWI 988.68.899.M	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Roll-In Shower
410		Shower Curtain Rod - Oval/Straight **Note: (A) New Build: Use BAWFA Face Plate. (B) Reno: Use BAW30 WingIT Fastener where no blocking available.	US26	WingIt Innovations	WOCSNT-5**	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Roll-In Shower
520		Soap Dish / Shower Caddy (Corner Surface Mount)	US26	Granite Tech, Inc.	GTI-918-CP	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Roll-In Shower
			US26	Mincey Marble Manufacturing Company	SD-08	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Roll-In Shower
610		Shower Seat - Nylon Coated **For use with 30" Deep Shower Compartments** (Size complies with 2010 ADA)	WHT	Hafele America Co.	980.20.399 (LH) or 980.20.499 (RH)	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Roll-In Shower

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright (Polished) US32 = Stainless Steel, Bright (Polished) US15 = Satin Nickel WHT =White
US26D = Chrome, Satin US32D = Stainless Steel, Satin

Note 1: Standard finish for Gen 5 Guestroom Bathrooms is Bright (Polished) Chrome (US26) / Polished Stainless Steel (US32).
Note 2: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.

Gen 5 - New Build - Transformations or Twilight PS / CYnergy GR

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
610		Shower Seat - Nylon Coated **For use with 30" Deep Shower Compartments** (Size complies with 2010 ADA)	WHT	WingIt Innovations	PUEX28xxWH (xx= LH / RH)	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Roll-In Shower
640		Folding Edge Water Retainer & Threshold	ALUM	Shower Solutions USA, Inc.	Shower Water Dam	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Roll-In Shower
316W		Grab Bar 16" - Nylon Coated	WHT	Hafele America Co.	HEWI 988.58.299.M	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Tub
			WHT	WingIt Innovations	WGB5PU16WH	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Tub
316W (OPT)		Grab Bar 16" - Polyester Painted (Option)	WHT	WingIt Innovations	WGB5YS16WH	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Tub
			WHT	WingIt Innovations	WGB5YS16WH	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Tub
318W		Grab Bar 18" - Nylon Coated	WHT	Hafele America Co.	HEWI 988.61.199.M	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Tub

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright (Polished) US32 = Stainless Steel, Bright (Polished) US15 = Satin Nickel WHT =White
US26D = Chrome, Satin US32D = Stainless Steel, Satin

Note 1: Standard finish for Gen 5 Guestroom Bathrooms is Bright (Polished) Chrome (US26) / Polished Stainless Steel (US32).
Note 2: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.

Gen 5 - New Build - Transformations or Twilight PS / CYnergy GR

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
318W		Grab Bar 18" - Nylon Coated	WHT	WingIt Innovations	WGB5PU18WH	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Tub
318W (OPT)		Grab Bar 18" - Polyester Painted (Option)	WHT	WingIt Innovations	WGB5YS18WH	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Tub
324S		Grab Bar 24" - Nylon Coated with Sliding Handheld Shower Holder	WHT	Hafele America Co.	HEWI 988.61.299.M / 988.66.799	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Tub
324W		Grab Bar 24" - Nylon Coated	WHT	Hafele America Co.	HEWI 988.61.299.M	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Tub
			WHT	WingIt Innovations	WGB5PU24WH	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Tub
324W (OPT)		Grab Bar 24" - Polyester Painted (Option)	WHT	WingIt Innovations	WGB5YS24WH	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Tub
362		Grab Bar / Slide Bar w/Additional Vertical Grab Bar - Nylon Coated with Sliding Handheld Shower Holder (Alternative Design in lieu of individual Grab Bars)	WHT	Hafele America Co.	HEWI 990.00.100.M	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Tub

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright (Polished) US32 = Stainless Steel, Bright (Polished) US15 = Satin Nickel WHT =White
US26D = Chrome, Satin US32D = Stainless Steel, Satin

Note 1: Standard finish for Gen 5 Guestroom Bathrooms is Bright (Polished) Chrome (US26) / Polished Stainless Steel (US32).
Note 2: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.

Gen 5 - New Build - Transformations or Twilight PS / CYnergy GR

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
401		Shower Curtain Rod - Oval/Curved (6" Bow)	US26	Franklin Brass, a Liberty Hardware Brand, A Masco Company	211-5SS	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Tub
		Shower Curtain Rod - Oval/Curved (6" Bow) *Note: (A) New Build: Use BAWFA Face Plate. (B) Reno: Use BAW30 WingIT Fastener where no blocking available. (C) Reno: Use OCP-SN Face Plate to cover holes from former straight rod.	US26	WingIt Innovations	WOCSN5-6*	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Tub
501		Corner Ceramic Soap Dish	WHT	Mincey Marble Manufacturing Company	SD-07	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Tub
601		Tub Seat - Nylon Coated (Size complies with 2010 ADA)	WHT	Hafele America Co.	980.20.799.M	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Tub
			WHT	WingIt Innovations	PUTB30WH	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Tub
112		Toilet Tissue Holder	US26	Symmons Industries Inc.	353TP	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Water Closet
318W		Grab Bar 18" - Nylon Coated	WHT	Hafele America Co.	HEWI 988.61.199.M	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Water Closet

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright (Polished) US32 = Stainless Steel, Bright (Polished) US15 = Satin Nickel WHT =White
US26D = Chrome, Satin US32D = Stainless Steel, Satin

Note 1: Standard finish for Gen 5 Guestroom Bathrooms is Bright (Polished) Chrome (US26) / Polished Stainless Steel (US32).
Note 2: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.

Gen 5 - New Build - Transformations or Twilight PS / CYnergy GR

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
318W		Grab Bar 18" - Nylon Coated	WHT	WingIt Innovations	WGB5PU18WH	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Water Closet
318W (OPT)		Grab Bar 18" - Polyester Painted (Option)	WHT	WingIt Innovations	WGB5YS18WH	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Water Closet
336W		Grab Bar 36" - Nylon Coated	WHT	Hafele America Co.	HEWI 988.61.499.M	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Water Closet
			WHT	WingIt Innovations	WGB5PU36WH	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Water Closet
336W (OPT)		Grab Bar 36" - Polyester Painted (Option)	WHT	WingIt Innovations	WGB5YS36WH	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Water Closet
342W		Grab Bar 42" - Nylon Coated	WHT	Hafele America Co.	HEWI 988.61.599.M	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Water Closet
			WHT	WingIt Innovations	WGB5PU42WH	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Water Closet

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright (Polished) US32 = Stainless Steel, Bright (Polished) US15 = Satin Nickel WHT =White
US26D = Chrome, Satin US32D = Stainless Steel, Satin

Note 1: Standard finish for Gen 5 Guestroom Bathrooms is Bright (Polished) Chrome (US26) / Polished Stainless Steel (US32).
Note 2: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.

Gen 5 - New Build - Transformations or Twilight PS / CYnergy GR

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
342W (OPT)		Grab Bar 42" - Polyester Painted (Option)	WHT	WingIt Innovations	WGB5YS42WH	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Water Closet
360W		Grab Bar - One Piece Combination Set - Nylon Coated (Alternative Design in lieu of individual Grab Bars)	WHT	Hafele America Co.	HEWI 988.65.599.M	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Water Closet
		Grab Bar - One Piece Combination Set - Nylon Coated (Alternative Design in lieu of individual Grab Bars)	WHT	WingIt Innovations	PUTWabWH (ab=bar size a&b)	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Water Closet
360W (OPT)		Grab Bar - One Piece Combination Set - Polyester Painted (Option) (Alternative Design in lieu of individual Grab Bars)	WHT	WingIt Innovations	WGB5HCabWH (ab=bar size a&b)	Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Bathroom - Accessible Water Closet
790		Ironing Board Caddy		Furnished by Others		Gen 5 Transformations or Twilight PS / CYnergy GR	Guestroom	Closet
705		Mirror w/ S/S Frame	US32D	American Specialties, Inc.	AS 0620 Series	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom
			US32D	Bobrick Washroom Equipment, Inc	B-165 Series	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright (Polished) US32 = Stainless Steel, Bright (Polished) US15 = Satin Nickel WHT =White
US26D = Chrome, Satin US32D = Stainless Steel, Satin

Note 1: Standard finish for Gen 5 Guestroom Bathrooms is Bright (Polished) Chrome (US26) / Polished Stainless Steel (US32).
Note 2: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.

Gen 5 - New Build - Transformations or Twilight PS / CYnergy GR

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
900		Feminine Napkin Vendor (Wall Mtd)	US32D	American Specialties, Inc.	AS 0864	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom
			US32D	Bobrick Washroom Equipment, Inc	B-2800	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom
910		Paper Towel Disp / Disposal (Recessed)	US32D	American Specialties, Inc.	AS 0469-BL	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom
			US32D	Bobrick Washroom Equipment, Inc	B-3944	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom
			US32D	GAMCO, Inc., A Bobrick Company	GA TW-1-18	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom
920		Soap Dispenser (Wall Mtd.)	US32D	American Specialties, Inc.	AS 0342	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom
			US32D	Bobrick Washroom Equipment, Inc	B-2112	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright (Polished) US32 = Stainless Steel, Bright (Polished) US15 = Satin Nickel WHT =White
US26D = Chrome, Satin US32D = Stainless Steel, Satin

Note 1: Standard finish for Gen 5 Guestroom Bathrooms is Bright (Polished) Chrome (US26) / Polished Stainless Steel (US32).
Note 2: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.

Gen 5 - New Build - Transformations or Twilight PS / CYnergy GR

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
920		Soap Dispenser (Wall Mtd.)	US32D	GAMCO, Inc., A Bobrick Company	GA 58AP	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom
120		Toilet Tissue Holder - Double (Heavy Duty)	US32D	American Specialties, Inc.	AS 7305-2B	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom-Water Closet
			US32D	Bobrick Washroom Equipment, Inc	B-686	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom-Water Closet
318		Grab Bar 18"	US32D	American Specialties, Inc.	AS 3701-18	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom-Water Closet
			US32D	Bobrick Washroom Equipment, Inc	B-5806 x 18"	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom-Water Closet
			US32D	Franklin Brass, a Liberty Hardware Brand, A Masco Company	FB 5718	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom-Water Closet
			US32D	WingIt Innovations	WGB5SS18	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom-Water Closet

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright (Polished) US32 = Stainless Steel, Bright (Polished) US15 = Satin Nickel WHT =White
US26D = Chrome, Satin US32D = Stainless Steel, Satin

Note 1: Standard finish for Gen 5 Guestroom Bathrooms is Bright (Polished) Chrome (US26) / Polished Stainless Steel (US32).
Note 2: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.

Gen 5 - New Build - Transformations or Twilight PS / CYnergy GR

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
336		Grab Bar 36"	US32D	American Specialties, Inc.	AS 3701-36	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom-Water Closet
			US32D	Bobrick Washroom Equipment, Inc	B-5806 x 36"	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom-Water Closet
			US32D	Franklin Brass, a Liberty Hardware Brand, A Masco Company	FB 5736	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom-Water Closet
			US32D	WingIt Innovations	WGB5SS36	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom-Water Closet
342		Grab Bar 42"	US32D	American Specialties, Inc.	AS 3701-42	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom-Water Closet
			US32D	Bobrick Washroom Equipment, Inc	B-5806 x 42"	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom-Water Closet
			US32D	Franklin Brass, a Liberty Hardware Brand, A Masco Company	FB 5742	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom-Water Closet

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright (Polished) US32 = Stainless Steel, Bright (Polished) US15 = Satin Nickel WHT =White
US26D = Chrome, Satin US32D = Stainless Steel, Satin

Note 1: Standard finish for Gen 5 Guestroom Bathrooms is Bright (Polished) Chrome (US26) / Polished Stainless Steel (US32).
Note 2: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.

Gen 5 - New Build - Transformations or Twilight PS / CYnergy GR

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
342		Grab Bar 42"	US32D	WingIt Innovations	WGB5SS42	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom-Water Closet
930		Seat Cover Dispenser (Dual - Partition Mtd.)	US32D	American Specialties, Inc.	AS 0476	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom-Water Closet
931		Seat Cover Dispenser (Single Recessed)	US32D	American Specialties, Inc.	AS 6477	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom-Water Closet
			US32D	Bobrick Washroom Equipment, Inc	B-301	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom-Water Closet
			US32D	GAMCO, Inc., A Bobrick Company	GA TSC-8	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom-Water Closet
940		Feminine Napkin Disposal (Wall Mtd.)	US32D	American Specialties, Inc.	AS 0473-1	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom-Water Closet
			US32D	Bobrick Washroom Equipment, Inc	B-353	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom-Water Closet

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright (Polished) US32 = Stainless Steel, Bright (Polished) US15 = Satin Nickel WHT =White
US26D = Chrome, Satin US32D = Stainless Steel, Satin

Note 1: Standard finish for Gen 5 Guestroom Bathrooms is Bright (Polished) Chrome (US26) / Polished Stainless Steel (US32).
Note 2: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.

Toilet & Bath Accessory Matrix — Courtyard by Marriott

Gen 5 - New Build - Transformations or Twilight PS / CYnergy GR

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
940		Feminine Napkin Disposal (Wall Mtd.)	US32D	GAMCO, Inc., A Bobrick Company	GA ND-4	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom-Water Closet
292		Robe Hook - Double	US15	Franklin Brass, a Liberty Hardware Brand, A Masco Company	FB 127766 (Astra)	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom - Accessible Transfer Shower (LVP Projects Only)
318W		Grab Bar 18" - Nylon Coated	WHT	Hafele America Co.	HEWI 988.61.199.M	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom - Accessible Transfer Shower (LVP Projects Only)
			WHT	WingIt Innovations	WGB5PU18WH	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom - Accessible Transfer Shower (LVP Projects Only)
318W (OPT)		Grab Bar 18" - Polyester Painted (Option)	WHT	WingIt Innovations	WGB5YS18WH	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom - Accessible Transfer Shower (LVP Projects Only)

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright (Polished) US32 = Stainless Steel, Bright (Polished) US15 = Satin Nickel WHT =White
US26D = Chrome, Satin US32D = Stainless Steel, Satin

Note 1: Standard finish for Gen 5 Guestroom Bathrooms is Bright (Polished) Chrome (US26) / Polished Stainless Steel (US32).
Note 2: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.

Gen 5 - New Build - Transformations or Twilight PS / CYnergy GR

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
324S		Grab Bar 24" - Nylon Coated with Sliding Handheld Shower Holder	WHT	Hafele America Co.	HEWI 988.61.299.M / 988.66.799	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom - Accessible Transfer Shower (LVP Projects Only)
324W		Grab Bar 24" - Nylon Coated	WHT	Hafele America Co.	HEWI 988.61.299.M	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom - Accessible Transfer Shower (LVP Projects Only)
			WHT	WingIt Innovations	WGB5PU24WH	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom - Accessible Transfer Shower (LVP Projects Only)
324W (OPT)		Grab Bar 24" - Polyester Painted (Option)	WHT	WingIt Innovations	WGB5YS24WH	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom - Accessible Transfer Shower (LVP Projects Only)

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright (Polished) US32 = Stainless Steel, Bright (Polished) US15 = Satin Nickel WHT =White
US26D = Chrome, Satin US32D = Stainless Steel, Satin

Note 1: Standard finish for Gen 5 Guestroom Bathrooms is Bright (Polished) Chrome (US26) / Polished Stainless Steel (US32).
Note 2: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.

Toilet & Bath Accessory Matrix — Courtyard by Marriott

Gen 5 - New Build - Transformations or Twilight PS / CYnergy GR

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
411		Shower Curtain Rod - Oval/Straight	US26	WingIt Innovations	WOCBST3 x BAWFA Face Plate	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom - Accessible Transfer Shower (LVP Projects Only)
501		Corner Ceramic Soap Dish	WHT	Mincey Marble Manufacturing Company	SD-07	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom - Accessible Transfer Shower (LVP Projects Only)
611		Shower Seat - Nylon Coated **For use with 36" Deep Shower Compartments** (Size complies with 2010 ADA)	WHT	Hafele America Co.	980.20.599 (LH) or 980.20.699 (RH)	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom - Accessible Transfer Shower (LVP Projects Only)
			WHT	WingIt Innovations	PUEX32xxWH (xx= LH / RH)	Gen 5 Transformations or Twilight PS / CYnergy GR	Back-of-House	Employee Restroom - Accessible Transfer Shower (LVP Projects Only)

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright (Polished) US32 = Stainless Steel, Bright (Polished) US15 = Satin Nickel WHT =White
US26D = Chrome, Satin US32D = Stainless Steel, Satin

Note 1: Standard finish for Gen 5 Guestroom Bathrooms is Bright (Polished) Chrome (US26) / Polished Stainless Steel (US32).
Note 2: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.

- SECTION 10 2800.02 -

TOILET, BATH AND LAUNDRY ACCESSORIES (RESIDENCE INN)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: **(RESIDENCE INN)**
   1. Typical:
      a. Toilet accessories.
      b. Bath accessories.
      c. Attachment hardware.
   2. Frameless Shower Door With Fixed Glass Panel – curved.
   3. Fixed Glass Panel at Shower – curved.

1.3 RELATED REQUIREMENTS

A. Pertinent Sections specifying Volatile Organic Compound (VOC) Content Restrictions.

B. Section 01 6116 “Volatile Organic Compound (VOC) Restrictions”.

C. Section 05 5000 “Metal Fabrications”.

D. Section 08 8300 “Mirrors” for unframed mirrors.

E. Section 09 3013 “Tiling” for coordinating installation of accessories.

F. Section 10 2113 “Toilet Compartments” for coordinating installation of accessories.

G. Section 10 2800.01a “Toilet & Bath Accessory Matrix (Courtyard).

H. Section 10 2800.02a “Toilet & Bath Accessory Matrix (Residence Inn).

1.4 REFERENCES

A. "Phoenix Building Construction Code", International Building Code 2006, with City of Phoenix administrative provisions and amendments.

B. ASTM International Publications:
   1. A167 - "Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip"
   2. A666 "Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar"

C. American National Standards Institute (ANSI)
   1. ICC/ANSI A117.1-2003 , "Accessible and Useable Buildings and Facilities"

D. Americans with Disabilities Act (ADA) II Public Accommodations

1.5 SUBMITTALS

A. General: Submit in accordance with Section 01 3300.

B. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

C. Product Data: For each type of product indicated, demonstrate compliance with specified attributes.

D. VOC Submittals:
   1. Product Data – VOC Limits: For adhesives sealants, fillers and primers, documentation including printed statement of VOC contents, comply with limits specified in Section 01 6116.

E. Submit "Letter of Conformance" in accordance with Section 01 3300 indicating specified items selected for use in project with the following supporting data.
   1. Product Data: Mark each copy to identify applicable products, characteristics, models, options and other supplemental data to clearly communicate information specific to this project.

1.6 QUALITY ASSURANCE:

A. Provide products of the same manufacturer for each type of accessory unit and for units exposed in the same area.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of Section 01 6000.

B. Do not deliver accessories to site until rooms in which they are to be installed are ready to receive them.

C. Store packages to prevent physical damage or wetting.

D. Pack accessories individually in a manner to protect accessory and its finish.

E. Maintain protective covers on all units until final clean-up.

F. Protection: Protect adjacent or adjoining finished surfaces and work from damage during installation of work of this Section.

1.8 WARRANTY

A. Work of this Section shall be jointly warrantied by the manufacturer and the installer for a period of one year after final payment. Any material or workmanship that is judged defective during this period shall be replaced at no cost to the Owner.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Limits for adhesives sealants, fillers and primers. Comply with limits specified in Section 01 6116.

2.2 DISTRIBUTORS

A. Avendra, LLC Preferred Distributor:
   1. Contract Hardware, Inc. (800-266-3418)
      a. Contact: Mark Tew
   2. Home Depot Supply
      a. Contact: Rajan Batra (703-404-4567)

2.3 MANUFACTURERS

A. See Toilet & Bath Accessory Matrix for list of which Manufacturer's are approved for use on a specific item.

B. Avendra, LLC Preferred Manufacturers:
   1. Franklin Brass, Liberty Hardware Manufacturing Corp., A Masco Company (800-421-3375)
   2. WingIts LLC (877-894-6448)

C. Approved Manufacturers:
   1. American Specialties, Inc. (ASI) (914-476-9000)
   2. Bobrick Washroom Equipment, Inc. (818-503-1630)
   3. C.R. Laurence Company (CRL) (800-421-6144)
   4. Continental Group (614-679-1201)
   5. Gamco, A Bobrick Company (800-421-3375)
   6. Hafele America Co. (HEWI) (336-889-2322)
   7. ProjectStone by Belstone (877-667-8663)

8. Mincey Marble Manufacturing Co. (800-533-1806)
9. Shower Solutions USA, Inc. (407-314-2176)

Symmons Industries, Inc. (800-796-6667)

2.4 MATERIALS - TOILET ACCESSORIES

A. 18-8 (Type 302) stainless steel alloy of at least 22 gauge in all elements of cabinet work. Unless shown otherwise, all exposed stainless steel to have a #4 Satin finish or Satin chrome finish where applicable with all elements of a unit to have brushing in one direction.

B. Exposed surfaces to be protected with a factory applied PVC film to be left in place until final clean-up.

C. Mirrors to be 1/4 -inch polished plate glass with 10-year guarantee against silver spoilage.

D. Stainless steel tubing: 18 ga., Type 304, seamless welded.

E. Fasteners, screws, and bolts: Hot dip galvanized. Expansion shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component substrate.

F. Adhesive: Epoxy type contact cement.

2.5 FIXED GLASS PANEL AT SHOWER (450)

A. Avendra, LLC Preferred Manufacturers:
1. None

B. Approved Manufacturers:
1. C.R. Laurence Company (CRL)
2. Complete System: “Model BB817701-P”; Continental Group
3. Complete System: “Model Belstone RIG9FP”; ProjectStone by Belstone

C. Glass Fixed Panels (A):
1. C.R. Laurence Company:
   a. 3/8 -inch thick tempered, polished edges. Glass furnished by others. Refer Section 08 8000 – Glazing.
2. 5/16 -inch thick tempered polished edges. “Model BB817701-P Glassside“; Continental Group
3. 3/8 -inch thick tempered polished edges. “Model FP8838“;ProjectStone by Belstone
4. Size: Refer to Drawings for width and height.
5. Profile: Curved unless indicated otherwise on Drawings.

D. U Channels for Fixed Panels (B): 3/4 -inch or 1 -inch deep ‘U’ channel:
1. Finish: Polished Chrome (Bright Anodized)
2. 3/4 -inch deep: “Model Number SDCD38BA”; C.R. Laurence Company
3. 1 -inch deep: “Model BH817705“; Continental Group
4. 3/4 -inch deep: “Model UC7360Po“; ProjectStone by Belstone

E. Glass Mounted Towel Bar for Fixed Panels (C):
1. Refer to Toilet & Bath Accessory Matrix Mark Number 226.
a. Profile: Curved unless indicated otherwise on Drawings.

F. Fasteners: All fasteners to be by the manufacturer.

G. Adhesives: Type as per manufacturer's recommendations.

H. Sealant: Silicone type as per manufacturer's recommendations

2.6 FRAMELESS SHOWER DOOR WITH ONE FIXED GLASS PANEL (462)

A. Avendra, LLC Preferred Manufacturers:
1. None

B. Approved Manufacturers:
1. C.R. Laurence Company (CRL)
2. Complete System: "Model BB817700"; Continental Group
3. Complete System: "Model Belstone RIG9FPWD"; ProjectStone by Belstone

C. Glass Doors and Fixed Panels (A): (Curved profile unless indicated otherwise on Drawings)
1. C.R. Laurence Company:
a. 3/8 -inch thick clear tempered polished edges. Glass furnished by others. Refer Section 08 80 00 – Glazing
2. 5/16 -inch thick clear tempered polished edges. "Model BB817700 Doorglass / BB817700 Glassside"; Continental Group
3. ProjectStone by Belstone:
a. "Model FP8838" Sidelight 1/2 -inch thick clear tempered, polished edges.
b. "Model GD7230" Door 3/8 -inch thick clear tempered, polished edges.

D. U Channels for Fixed Panels (B): 3/4 -inch or 1 -inch deep 'U' channel.
1. Finish: Polished Chrome (Bright Anodized)
2. 3/4 -inch deep: "Model Number SDCD38BA"; C.R. Laurence Company
3. 1 -inch deep: "Model BH817705"; Continental Group
4. 3/4 -inch deep: "Model UC7360Po"; ProjectStone by Belstone

E. Hinges (C): Glass to Wall 90° inward and outward: Self-centering with reversible 5° pivot pin. Adjustable for glass thickness from 3/8 -inch to 1/2 -inch.
1. Finish: Polished Chrome
2. "Geneva Series Model Number GEN337CH"; C.R. Laurence Company
3. "Model BH808500"; Continental Group
4. "Model SH7248P" Sliding; ProjectStone by Belstone
a. Sliding Hinges (SH), Glass to Glass 170 degrees outward opening, reversible pivot pin. Adjustable for glass thickness from 3/8 -inch to 1/2 -inch.
1) Adjustable 2-1/2 -inch overall opening.

F. Back to Back Pull Handles (D):

1. Refer to Toilet & Bath Accessory Matrix Mark Number 430.

G. Door Wipe and Drip Rail (E): Clear co-extruded polycarbonate bottom wipe with 45° drip rail to shed water back into shower. Dual wipes on bottom to create water tight seal. Wipe to snap onto bottom of door.
1. "Model Number P99WS"; C.R. Laurence Company
2. "Model 42831902"; Continental Group
3. "Model DS7260"; ProjectStone by Belstone

H. Polycarbonate Strike (F): Clear polycarbonate "h" jamb:
1. "Model Number P380HJ"; C.R. Laurence Company
2. "Model 42831902"; Continental Group
3. "Model SJ7260"; ProjectStone by Belstone

I. Glass Mounted Towel Bar for Fixed Panels (G):
1. Refer to Toilet & Bath Accessory Matrix Mark Number 226.

J. Polycarbonate or Vinyl Seals: Provide clear polycarbonate or vinyl seals for glass to glass edges, and glass to wall edges per manufacturer's recommendations.

K. Fasteners: All fasteners to be by the manufacturer.

L. Adhesives: Type as per manufacturer's recommendations.

M. Sealant: Silicone type as per manufacturer's recommendations

2.7 FINISHES

A. Guest Rooms: Refer to Toilet & Bath Accessory Matrix for Finishes. Grab bars shall have peened gripping surface with bright polished ends.
1. Section 10 2800.01 Toilet & Bath Accessory Matrix (Courtyard)
2. Section 10 2800.02 Toilet & Bath Accessory Matrix (Residence Inn)

B. Employee and Public Toilet Rooms: Refer to Toilet & Bath Accessory Matrix for Finishes. Grab Bars shall have peened gripping surface with satin finish ends.
1. Section 10 2800.01 Toilet & Bath Accessory Matrix (Courtyard)
2. Section 10 2800.02 Toilet & Bath Accessory Matrix (Residence Inn

C. Exposed heads of fasteners shall match finish of accessory.

2.8 FABRICATION - TOILET ACCESSORIES

A. Provide steel anchor plates and anchor components for installation on building finishes.

B. Form surfaces flat without distortion. Maintain flat surface without scratches or dents.

C. Back paint components where contact is made with building finishes to prevent electrolysis.

D. Hot dip galvanize ferrous metal anchors and fastening devices.

E. Shop assemble components and package complete with anchors and fittings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Deliver inserts and rough-in frames to job site and in appropriate time for building-in. Provide templates and rough-in measurements as required.

B. Before starting work, notify Owner's Representative in writing of any conflicts detrimental to installation or operation of units.

C. Verify with Owner's Representative exact location of accessories.

3.2 INSTALLATION

A. Install fixtures, accessories, and items in accordance with manufacturer's printed instructions.

B. Use concealed fastenings wherever possible.

C. Install true, plumb, and level, securely and rigidly anchored to substrate in accordance with manufacturer's instructions for each item and each type of substrate construction.
   1. Wood blocking shall be provided at grab bars and fold down shower seats, and as shown on Drawings.
   2. Strap metal may be used for all other areas, as approved by Owner's Representative, unless indicated otherwise.

D. Fasteners for all accessory mounting to be theft-resistant.

PART 4 - ACCESSORY SCHEDULE

4.1 SCHEDULE

A. Refer to;
   1. Section 10 2800.01a Toilet & Bath Accessory Matrix (Courtyard)
   2. Section 10 2800.02a Toilet & Bath Accessory Matrix (Residence Inn)

B. Shelf (Paraphernalia):
   1. Basis-Of-Design:
      a. Type: Fixed
      b. Applications:
         1) Where indicated
         2) Inside Accessible toilet stalls adjacent to toilet paper dispenser
      c. Mfgr: Bradley
      d. Model: 755-8

e. Size: 8 –inches long by 5 –inches deep
f. Material: 18 gauge satin stainless steel
g. Edges: 3/4 -inch return;

2. Alternate manufacturer:
   a. American Specialties: 0692 (5 –inch deed by 12 –inches long)
   b. Bobrick: 295-16 (5 –inch deed by 16 –inches long)

- END OF SECTION -

Toilet & Bath Accessory Matrix — Residence Inn

Gen 9 - New Build - IMPROV / Possibilities

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
130	116	Toilet Tissue Holder - Double (Surface Mtd.)	US26	American Specialties, Inc.	AS 7305-2B X R009	Gen 9 IMPROV / Possibilities	Public	Restroom
			US26	Bobrick Washroom Equipment, Inc	B-7686.60	Gen 9 IMPROV / Possibilities	Public	Restroom
			US26	Franklin Brass, a Liberty Hardware Brand, A Masco Company	FB 980C	Gen 9 IMPROV / Possibilities	Public	Restroom
705		Mirror w/ S/S Frame	US32D	American Specialties, Inc.	AS 0620 Series	Gen 9 IMPROV / Possibilities	Public	Restroom
			US32D	Bobrick Washroom Equipment, Inc	B-165 Series	Gen 9 IMPROV / Possibilities	Public	Restroom
900	302	Feminine Napkin Vendor (Wall Mtd)	US32D	American Specialties, Inc.	AS 04684	Gen 9 IMPROV / Possibilities	Public	Restroom
			US32D	Bobrick Washroom Equipment, Inc	B-3500	Gen 9 IMPROV / Possibilities	Public	Restroom
			US32D	GAMCO, Inc., A Bobrick Company	GA NV-2-4	Gen 9 IMPROV / Possibilities	Public	Restroom
912	312	Paper Towel Disp / Disposal (Recessed)	US32D	American Specialties, Inc.	AS 0469	Gen 9 IMPROV / Possibilities	Public	Restroom

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright; US26D = Chrome, Satin; US32 = Stainless Steel, Bright (Polished); US32D = Stainless Steel, Satin; US15 = Satin Nickel; WHT =White

Note 1: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.
Note 2: All Universal Mark Numbers have been changed. Drawings issued on 9/3/12 or later, now reflect the revised mark numbers under the Universal Mark (New) column.

Toilet & Bath Accessory Matrix — Residence Inn

Gen 9 - New Build - IMPROV / Possibilities

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
912	312	Paper Towel Disp / Disposal (Recessed)	US32D	Bobrick Washroom Equipment, Inc	B-3944	Gen 9 IMPROV / Possibilities	Public	Restroom
			US32D	GAMCO, Inc., A Bobrick Company	GA TW-1-18	Gen 9 IMPROV / Possibilities	Public	Restroom
925	325	Soap Dispenser (Lavatory-Mtd., Top Load, 6" Spout, 34 oz)	US32D	American Specialties, Inc.	AS 0332D	Gen 9 IMPROV / Possibilities	Public	Restroom
			US32D	Bobrick Washroom Equipment, Inc	B-8226	Gen 9 IMPROV / Possibilities	Public	Restroom
932	332	Seat Cover Dispenser (Single Recessed)	US32D	American Specialties, Inc.	AS 6477	Gen 9 IMPROV / Possibilities	Public	Restroom
			US32D	Bobrick Washroom Equipment, Inc	B-3013	Gen 9 IMPROV / Possibilities	Public	Restroom
			US32D	GAMCO, Inc., A Bobrick Company	GA TSC-8	Gen 9 IMPROV / Possibilities	Public	Restroom
941	341	Feminine Napkin Disposal (Partition Mtd.)	US32D	American Specialties, Inc.	AS 0472-1	Gen 9 IMPROV / Possibilities	Public	Restroom
			US32D	Bobrick Washroom Equipment, Inc	B-354	Gen 9 IMPROV / Possibilities	Public	Restroom

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright; US26D = Chrome, Satin; US32 = Stainless Steel, Bright (Polished); US32D = Stainless Steel, Satin; US15 = Satin Nickel; WHT =White

Note 1: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.
Note 2: All Universal Mark Numbers have been changed. Drawings issued on 9/3/12 or later, now reflect the revised mark numbers under the Universal Mark (New) column.

Toilet & Bath Accessory Matrix — Residence Inn

Gen 9 - New Build - IMPROV / Possibilities

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
941	341	Feminine Napkin Disposal (Partition Mtd.)	US32D	GAMCO, Inc., A Bobrick Company	GA ND-6	Gen 9 IMPROV / Possibilities	Public	Restroom
318	152	Grab Bar 18"	US32D	American Specialties, Inc.	AS 3701-18	Gen 9 IMPROV / Possibilities	Public	Restroom (Accessible Stall)
			US32D	Bobrick Washroom Equipment, Inc	B-5806 x 18"	Gen 9 IMPROV / Possibilities	Public	Restroom (Accessible Stall)
			US32D	Franklin Brass, a Liberty Hardware Brand, A Masco Company	FB 5718	Gen 9 IMPROV / Possibilities	Public	Restroom (Accessible Stall)
			US32D	WingIt Innovations	WGB5SS18	Gen 9 IMPROV / Possibilities	Public	Restroom (Accessible Stall)
336	158	Grab Bar 36"	US32D	American Specialties, Inc.	AS 3701-36	Gen 9 IMPROV / Possibilities	Public	Restroom (Accessible Stall)
			US32D	Bobrick Washroom Equipment, Inc	B-5806 x 36"	Gen 9 IMPROV / Possibilities	Public	Restroom (Accessible Stall)
			US32D	Franklin Brass, a Liberty Hardware Brand, A Masco Company	FB 5736	Gen 9 IMPROV / Possibilities	Public	Restroom (Accessible Stall)
			US32D	WingIt Innovations	WGB5SS36	Gen 9 IMPROV / Possibilities	Public	Restroom (Accessible Stall)

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright; US26D = Chrome, Satin; US32 = Stainless Steel, Bright (Polished); US32D = Stainless Steel, Satin; US15 = Satin Nickel; WHT =White

Note 1: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.
Note 2: All Universal Mark Numbers have been changed. Drawings issued on 9/3/12 or later, now reflect the revised mark numbers under the Universal Mark (New) column.

Toilet & Bath Accessory Matrix — Residence Inn

Gen 9 - New Build - IMPROV / Possibilities

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
342	160	Grab Bar 42"	US32D	American Specialties, Inc.	AS 3701-42	Gen 9 IMPROV / Possibilities	Public	Restroom (Accessible Stall)
			US32D	Bobrick Washroom Equipment, Inc	B-5806 x 42"	Gen 9 IMPROV / Possibilities	Public	Restroom (Accessible Stall)
			US32D	Franklin Brass, a Liberty Hardware Brand, A Masco Company	FB 5742	Gen 9 IMPROV / Possibilities	Public	Restroom (Accessible Stall)
			US32D	WingIt Innovations	WGB5SS42	Gen 9 IMPROV / Possibilities	Public	Restroom (Accessible Stall)
270	143	Robe Hook - Single	US26	Symmons Industries Inc.	Museo Robe Hook Model No. 533RH	Gen 9 IMPROV / Possibilities	Guestroom	Entry (Located on Vertical Wood Trim)
103		Toilet Tissue Holder (Surface Mtd)	US26	Symmons Industries Inc.	533TPR (Right) or 533TPl (Left) (Install with open end pointed towards front of Water Closet)	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom
270	143	Robe Hook - Single	US26	Symmons Industries Inc.	Museo Robe Hook Model No. 533RH	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom
750		Glass & Metal Shelf (14" x 5")	US26	Symmons Industries Inc.	CD01003-GSH-14	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright; US26D = Chrome, Satin; US32 = Stainless Steel, Bright (Polished); US32D = Stainless Steel, Satin; US15 = Satin Nickel; WHT =White

Note 1: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.
Note 2: All Universal Mark Numbers have been changed. Drawings issued on 9/3/12 or later, now reflect the revised mark numbers under the Universal Mark (New) column.

Toilet & Bath Accessory Matrix — Residence Inn

Gen 9 - New Build - IMPROV / Possibilities

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
324	154	Grab Bar 24"	US32D	American Specialties, Inc.	AS 3701-24	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Tub
			US32D	Bobrick Washroom Equipment, Inc	B-5806 x 24"	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Tub
			US32D	Franklin Brass, a Liberty Hardware Brand, A Masco Company	FB 5724	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Tub
			US32D	WingIt Innovations	WGB5SS24	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Tub
324 (OPT)	154 (OPT)	Grab Bar 24" - Platinum BANDS Series	US32D	WingIt Innovations	WPGB5SN24BAN	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Tub
401	170	Shower Curtain Rod - Oval/Curved (6" Bow)	US32	Franklin Brass, a Liberty Hardware Brand, A Masco Company	211-5BS	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Tub
		Shower Curtain Rod - Oval/Curved (6" Bow) *Note: (A) New Build: Use BAWFA Face Plate.	US32	WingIt Innovations	WOCBS5-6*	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Tub
521		Soap Basket (Corner Mount)	US26	Symmons Industries Inc.	CD01003-SB	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Tub
226		Towel Bar 24" (Glass Mounted)	US26	Continental Group	BH2062	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Shower

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright; US26D = Chrome, Satin; US32 = Stainless Steel, Bright (Polished); US32D = Stainless Steel, Satin; US15 = Satin Nickel; WHT =White

Note 1: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.
Note 2: All Universal Mark Numbers have been changed. Drawings issued on 9/3/12 or later, now reflect the revised mark numbers under the Universal Mark (New) column.

Toilet & Bath Accessory Matrix — Residence Inn

Gen 9 - New Build - IMPROV / Possibilities

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
226		Towel Bar 24" (Glass Mounted)	US26	Symmons Industries Inc.	CD01003-GMTB-24	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Shower
250		Towel Bar 24" / Robe Hooks (2) on 40" x 6" Custom Panel	US26	Symmons Industries Inc.	CD01003-ACP-24-TBRH-RGHT (Robe Hooks on Right) or CD01003-ACP-24-TBRH-LFT (Robe Hooks on Left)	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Shower
430		Door Pulls - 191mm center to center (Glass Mounted Back-to-Back)	US26	Continental Group	BH2007	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Shower
		Door Pulls - 7.5" center to center (Glass Mounted Back-to-Back)	US26	Symmons Industries Inc.	CD01003-GMDBLDP-7.5	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Shower
450	174	Fixed Glass Panel at Shower including: (A) Glass Fixed Panel (B) U-Channels (C) Towel Bar (See #226)	US32	See Section 10 28 00 for Manufacturer and Components		Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Shower
462	178	Glass Shower Door w/Fixed Panel including: (A) Glass Fixed Panel (B) U-Channels (C) Hinges (D) Pull Handles (See #430) (E) Door Wipe/Drip Rail (F) Polycarbonate Strike (G) Towel Bar (See #226)	US32	See Section 10 28 00 for Manufacturer and Components		Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Shower
521		Soap Basket (Corner Mount)	US26	Symmons Industries Inc.	CD01003-SB	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Shower

Finish Codes: US26 = Chrome, Bright; US26D = Chrome, Satin; US32 = Stainless Steel, Bright (Polished); US32D = Stainless Steel, Satin; US15 = Satin Nickel; WHT =White

Note 1: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.
Note 2: All Universal Mark Numbers have been changed. Drawings issued on 9/3/12 or later, now reflect the revised mark numbers under the Universal Mark (New) column.

Toilet & Bath Accessory Matrix — Residence Inn

Gen 9 - New Build - IMPROV / Possibilities

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
550	188	Shower Foot Rest (Refer to Tub and Shower Surround Product Manual for Surrounds)	#7400 Cream - Matte Finish w/textured finish on top	Mincey Marble Manufacturing Company	FR-03	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Shower
555	189	Shower Accessory Ledge (Refer to Tub and Shower Surround Product Manual for Surrounds)	#7400 Cream - Matte Finish	Mincey Marble Manufacturing Company	SS-03	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Shower
227		Towel Bar 24"	US26	Symmons Industries Inc.	533TB-24	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible
103		Toilet Tissue Holder (Surface Mtd)	US26	Symmons Industries Inc.	533TPR (Right) or 533TPI (Left) (Install with open end pointed towards front of Water Closet)	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Water Closet
318W	152W	Grab Bar 18" - Nylon Coated	WHT	Hafele America Co.	HEWI 988.61.199.M	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Water Closet
			WHT	WingIt Innovations	WGB5PU18WH	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Water Closet
318W (OPT)	152W (OPT)	Grab Bar 18" - Polyester Painted (Option)	WHT	WingIt Innovations	WGB5YS18WH	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Water Closet

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright; US26D = Chrome, Satin; US32 = Stainless Steel, Bright (Polished); US32D = Stainless Steel, Satin; US15 = Satin Nickel; WHT =White

Note 1: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.
Note 2: All Universal Mark Numbers have been changed. Drawings issued on 9/3/12 or later, now reflect the revised mark numbers under the Universal Mark (New) column.

Toilet & Bath Accessory Matrix — Residence Inn

Gen 9 - New Build - IMPROV / Possibilities

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
336W	159	Grab Bar 36" - Nylon Coated	WHT	Hafele America Co.	HEWI 988.61.499.M	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Water Closet
			WHT	WingIt Innovations	WGB5PU36WH	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Water Closet
336W (OPT)	159 (OPT)	Grab Bar 36" - Polyester Painted (Option)	WHT	WingIt Innovations	WGB5YS36WH	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Water Closet
342W	161	Grab Bar 42" - Nylon Coated	WHT	Hafele America Co.	HEWI 988.61.599.M	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Water Closet
			WHT	WingIt Innovations	WGB5PU42WH	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Water Closet
342W (OPT)	161 (OPT)	Grab Bar 42" - Polyester Painted (Option)	WHT	WingIt Innovations	WGB5YS42WH	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Water Closet
360W	165	Grab Bar - One Piece Combination Set - Nylon Coated (Alternative Design in lieu of individual Grab Bars)	WHT	Hafele America Co.	HEWI 988.65.599.M	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Water Closet
			WHT	WingIt Innovations	PUTWabWH (ab=bar size a&b)	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Water Closet
360W (OPT)	165 (OPT)	Grab Bar - One Piece Combination Set - Polyester Painted (Option) (Alternative Design in lieu of individual Grab Bars)	WHT	WingIt Innovations	WGB5HCabWH (ab=bar size a&b)	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Water Closet

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright; US26D = Chrome, Satin; US32 = Stainless Steel, Bright (Polished); US32D = Stainless Steel, Satin; US15 = Satin Nickel; WHT =White

Note 1: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.
Note 2: All Universal Mark Numbers have been changed. Drawings issued on 9/3/12 or later, now reflect the revised mark numbers under the Universal Mark (New) column.

Toilet & Bath Accessory Matrix — Residence Inn

Gen 9 - New Build - IMPROV / Possibilities

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
316W	153W	Grab Bar 16" - Nylon Coated	WHT	Hafele America Co.	HEWI 988.58.099.M	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Tub
			WHT	WingIt Innovations	WGB5PU16WH	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Tub
316W (OPT)	153W (OPT)	Grab Bar 16" - Polyester Painted (Option)	WHT	WingIt Innovations	WGB5YS16WH	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Tub
318W	152W	Grab Bar 18" - Nylon Coated	WHT	Hafele America Co.	HEWI 988.61.199.M	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Tub
			WHT	WingIt Innovations	WGB5PU18WH	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Tub
318W (OPT)	152W (OPT)	Grab Bar 18" - Polyester Painted (Option)	WHT	WingIt Innovations	WGB5YS18WH	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Tub
324S	155S	Grab Bar 24" - Nylon Coated with Sliding Handheld Shower Holder	WHT	Hafele America Co.	HEWI 988.61.299.M / 988.66.799	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Tub
324W	155	Grab Bar 24" - Nylon Coated	WHT	Hafele America Co.	HEWI 988.61.299.M	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Tub
			WHT	WingIt Innovations	WGB5PU24WH	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Tub

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright; US26D = Chrome, Satin; US32 = Stainless Steel, Bright (Polished); US32D = Stainless Steel, Satin; US15 = Satin Nickel; WHT =White

Note 1: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.
Note 2: All Universal Mark Numbers have been changed. Drawings issued on 9/3/12 or later, now reflect the revised mark numbers under the Universal Mark (New) column.

Toilet & Bath Accessory Matrix — Residence Inn

Gen 9 - New Build - IMPROV / Possibilities

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
324W (OPT)	155 (OPT)	Grab Bar 24" - Polyester Painted (Option)	WHT	WingIt Innovations	WGB5YS24WH	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Tub
336W	159	Grab Bar 36" - Nylon Coated	WHT	Hafele America Co.	HEWI 988.61.499.M	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Tub
			WHT	WingIt Innovations	WGB5PU36WH	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Tub
336W (OPT)	159 (OPT)	Grab Bar 36" - Polyester Painted (Option)	WHT	WingIt Innovations	WGB5YS36WH	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Tub
342W	161	Grab Bar 42" - Nylon Coated	WHT	Hafele America Co.	HEWI 988.61.599.M	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Tub
			WHT	WingIt Innovations	WGB5PU42WH	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Tub
342W (OPT)	161 (OPT)	Grab Bar 42" - Polyester Painted (Option)	WHT	WingIt Innovations	WGB5YS42WH	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Tub
362	167	Grab Bar / Slide Bar w/Additional Vertical Grab Bar - Nylon Coated with Sliding Handheld Shower Holder (Alternative Design in lieu of individual Grab Bars)	WHT	Hafele America Co.	HEWI 990.00.100.M	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Tub
401	170	Shower Curtain Rod - Oval/Curved (6" Bow)	US32	Franklin Brass, a Liberty Hardware Brand, A Masco Company	211-5BS	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Tub

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright; US26D = Chrome, Satin; US32 = Stainless Steel, Bright (Polished); US32D = Stainless Steel, Satin; US15 = Satin Nickel; WHT =White

Note 1: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.
Note 2: All Universal Mark Numbers have been changed. Drawings issued on 9/3/12 or later, now reflect the revised mark numbers under the Universal Mark (New) column.

Toilet & Bath Accessory Matrix — Residence Inn

Gen 9 - New Build - IMPROV / Possibilities

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
401	170	Shower Curtain Rod - Oval/Curved (6" Bow) *Note: (A) New Build: Use BAWFA Face Plate.	US32	WingIt Innovations	WOCBS5-6*	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Tub
521		Soap Basket (Corner Mount)	US26	Symmons Industries Inc.	CD01003-SB	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Tub
601	181	Tub Seat - Nylon Coated (Size complies with 2010 ADA)	WHT	WingIt Innovations	PUTB30WH	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Tub
318W	152W	Grab Bar 18" - Nylon Coated	WHT	Hafele America Co.	HEWI 988.61.199.M	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Roll-In Shower
			WHT	WingIt Innovations	WGB5PU18WH	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Roll-In Shower
318W (OPT)	152W (OPT)	Grab Bar 18" - Polyester Painted (Option)	WHT	WingIt Innovations	WGB5YS18WH	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Roll-In Shower
324S	155S	Grab Bar 24" - Nylon Coated with Sliding Handheld Shower Holder	WHT	Hafele America Co.	HEWI 988.61.299.M / 988.66.799	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Roll-In Shower
324W	155	Grab Bar 24" - Nylon Coated	WHT	Hafele America Co.	HEWI 988.61.299.M	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Roll-In Shower
			WHT	WingIt Innovations	WGB5PU24WH	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Roll-In Shower

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright; US26D = Chrome, Satin; US32 = Stainless Steel, Bright (Polished); US32D = Stainless Steel, Satin; US15 = Satin Nickel; WHT =White

Note 1: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.
Note 2: All Universal Mark Numbers have been changed. Drawings issued on 9/3/12 or later, now reflect the revised mark numbers under the Universal Mark (New) column.

Toilet & Bath Accessory Matrix — Residence Inn

Gen 9 - New Build - IMPROV / Possibilities

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
324W (OPT)	155 (OPT)	Grab Bar 24" - Polyester Painted (Option)	WHT	WingIt Innovations	WGB5YS24WH	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Roll-In Shower
336W	159	Grab Bar 36" - Nylon Coated	WHT	Hafele America Co.	HEWI 988.61.499.M	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Roll-In Shower
			WHT	WingIt Innovations	WGB5PU36WH	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Roll-In Shower
336W (OPT)	159 (OPT)	Grab Bar 36" - Polyester Painted (Option)	WHT	WingIt Innovations	WGB5YS36WH	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Roll-In Shower
342W	161	Grab Bar 42" - Nylon Coated	WHT	Hafele America Co.	HEWI 988.61.599.M	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Roll-In Shower
			WHT	WingIt Innovations	WGB5PU42WH	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Roll-In Shower
342W (OPT)	161 (OPT)	Grab Bar 42" - Polyester Painted (Option)	WHT	WingIt Innovations	WGB5YS42WH	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Roll-In Shower
361	166	Grab Bar / Slide Bar w/Additional Vertical Grab Bar - Nylon Coated with Sliding Handheld Shower Holder (Alternative Design in lieu of individual Grab Bars)	WHT	Hafele America Co.	HEWI 988.68.899.M	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Roll-In Shower
410	171	Shower Curtain Rod - Oval/Straight **Note: (A) New Build: Use BAWFA Face Plate.	US32	WingIt Innovations	WOCBST-5**	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Roll-In Shower

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright; US26D = Chrome, Satin; US32 = Stainless Steel, Bright (Polished); US32D = Stainless Steel, Satin; US15 = Satin Nickel; WHT =White

Note 1: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.
Note 2: All Universal Mark Numbers have been changed. Drawings issued on 9/3/12 or later, now reflect the revised mark numbers under the Universal Mark (New) column.

Toilet & Bath Accessory Matrix — Residence Inn

Gen 9 - New Build - IMPROV / Possibilities

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
521		Soap Basket (Corner Mount)	US26	Symmons Industries Inc.	CD01003-SB	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Roll-In Shower
610	182	Shower Seat - Nylon Coated **For use with 30" Deep Shower Compartments** (Size complies with 2010 ADA)	WHT	WingIt Innovations	PUEX28xxWH (xx= LH / RH)	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Roll-In Shower
640	183	Folding Edge Water Retainer & Threshold	ALUM	Shower Solutions USA, Inc.	Shower Water Dam	Gen 9 IMPROV / Possibilities	Guestroom	Bathroom - Accessible Roll-In Shower
911	311	Paper Towel Disp / Soap Dish / Mirror	US32D	American Specialties, Inc.	AS 0430	Gen 9 IMPROV / Possibilities	Back-of-House	Employee Restroom
912	312	Paper Towel Disp / Disposal (Recessed)	US32D	American Specialties, Inc.	AS 0469-BL	Gen 9 IMPROV / Possibilities	Back-of-House	Employee Restroom
			US32D	Bobrick Washroom Equipment, Inc	B-3944	Gen 9 IMPROV / Possibilities	Back-of-House	Employee Restroom
			US32D	GAMCO, Inc., A Bobrick Company	GA TW-1-18	Gen 9 IMPROV / Possibilities	Back-of-House	Employee Restroom
270	143	Robe Hook - Single	US26	Symmons Industries Inc.	Museo Robe Hook Model No. 533RH	Gen 9 IMPROV / Possibilities	Guestroom	Employee Restroom - Accessible Transfer Shower (LVP Projects Only)

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright; US26D = Chrome, Satin; US32 = Stainless Steel, Bright (Polished); US32D = Stainless Steel, Satin; US15 = Satin Nickel; WHT =White

Note 1: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.
Note 2: All Universal Mark Numbers have been changed. Drawings issued on 9/3/12 or later, now reflect the revised mark numbers under the Universal Mark (New) column.

Toilet & Bath Accessory Matrix — Residence Inn

Gen 9 - New Build - IMPROV / Possibilities

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
318W	152W	Grab Bar 18" - Nylon Coated	WHT	Hafele America Co.	HEWI 988.61.199.M	Gen 9 IMPROV / Possibilities	Guestroom	Employee Restroom - Accessible Transfer Shower (LVP Projects Only)
318W (OPT)	152W (OPT)	Grab Bar 18" - Polyester Painted (Option)	WHT	WingIt Innovations	WGB5YS18WH	Gen 9 IMPROV / Possibilities	Guestroom	Employee Restroom - Accessible Transfer Shower (LVP Projects Only)
324S	155S	Grab Bar 24" - Nylon Coated with Sliding Handheld Shower Holder	WHT	Hafele America Co.	HEWI 988.61.299.M / 988.66.799	Gen 9 IMPROV / Possibilities	Guestroom	Employee Restroom - Accessible Transfer Shower (LVP Projects Only)
324W	155	Grab Bar 24" - Nylon Coated	WHT	Hafele America Co.	HEWI 988.61.299.M	Gen 9 IMPROV / Possibilities	Guestroom	Employee Restroom - Accessible Transfer Shower (LVP Projects Only)

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright; US26D = Chrome, Satin; US32 = Stainless Steel, Bright (Polished); US32D = Stainless Steel, Satin; US15 = Satin Nickel; WHT =White

Note 1: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.
Note 2: All Universal Mark Numbers have been changed. Drawings issued on 9/3/12 or later, now reflect the revised mark numbers under the Universal Mark (New) column.

Toilet & Bath Accessory Matrix — Residence Inn

Gen 9 - New Build - IMPROV / Possibilities

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
324W	155	Grab Bar 24" - Nylon Coated	WHT	WingIt Innovations	WGB5PU24WH	Gen 9 IMPROV / Possibilities	Guestroom	Employee Restroom - Accessible Transfer Shower (LVP Projects Only)
410	171	Shower Curtain Rod - Oval/Straight **Note: (A) New Build: Use BAWFA Face Plate.	US32	WingIt Innovations	WOCBST-5**	Gen 9 IMPROV / Possibilities	Guestroom	Employee Restroom - Accessible Transfer Shower (LVP Projects Only)
521		Soap Basket (Corner Mount)	US26	Symmons Industries Inc.	CD01003-SB	Gen 9 IMPROV / Possibilities	Guestroom	Employee Restroom - Accessible Transfer Shower (LVP Projects Only)
611		Shower Seat - Nylon Coated **For use with 36" Deep Shower Compartments** (Size complies with 2010 ADA)	WHT	WingIt Innovations	PUEX32xxWH (xx= LH / RH)	Gen 9 IMPROV / Possibilities	Guestroom	Employee Restroom - Accessible Transfer Shower (LVP Projects Only)
130	116	Toilet Tissue Holder - Double (Surface Mtd.)	US26	American Specialties, Inc.	AS 7305-2B X R009	Gen 9 IMPROV / Possibilities	Back-of-House	Employee Restroom - Water Closet

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright; US26D = Chrome, Satin; US32 = Stainless Steel, Bright (Polished); US32D = Stainless Steel, Satin; US15 = Satin Nickel; WHT =White

Note 1: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.
Note 2: All Universal Mark Numbers have been changed. Drawings issued on 9/3/12 or later, now reflect the revised mark numbers under the Universal Mark (New) column.

Toilet & Bath Accessory Matrix — Residence Inn

Gen 9 - New Build - IMPROV / Possibilities

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
130	116	Toilet Tissue Holder - Double (Surface Mtd.)	US26	Bobrick Washroom Equipment, Inc	B-7686.60	Gen 9 IMPROV / Possibilities	Back-of-House	Employee Restroom - Water Closet
			US26	Franklin Brass, a Liberty Hardware Brand, A Masco Company	FB 980C	Gen 9 IMPROV / Possibilities	Back-of-House	Employee Restroom - Water Closet
318	152	Grab Bar 18"	US32D	American Specialties, Inc.	AS 3701-18	Gen 9 IMPROV / Possibilities	Back-of-House	Employee Restroom - Water Closet
			US32D	Bobrick Washroom Equipment, Inc	B-5806 x 18"	Gen 9 IMPROV / Possibilities	Back-of-House	Employee Restroom - Water Closet
			US32D	Franklin Brass, a Liberty Hardware Brand, A Masco Company	FB 5718	Gen 9 IMPROV / Possibilities	Back-of-House	Employee Restroom - Water Closet
			US32D	WingIt Innovations	WGB5SS18	Gen 9 IMPROV / Possibilities	Back-of-House	Employee Restroom - Water Closet
336	158	Grab Bar 36"	US32D	American Specialties, Inc.	AS 3701-36	Gen 9 IMPROV / Possibilities	Back-of-House	Employee Restroom - Water Closet
			US32D	Bobrick Washroom Equipment, Inc	B-5806 x 36"	Gen 9 IMPROV / Possibilities	Back-of-House	Employee Restroom - Water Closet
			US32D	Franklin Brass, a Liberty Hardware Brand, A Masco Company	FB 5736	Gen 9 IMPROV / Possibilities	Back-of-House	Employee Restroom - Water Closet

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright; US26D = Chrome, Satin; US32 = Stainless Steel, Bright (Polished); US32D = Stainless Steel, Satin; US15 = Satin Nickel; WHT =White

Note 1: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.
Note 2: All Universal Mark Numbers have been changed. Drawings issued on 9/3/12 or later, now reflect the revised mark numbers under the Universal Mark (New) column.

Toilet & Bath Accessory Matrix — Residence Inn

Gen 9 - New Build - IMPROV / Possibilities

Universal Mark (New)	Universal Mark (Old)	Description	Finish	Manufacturer	Model No.	Gen / Decor Scheme	Area	Location
336	158	Grab Bar 36"	US32D	WingIt Innovations	WGB5SS36	Gen 9 IMPROV / Possibilities	Back-of-House	Employee Restroom - Water Closet
342	160	Grab Bar 42"	US32D	American Specialties, Inc.	AS 3701-42	Gen 9 IMPROV / Possibilities	Back-of-House	Employee Restroom - Water Closet
			US32D	Bobrick Washroom Equipment, Inc	B-5806 x 42"	Gen 9 IMPROV / Possibilities	Back-of-House	Employee Restroom - Water Closet
			US32D	Franklin Brass, a Liberty Hardware Brand, A Masco Company	FB 5742	Gen 9 IMPROV / Possibilities	Back-of-House	Employee Restroom - Water Closet
			US32D	WingIt Innovations	WGB5SS42	Gen 9 IMPROV / Possibilities	Back-of-House	Employee Restroom - Water Closet
932	332	Seat Cover Dispenser (Single Recessed)	US32D	American Specialties, Inc.	AS 6477	Gen 9 IMPROV / Possibilities	Back-of-House	Employee Restroom - Water Closet
			US32D	Bobrick Washroom Equipment, Inc	B-3013	Gen 9 IMPROV / Possibilities	Back-of-House	Employee Restroom - Water Closet
			US32D	GAMCO, Inc., A Bobrick Company	GA TSC-8	Gen 9 IMPROV / Possibilities	Back-of-House	Employee Restroom - Water Closet

FINAL FOR CONSTRUCTION

Finish Codes: US26 = Chrome, Bright; US26D = Chrome, Satin; US32 = Stainless Steel, Bright (Polished); US32D = Stainless Steel, Satin; US15 = Satin Nickel; WHT =White

Note 1: When adequate blocking is not available for grab bars, install grab bars using WingIT's Grab Bar Fasteners Model #GBW40 or RESGBW35. WingIT's Grab Bar Fasteners are compatible with WingITS and Bobrick Grab Bars, for all other manufacturers, adequate blocking must be provided.
Note 2: All Universal Mark Numbers have been changed. Drawings issued on 9/3/12 or later, now reflect the revised mark numbers under the Universal Mark (New) column.

- SECTION 10 3100 -

MANUFACTURED FIREPLACES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Manufactured fireplace units.
   2. All required accessories.

1.3 RELATED REQUIREMENTS

A. Pertinent Sections specifying Volatile Organic Compound (VOC) Content Restrictions.

B. Section 01 6116 “Volatile Organic Compound (VOC) Restrictions”

C. Section 05 4000 “Cold-Formed Metal Framing” for framing of custom box enclosure around Fireplace Box.

D. Section 05 7000 “Decorative Metal” for exposed decorative sheet metal cladding around vent flue and custom exposed box enclosure for fireplace box.

E. Division 06 for wood trim.

F. Section 08 4114 “Interior Aluminum Framed Entrances and Storefront” for assembly the Fireplace enclosure will fit into.

G. Division 09 for related finishes.

H. Section 09 2900 “Gypsum Board” for custom fireplace enclosure reinforced cement sheathing.

I. Division 23 Sections:
   1. Gas pipe to firebox and connection to gas log burner.

J. Division 26 Sections for wall switch connected to gas electronic ignition.

1.4 REFERENCES

A. "Phoenix Building Construction Code", International Building Code 2006, with City of Phoenix administrative provisions and amendments.

B. Uniform Plumbing Code (UPC) 2006 with City of Phoenix administrative provisions and amendments.

C. ANSI Z223.1, NFPA 54 - National Fuel Gas Code.
   1. Specifically relating to unlisted decorative appliances and clearances to combustibles

D. CAN/ULC S610 - Factory-Built Fireplaces.

E. UL 127 - Standard for Factory-Built Fireplaces.

F. UL 907 - Standard for Fireplace Accessories

G. UL 1482 - Standard for Safety for Solid-Fuel Type Room Heaters

H. National Fire Protection Association (NFPA) 211.

I. International Plumbing Code
   1. Provisions governing Fuel Gas Piping
   2. Other chapters as applicable

J. International Mechanical Code
   1. Chapter 3 – General Requirements
   2. Other chapters as applicable

K. Local codes and ordinance

1.5 SUBMITTALS

A. Submit "Letter of Conformance" in accordance with Section 01 3300 with the following supporting data:
   1. Submit product data, mark each copy to identify applicable products, characteristics, models, options and other supplemental data to clearly communicate information specific to this project.

B. Shop Drawings and Samples:
   1. Submit copies of Shop Drawings of all items specified herein to Architect for approval.
   2. Obtain approval of drawings prior to proceeding with manufacturing.

C. Shop Drawings shall indicate:
   1. Dimensioned plans, elevations; details; location in the building of each item; conditions at openings with various wall thicknesses and materials; typical and special details of construction; methods of assembling sections; locations and installations requirements for hardware; size, shape, and thickness of materials; and joints and connections.
   2. Typical and special fabrication and installation details.
   3. Design criteria, drawings and calculations.

4. Materials and finishes.
5. Manufacturer’s Sequence of Operation.
6. Unit certification or manufacturer's certification of code compliance for unit and acceptance of all details of intended installation.

D. Qualification Data: For Installer and Fabricator.

E. Operation and Maintenance Data: For manufactured fireplace equipment to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 sections, include the following:
1. Record Drawings: AutoCAD format, on CD-ROM.
2. Product Schedule: For each fireplace or gas log item, include the following:
a. Designation indicated on Drawings.
b. Manufacturer's name and model number.
c. List of factory-authorized service agencies including addresses and telephone numbers.
d. Availability and costs of service contracts.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Firm with not less than five (5) years of experience in installation of fireplace units of type, quantity, and installation methods similar to work of this Section.
1. The system shall be installed by a licensed contractor familiar with gas appliance controls and the proper functioning of same.

B. Manufacture Qualifications: A company experienced in manufacturing fireplace designs similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
1. Units certification must be tested and certified by independent testing lab and must be current per ANSI Z21.11.2b-2004

C. Source Limitations: Obtain each formed-metal item through one source from a single manufacturer.

D. All materials shall be installed in accordance with the manufacturer's printed directions.

E. Comply with the fire-resistance ratings as indicated and as required by governing authority and codes. Provide materials, accessories, and application procedures which have been listed by UL.

F. Verify that components and proposed installation comply with local and state requirements for gas burning fireplaces.

G. U.L. Listing: Flue and Throat shall be UL rated insulated type for zero clearance installation to combustible surfaces.

H. Welding: Qualify procedures and personnel according to the following:
1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.3, "Structural Welding Code--Sheet Steel."

3. AWS D1.6, "Structural Welding Code--Stainless Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of Section 01 6000.

B. All materials shall be delivered in their original unopened packages and stored in an enclosed shelter providing protection from damage and exposure to the elements.
   1. Damaged or deteriorated materials shall be removed from the premises.

C. Store products in secure, covered area, well protected from weather.

D. Special Assembly Warranty: Standard form in which Fabricator/Installer agrees to repair or replace components of manufactured fireplace unit that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including, but not limited to, excessive deflection.
      b. Noise or vibration created by wind and thermal and structural movements.
      c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
      d. Failure or lack of performance of operating components.
   2. Warranty Period:
      a. Five years from date of Substantial Completion.

E. Special Assembly Warranty: Standard form in which Manufacturer agrees to repair or replace components of manufactured fireplace unit that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including, but not limited to, excessive deflection.
      b. Noise or vibration created by wind and thermal and structural movements.
      c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
      d. Failure or lack of performance of operating components.
   2. Warranty Period: Limited Lifetime from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Limits for adhesives sealants, fillers and primers. Comply with limits specified in Section 01 6116.

B. Thermal Movements: Provide formed-metal assemblies that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects.

C. Corrosion Control: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

D. Provide complete installations, including fireboxes, flues, controls, gas valves, pilot lights, and other accessories as required for installation and code-compliant operation of each unit

2.2 MANUFACTURERS

1. Subject to compliance with requirements, provide products as specified:

2.3 MANUFACTURED FIREPLACE UNITS

A. Types and manufacturers as shown on the drawings.

1. Schedule;
   - a. Mfgr: NAPOLEON Quality Fireplaces, www.napoleonfireplaces.com
   - b. Model:
     1) High Definition, HD81NT – See Thru (Natural gas)
   - c. Type: See thru
   - d. Vent: Direct Vent with Power Vent option, WHISPER QUIET™
   - e. Features:
     1) Wall switch control and Control Module
     2) Wireless remote control with Remote receiver with battery backup
        a) On/Off
        b) Flame control
        c) Blower
        d) Night Light
     3) Electronic ignition
     4) Blower
     5) Night light
   - f. Burner:
     1) Fuel: Natural Gas.
     2) Model:
        a) River Rock configuration
   - g. Interior walls:
     1) Sandstone panels
   - h. Specifications:
     1) BTU: 60,000
     2) Venting: Top
     3) Height: 40 3/8 –inch actual (49 1/4 -inch framing)
     4) Front width: 39 –inches actual (54 3/4 -inch framing)
     5) Depth: 24 5/8 –inch actual (23 5/8 –inch framing)
     6) Glass type: Ceramic
     7) Glass size:
        a) 30 3/4 -inch tall by 36 3/4 -inch wide
     8) Glass area:

a) 2,260 sq. inches
9) EnerGuide: 65 percent
10) AFUE: 68 percent
11) Steady rate: 67 percent

i. Certifications and standards:
1) NFI, National Fireplace Institute
2) NFPA 54
3) ANSI / NFPA 70 National Electric CodeZ223.1
4) ANSI Z21.50

2.4 METAL FLUES FOR FIREPLACES

A. Comply with Division 23.

B. Fireplace manufacturer's approved flue assembly for venting application.
1. Refer also to mechanical drawings.

C. Accessories:
1. Horizontal Flue Installation:
a. Wall flange: Firestop Spacer Assembly for wall framing penetration
2. Gas Power Vent assembly:
a. PVA81 Power Vent Adapter Kit
b. Wall Frame Assembly: Adapter for wall framing and Gas Power Vent Terminal.
c. Gas Power Vent (GPV)Terminal.
d. Terminal Access Cover
e. Wiring and all connection terminals

D. Custom fabrications:
1. Decorative sheet metal flue cover.
a. Refer to and coordinate with Section 05 7000
2. Assembly:
a. Single vertical butt joint seam by full legth as indicated on Drawings

2.5 MATERIALS

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
1. Rooms designated on Rottet Studio's Interiors Drawings: Provide products, colors and finishes as designated on Interiors Drawings and Interiors Finish Schedule.
2. All other locations: As indicated on the Architectural Drawings and Architectural Finish Schedule or, if none are shown, as specified in this section.

B. Steel Sheet, Cold Rolled: ASTM A 1008/A 1008M, either commercial steel, Type B, or structural steel, Grade 25 (Grade 170), metallic zinc-coated of grade and coating weight as follows:

1. Coating: G90 (Z275) or equivalent.

C. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

D. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 316, stretcher-leveled standard of flatness.

2.6 MISCELLANEOUS MATERIALS

A. Gaskets: As required to seal joints in ornamental formed metal and remain weathertight; and as recommended in writing by ornamental formed-metal manufacturer.

1. ASTM D 1056, Type 1, Class A, grade as recommended by gasket manufacturer to obtain seal for application indicated.
2. Closed cell polyurethane foam, adhesive on two sides, release paper protected.

B. Sealants: Nonsag, paintable, nonstaining, latex sealant complying with ASTM C 834; of type and grade required to seal joints in ornamental formed metal; and as recommended in writing by ornamental formed-metal manufacturer.

C. Fasteners: Use fasteners fabricated from same basic metal and alloy as fastened metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.

1. Provide concealed fasteners for interconnecting ornamental formed-metal items and for attaching them to other work, unless otherwise indicated.
2. Provide security-type machine screws for exposed fasteners, unless otherwise indicated.

D. Fire Pit Flame Bed Medium: Steel frame supported mesh under full coverage bed of Fire Glass, as required by manufacturer. Fire Glass to be 1 inch to 2 inch size, colors selected rfom manufacturer's standard options.

2.7 FABRICATION, GENERAL

A. Shop Assembly: Preassemble formed-metal items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

1. Firebox Shell: 16 gauge, minimum unless approved otherwise by specific specified model.
2. Outer Shell Skin: 24 gauge, minimum unless approved otherwise by specific specified model.
3. Combustion Collar 22 gauge satin coat metal, minimum unless approved otherwise by specific specified model.

B. Coordinate dimensions and attachment methods of ornamental formed-metal items with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned, unless otherwise indicated.

C. Form metal to profiles indicated, in maximum lengths to minimize joints. Produce flat, flush surfaces without cracking or grain separation at bends. Fold back exposed edges of unsupported sheet metal to form a 1/2 -inch (12-mm-) wide hem on the concealed side, or ease edges to a radius of approximately 1/32 -inch (1 mm) and support with concealed stiffeners.

D. Increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as needed to provide surface flatness equivalent to stretcher-leveled standard of flatness and sufficient strength for indicated use.
   1. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.

E. Build in straps, plates, and brackets as needed to support and anchor fabricated items to adjoining construction. Reinforce ornamental formed-metal items as needed to attach and support other construction.

F. Provide support framing, mounting and attachment clips, splice sleeves, fasteners, and accessories needed to install ornamental formed-metal items.

2.8 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for steel sheet finishes.

C. Complete mechanical finishes of flat sheet metal surfaces before fabrication where possible. After fabrication, finish all joints, bends, abrasions, and other surface blemishes to match sheet finish.

D. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

E. Apply organic and anodic finishes to formed metal after fabrication, unless otherwise indicated.

F. Finish custom fireplace face frame after assembly.

G. Appearance of Finished Work:
   1. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples.
   2. Noticeable variations in the same piece are not acceptable.
   3. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Contractor shall inspect site conditions to which work is to be installed.
   1. Report discrepancies to Architect in writing.

B. Do not begin installation until substrates have been properly prepared.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

D. Verify proper power supply and fuel source are available.
   1. The supply gas piping shall be sized to accommodate 60,000 BTU/h at a minimum 5.0 w.c.

E. Examine roughing-in for gas piping and electrical control wiring to verify actual locations of connections before equipment installation.
   1. Provide gas line in compliance with Division 22 Sections or the requirements of the local natural gas utility supplier and authorities having jurisdiction.
      a. Comply with requirements of Division 22 for Natural Gas Piping inside of building including Section 22 1623 “Facility Natural Gas Piping”.

F. Verify that Fire Place dimensions, clearances, combustion air ventilation and drainage are in accordance with manufacturer’s published directions and listing requirements of the equipment being installed.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. General:
   1. Coordinate with Drawings and Section 08 4114 “Interior Aluminum Framed Entrances and Storefront” for placing Fireplace assembly within window assembly.
      a. See Drawings including , but not limited to;
         1) A1.2
         2) Window Type “W40”, A8.5

B. Gas Fireplace:
   1. Install in accordance with manufacturer's instructions, ANSI Z21.44 and the requirements of authorities having jurisdiction.
   2. Anchor all components firmly in position for long life under hard use.
   3. The system shall be installed such that the gas piping has proper distance between the control box and the burner.
   4. All wiring to control boxes to be performed as to preserve the NEMA 4X rating of the control box.
   5. Control boxes are to be mounted at least 6 inches above finish grade to the bottom of the control box.
   6. The control boxes may be covered with a non-airtight method of concealment such as a faux rock.
   7. The fire pit must be constructed of non-combustible materials.

8. Clearance to all landscape and planting materials (to the sides and overhead) must be maintained per NFPA 54.
9. Upon completion of installation, visually inspect all exposed surfaces. Touch up scratches and abrasions with touch up paint recommended by the manufacturer; make imperfections invisible to the unaided eye from a distance of 5 -feet (1.5 m).

C. Firebox Face Frame:
1. Locate and place formed-metal items level and plumb and in alignment with adjacent construction.
2. Provide manufacture recommend clearances on all sides of unit.
3. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where needed to protect metal surfaces and to make a weathertight connection.
4. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.
5. Install concealed gaskets, joint fillers, insulation, sealants, and flashings, as the Work progresses, to make ornamental formed-metal items airtight.
6. Install concealed gaskets, joint fillers, sealants, and insulation, as the Work progresses, to make interior ornamental formed-metal items soundproof or lightproof as applicable to the type of fabrication indicated.
7. Corrosion Protection: Apply nonmelting/nonmigrating-type bituminous coating or other permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finish.

D. Controls:
1. Low Voltage illuminated keyed switch to control panel to be located at location as indicated, otherwise as directed by Architect..
   a. All wiring to be performed as to preserve the NEMA 4X rating of the control box.
   b. Furnish wireless control as part of project closeout.

3.4 FIELD QUALITY CONTROL

A. Verify all equipment and controls are functioning in accordance with manufactures written sequence of operation procedure and are in compliance with all applicable codes and standards.

3.5 ADJUSTING

A. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

3.6 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

3.7 START-UP AND DEMONSTRATION

A. Start up equipment as recommended by manufacturer, in presence in of representative of each manufacturer.

B. During test run of new equipment operation, a representative of the fireplace equipment contractor is to be present together with a representative of each manufacturer, to review and demonstrate the operation of the equipment items to the operating personnel.

1. The exact date of the demonstration is to be established by the architect and the owner's representative.

C. Ensure successful passage of all required jurisdictional inspections.

D. Repair or replace, at Owner's discretion, damaged, malfunctioning, or non code-compliant equipment.

E. Train Owner's maintenance personnel to adjust, operate, and maintain fireplace equipment, as specified in Division 01.

- END OF SECTION -

- SECTION 10 4400 -

FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Fire Extinguishers and Brackets
2. Fire Extinguisher Cabinets
3. Fire Hose and Valve Cabinet
4. Accessories

1.3 RELATED REQUIREMENTS

A. Pertinent Sections specifying Volatile Organic Compound (VOC) Content Restrictions.

B. Section 01 6116 “Volatile Organic Compound (VOC) Restrictions”

C. Section 09 2216 “Non-Structural Metal Framing”.

D. Section 09 2900 “Gypsum Board”.

1.4 REFERENCES

A. “Phoenix Building Construction Code”, International Building Code 2006, with City of Phoenix administrative provisions and amendments.

B. 36 CFR 1191 - Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities; Final Rule; Federal Register, July 26, 1991; updated 2010.

C. National Fire Protection Association (NFPA) Publications:
1. 10 “Portable Fire Extinguishers”

D. Underwriter's Laboratories, Inc. (UL) Standards:
1. 4A-“60BC classification”

1.5 SUBMITTALS

A. General: Submit in accordance with Section 01 3300.

B. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

C. Product Data: For each type of product indicated, demonstrate compliance with specified attributes.

D. VOC Submittals:

1. Product Data – VOC Limits: For adhesives sealants, fillers and primers, documentation including printed statement of VOC contents, comply with limits specified in Section 01 6116.

E. Submit “Letter of Conformance” in accordance with Section 01 3300 indicating specified items selected for use in project with the following supporting data.

1. Submit product data which shall include physical dimensions, operational features, color and finish, anchorage details, rough-in measurements, location, and details.
2. Submit manufacturer's installation instructions.

F. Operation and Maintenance Data:

1.6 QUALITY ASSURANCE

A. Conform to NFPA 10 requirements for extinguishers.

1.7 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements of Section 01 6000.

1.8 AMBIENT CONDITIONS REQUIREMENTS

A. Do not install extinguishers when ambient temperatures may cause freezing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Limits for adhesives sealants, fillers and primers. Comply with limits specified in Section 01 6116.

2.2 ACCEPTABLE MANUFACTURERS

A. Avendra, LLC Preferred Manufacturers:

1. None

B. Approved Manufacturers:

1. Larsen's Manufacturing Company (800-527-7367).
2. J. L. Industries, Inc. (800-554-6077).
3. Modern Metal Products, a Division of Technico, Inc. (800-435-5544)

2.3 EXTINGUISHERS:

A. Typical:
1. UL 4A/60BC, Multi-Purpose, Dry-Chemical Type: Steel Tank, pressurized, including hose and nozzle; 10-pound, ABC classification.

B. Kitchen: UL 80BC, 10lb Purple K, Dry Chemical in Brass container

C. Emergency Generator room: (Class A type required)
1. UL 4A/60BC, Multi-Purpose, Dry-Chemical Type: Steel Tank, pressurized, including hose and nozzle; 10-pound, ABC classification.

D. Electrical rooms: (Class C type required)
1. UUL 4A/60BC, Multi-Purpose, Dry-Chemical Type: Steel Tank, pressurized, including hose and nozzle; 10-pound, ABC classification.

2.4 BRACKET:

A. Furnish wall mount bracket where shown on Drawings complete with mounting hardware.

2.5 CABINETS:

A. Items specified below are by Larsen's Manufacturing Co. Equivalent products by listed manufacturer will be acceptable.
1. Wall Mounted on Bracket (FE): "MP10" Extinguisher with "B2" bracket.
2. Semi-recessed Fire Extinguisher Cabinet (FEC-1):
   a. "MP10" Extinguisher with “Gemini Series
   b. Rated walls: Model FS-G-2409-6R"; semi-recessed cabinet, projecting 2-1/2 -inch, rough opening of 10-1/2 -inchW x 25 -inch H x 4 -inch D.
   c. Non-Rated walls: Model G-2409-6R"; semi-recessed cabinet, projecting 2-1/2 -inch, rough opening of 10-1/2 -inchW x 25 -inch H x 4 -inch D.
3. Surface Mounted Fire Extinguisher Cabinet (FEC-2): "MP10" Extinguisher with “Gemini Series
   a. Rated Walls: Model FS-G-2409-SM "; surface-mounted cabinet.
   b. Non-Rated Walls: Model G-2409-SM "; surface-mounted cabinet.
4. Recessed Fire Hose and Valve Cabinet with Fire Extinguisher (FVC-1): "MP10" Extinguisher with;
   a. Rated wall: "FS-G-3238-R"; Recessed Fire Hose and Valve Cabinet, projecting 2-1/2 -inch, rough opening of 34-1/8 -inch W x 40-1/8 -inch H x 9-1/8 -inch D.
   b. Non-Rated Wall: "G-3238-R"; Recessed Fire Hose and Valve Cabinet, projecting 2-1/2 -inch, rough opening of 34-1/8 -inch W x 40-1/8 -inch H x 9-1/8 -inch D.

5. Semi-recessed Fire Hose and Valve Cabinet with Fire Extinguisher (FVC-2): "MP10" Extinguisher with;
   a. Rated wall: "FS-G-3238-RL"; Semi-Recessed Fire Hose and Valve Cabinet, projecting 2-1/2 -inch, rough opening of 33 -inch W x 39 -inch H x 6 -inch D.
   b. Non-Rated wall: "G-3238-RL"; Semi-Recessed Fire Hose and Valve Cabinet, projecting 2-1/2 -inch, rough opening of 33 -inch W x 39 -inch H x 6 -inch D.

B. Cabinet:
1. Semi-Recessed Fire Extinguisher Cabinet: 18 gauge steel with acrylic thermosetting enamel finish box construction, rolled-edge trim type, matching continuous hinge, pull handle, 1/4 -inch Frameless Acrylic door, baked enamel coated steel trim.
   a. Door Style to be Larson “Gemini" series door with black vertical letters on white background stating equipment in cabinet, or approved substitution by other listed manufacturers.
      1) Provide lock similar to “Larsen-Loc” on all cabinets.
   b. Finish: White finish for box and trim.
   c. Provide black text “FIRE EXTINGUISHER” on side of cabinet where required by code.
2. Surface Mounted Fire Extinguisher Cabinet: 18 gauge steel with acrylic thermosetting enamel finish box construction, matching continuous hinge, pull handle, 1/4 -inch Frameless Acrylic door, baked enamel coated steel trim..
   a. Door Style to be Larson “Gemini" series door with black vertical letters on white background stating equipment in cabinet, or approved substitution by other listed manufacturers.
      1) Provide lock similar to “Larsen-Loc” on all cabinets.
   b. Finish: White finish for box and trim.

C. Recessed Fire Hose and Valve Cabinet: 18 gauge steel with acrylic thermosetting enamel finish box construction, flat trim type, matching continuous hinge, pull handle, 1/4 -inch Frameless Acrylic door, baked enamel coated steel trim.
1. Door Style to be Larson “Full Glass”, or approved substitution by other listed manufacturers. Glazing to be Clear Tempered Safety Glass.
   a. Provide lock similar to “Larsen-Loc” on all cabinets.
2. Finish: White finish for box and trim.
3. Provide black text “FIRE EXTINGUISHER” on front of glass where required by code.

D. Semi-recessed Fire Hose and Valve Cabinet: 18 gauge steel with acrylic thermosetting enamel finish box construction, rolled-edge trim type, matching continuous hinge, pull handle, 1/4” Frameless Acrylic door, baked enamel coated steel trim.
1. Door Style to be Larson “Full Glass”, or approved substitution by other listed manufacturers. Glazing to be Clear Tempered Safety Glass.
   a. Provide lock similar to “Larsen-Loc” on all cabinets.
2. Finish: White finish for box and trim.
3. Provide text “FIRE EXTINGUISHER” on side of cabinet where required by code.

E. Mounting Hardware: Appropriate to Cabinet.

F. Fabrication:

1. Form body of cabinet with tight inside corners and seams.
2. Pre-drill holes for anchorage.
3. Form perimeter trim and door stiles by welding, filling, and grinding smooth.
4. Hinge doors for 180 degree opening with continuous piano hinge. Provide pull handle and roller type catch.

2.6 FINISHES

A. Extinguishers: Red enamel.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify rough openings for cabinet are correctly sized and located.

B. Beginning of installation means acceptance of existing conditions.

3.2 INSTALLATION

A. Install cabinets plumb and level in wall openings. Secure rigidly in place in accordance with manufacturer's instructions.

- END OF SECTION -

- SECTION 10 5113 -

METAL LOCKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Locker units with hinged doors.
2. Base, top, and filler panels.
3. Hooks, latches, and hardware.
4. Attachment hardware.
5. Bench bases.

1.3 RELATED REQUIREMENTS

A. Pertinent Sections specifying Volatile Organic Compound (VOC) Content Restrictions.

B. Section 01 6116 “Volatile Organic Compound (VOC) Restrictions”.

C. Section 09 2216 “Non-Structural Metal Framing”.

D. Section 09 2900 “Gypsum Board”.

E. Division 9 floor finishes.

1.4 REFERENCES

A. “Phoenix Building Construction Code”, International Building Code 2006, with City of Phoenix administrative provisions and amendments.

B. 36 CFR 1191 - Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities; Final Rule; Federal Register, July 26, 1991; updated 2010.

1.5 SUBMITTALS

A. General: Submit in accordance with Section 01 3300.

B. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

C. Product Data: For each type of product indicated, demonstrate compliance with specified attributes.

D. VOC Submittals:

1. Product Data – VOC Limits: For adhesives sealants, fillers and primers, documentation including printed statement of VOC contents, comply with limits specified in Section 01 6116.

E. Submit “Letter of Conformance” in accordance with Section 01 33 00 (01330) indicating specified items selected for use in project with the following supporting data.

1. Submit Shop Drawings and product data that clearly indicate locker types, sizes, configurations, layout of groups of lockers, benches, accessories, and numbering plan.
2. Submit manufacturer's installation instructions and actual color samples, on squares of same metal to be used for fabrication.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of Section 01 6000.

B. Store and protect locker finishes and adjacent surfaces from damage during installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Limits for adhesives sealants, fillers and primers. Comply with limits specified in Section 01 6116.

2.2 SYSTEM DESCRIPTION

A. COURTYARD:

1. Lockers: Two-tier locker with benches. Provide standard recessed padlock handle, number plate bases, end panels, filler panels, matching sloped top and top filler panels.

B. RESIDENCE INN:

1. Lockers: Three-tier locker with benches. Provide standard recessed padlock handle, number plate bases, end panels, filler panels, matching sloped top and top filler panels.

2.3 MANUFACTURERS

A. Avendra, LLC Preferred Manufacturers:

1. None

B. Approved Manufacturers:

1. “Industrial”; Lyon Workspace Products LLC (800-433-8488)

a. Color: No. BN 931 – B6

2. "Standard Lockers"; Republic Storage Systems Company (800-477-1255)
   a. Color: No. 89 Cork
3. "Vanguard Lockers"; Penco Products, Inc. (800-562-1000)
   a. Color: No. 073 Champagne
4. "Emperor Locker System"; Hadrian Manufacturing, Inc. (905-333-0300)
   a. Color: No. 603 Almond

2.4 LOCKER MATERIALS

A. Sheet Steel: ASTM A1008, Mild, stretcher-leveled cold-rolled carbon sheet steel free of buckling, scale, and surface imperfections of the following minimum thicknesses:
   1. Body and Shelf: 24 Gauge
   2. Doors: 16 Gauge
   3. Door Frames: 16 Gauge
   4. Hinges: Minimum 2 -inch wide, full loop, tight pin type.

2.5 LOCKER ACCESSORIES

A. Provide each locker with metal number plate, rubber bumpers, and hat/bookshelf.

2.6 LOCKER FABRICATION

A. Locker Units: Provide the following types in locations shown on the Drawings:
   1. COURTYARD:
      a. Two tier units, each locker to be 12 -inch wide by 15 -inch deep by 36 -inch high.
   2. RESIDENCE INN:
      a. Three tier units, each locker to be 12 -inch wide by 15 -inch deep by 24 -inch high.

B. Bodies: Formed and flanged with stiffener ribs; electrically spot welded.

C. Door Frame: Formed channel shape, welded and ground flush, welded to body.

D. Doors: Welded inner and outer faces; channel reinforced top and bottom with intermediate stiffener ribs. Finish edges smooth.

E. Hinges: Three full loop hinges. Weld securely to unit body and secure to door with no fewer than 2 factory installed fasteners that are completely concealed and tamperproof when door is closed.

F. Recessed Handle and Latch: Manufacturer's standard housing to form a recess for latch lifter and locking devices; non-protruding latch lifter containing strike and eye for padlock; and automatic, pre-locking, pry-resistant latch with latching action with not less than three-point latching. Locking device supplied by Owner.

G. Provide finished filler panels, end panels, continuous sloped 20-gauge metal tops and top filler panels to close off all openings, finished to match lockers.
   1. Sloped tops are to be in lengths as long as practicable, but not less than four lockers.

H. Provide matching 12 gage, "Z" type base, 4 -inch high at non-recessed lockers.

I. Trim: 3 -inch, 18 gauge steel matching trim for recessed lockers.

J. Provide full perimeter concealed ventilation system.

K. Finish edges smooth without burrs.

L. Provide number plates.

M. Fabricate lockers square, rigid, and without warp, with metal faces flat and free of dents or distortion. Make exposed metal edges free of sharp edges and burrs, and safe to touch. Weld frame members together to form a rigid, one-piece structure.

1. Form locker body panels, doors, shelves and accessories from one-piece steel sheet unless otherwise indicated.

N. Accessible Lockers:

1. Accessible Locker to meet ICC/ANSI A117.1-2003-Side Reach Requirement: Single tier lockers shall have a hat/book shelf and coat hooks located no more than 46-inches above the finished floor. One additional shelf shall be placed near the bottom of the locker so that it is no lower than 15-inches above finished floor.
2. Apply a decal with the international symbol of accessibility to the face of the designated handicapped accessible single tier locker, refer to Drawings for location.

2.7 BENCHES

A. Manufacturer: Same as lockers

B. Bench Units: (COURTYARD & RESIDENCE INN)

1. Bench Top:
   a. Size as indicated on Drawings.
   b. 2 –inch thick solid wood material.
      1) Refer to Section 06 4023 “Interior Architectural Woodwork:
   c. Size: 4 –feet by 18 –inches unless indicated otherwise on Drawings.
   d. Provide the following types in locations shown on the Drawings:
2. Bench Bases:
   a. Mfgr: Lyon
   b. Material: Steel
   c. Finish: Factory painted “Putty” (PP)
      1) Field painted custom color as selected by Architect.
   d. Model No: CAT No. 5818-2
   e. Fasteners:
      1) Stainless steel lab bolts at Bench
      2) Stainless steel anchor bolts at floor

2.8 FINISHES

A. Clean, degrease, and neutralize metal; prime and finish with two coats of baked enamel, color as selected by Architect from standard colors.

B. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to applying and designating finishes.

C. Finish all steel surfaces and accessories, except prefinished stainless-steel and chrome-plated surfaces.

D. Protect mechanical finishes on exposed surfaces from damage by applying strippable, temporary protective covering prior to shipment.

E. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within 1/2 of the range of approved samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved samples and they are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify bases are properly sized and located.

3.2 INSTALLATION

A. Install metal lockers complete with accessories according to manufacturer's recommendations. Install plumb, level, rigid, flush and in-line.

B. Anchor lockers with appropriate anchor devices to suit materials encountered, to floor and walls. Apply fasteners through back-up reinforcing plates where necessary to avoid metal distortion, using concealed fasteners.

C. Bolt adjoining locker units together to provide rigid installation.

D. Install end panels, filler panels, and tops to completely close-off all openings.

E. Anchor lockers to floors and walls at intervals recommended by manufacturer but no greater than 36 -inches (910 mm). Install anchors through back-up reinforcing plates where necessary to avoid metal distortion, using concealed fasteners.

1. Install recess trim to recessed lockers using concealed fasteners. Provide hairline joints and concealed splice plates.
2. Install sloping top units to lockers using concealed fasteners. Provide hairline joints and concealed splice plates.
3. Install finished end panels to conceal exposed ends of non-recessed lockers.

3.3 ADJUST AND CLEAN

A. Adjust doors and latches to operate easily without bending. Verify that integral locking devices are operating properly.

B. Touch-up marred finishes, but replace units that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

C. Clean interior and exposed exterior surfaces and polish steel and non-ferrous metal surfaces.

D. Protect lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit locker use during construction.

- END OF SECTION -

- SECTION 10 5613 -

METAL STORAGE SHELVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Metal storage shelving.

1.3 RELATED REQUIREMENTS

A. Pertinent Sections specifying Volatile Organic Compound (VOC) Content Restrictions.

B. Section 01 6116 “Volatile Organic Compound (VOC) Restrictions”.

C. Section 09 2216 “Non-Structural Metal Framing”.

D. Section 09 2900 “Gypsum Board”.

1.4 REFERENCES

A. “Phoenix Building Construction Code”, International Building Code 2006, with City of Phoenix administrative provisions and amendments.

1.5 SUBMITTALS

A. General: Submit in accordance with Section 01 3300.

B. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

C. Product Data: For each type of product indicated, demonstrate compliance with specified attributes.

D. VOC Submittals:

1. Product Data – VOC Limits: For adhesives sealants, fillers and primers, documentation including printed statement of VOC contents, comply with limits specified in Section 01 6116.

E. Submit "Letter of Conformance" in accordance with Section 01 33 00 with the following supporting data:
   1. Mark each copy to identify applicable products, characteristics, models, options and other supplemental data to clearly communicate information specific to this project.
   2. Color Chart: Each product specified.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain metal storage shelving through one source from a single manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of Section 01 6000.

B. Deliver metal storage shelving palleted, wrapped, or crated to provide protection during transit and Project-site storage.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install metal storage shelving until spaces are enclosed and weatherproof, wet work in spaces is completed and dry, and ambient temperature is being maintained at the levels indicated for Project when occupied for its intended use.

1.9 COORDINATION

A. Coordinate locations and installation of metal storage shelving that may interfere with ceiling systems including lighting, HVAC, and sprinklers.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Limits for adhesives sealants, fillers and primers. Comply with limits specified in Section 01 6116.

2.2 STORAGE SHELVING

A. Avendra, LLC Preferred Manufacturers:
   1. None

B. Approved Manufacturers:
   1. "Open Clip Type Shelving" - Republic Storage Systems Company (800-477-1255)
   2. "Clip - Support Shelving" - Adapto Storage Products, (800-923-2786)
   3. "8000 Series" - - Lyon Workspace Products, LLC (800-433-8488)
   4. "Clipper Shelving" - Penco Products, Inc (800-562-1000)

C. Design:
   1. Stand alone clip type consisting of 4 angle posts, 2 back sway braces, 4 side sway braces and 6 shelves.
      a. 3-feet-0-inch Long Units: Minimum 800 pounds load capacity per shelf.
      b. 4-feet -0-inch Long Units: Minimum 550 pounds load capacity per shelf.

D. Components:
   1. Angle posts; 13 gage steel, with slots to receive shelf clips.
   2. Shelves: 18 gage steel. Front and back shelf flanges turned down to accommodate 1 -inch by 1 -inch x 1/8 -inch reinforcing angles.
   3. Shelf Clips: Type recommended and used by shelving manufacturer for required loading.
   4. Sway Braces: 1 -inch by 1/8 -inch band iron with holes at ends for attachment to shelving units.
   5. Accessories: As required by classification, design and installation requirements.

E. Finish:
   1. Factory finish in manufacturers standard color selected by Owner's representative.

F. Size and layout as indicated on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Set units plumb, level and square. Do not secure to adjacent walls. Adjust for rigidity.

- END OF SECTION -

- SECTION 10 5723.13 -

WIRE CLOSET AND UTILITY SHELVING (RESIDENCE INN)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes penetrating water-repellent coatings for the following vertical and horizontal surfaces:

1. **RESIDENCE INN**:

a. Wire closet shelves.

1.3 RELATED REQUIREMENTS

A. Pertinent Sections specifying Volatile Organic Compound (VOC) Content Restrictions.

B. Section 01 6116 “Volatile Organic Compound (VOC) Restrictions”

C. Section 09 2216 “Non-Structural Metal Framing”

D. Section 09 2900 “Gypsum Board”

1.4 REFERENCES

A. “Phoenix Building Construction Code”, International Building Code 2006, with City of Phoenix administrative provisions and amendments.

1.5 SUBMITTALS

A. General: Submit in accordance with Section 01 3300.

B. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

C. Product Data: For each type of product indicated, demonstrate compliance with specified attributes.

D. VOC Submittals:
   1. Product Data – VOC Limits: For adhesives sealants, fillers and primers, documentation including printed statement of VOC contents, comply with limits specified in Section 01 6116.

E. Submit "Letter of Conformance" in accordance with Section 01 3300 with the following supporting data:
   1. Mark each copy to identify applicable products, characteristics, models, options and other supplemental data to clearly communicate information specific to this Project.
   2. Color Chart: Each product specified.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain metal storage shelving through one source from a single manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of Section 01 6000.

B. Deliver storage shelving palleted, wrapped, or crated to provide protection during transit and Project-site storage.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install metal storage shelving until spaces are enclosed and weatherproof, wet work in spaces is completed and dry, and ambient temperature is being maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Limits for adhesives sealants, fillers and primers. Comply with limits specified in Section 01 6116.

2.2 WIRE CLOSET SHELVES (RESIDENCE INN)

A. Avendra, LLC Preferred Manufacturers:
   1. None.

B. Approved Manufacturers:
   1. “Lifetime Ventilated Series Shelf with Hanging Rod”; Organized Living (888-674-5484).

C. Components:

1. Structural Performance:
   a. Structural Performance: Back clips spaced 11 -inches with support braces at 3 -feet 6 -inches.
   b. Static Load: 75 lb/ft of shelf minimum.
   c. For heavy duty applications in pantry and garage applications space support brace on 2 -feet.
   d. Back Clips and Down Back Clips shall be Tri-Loc II Patented hollow wall anchoring system.
2. Material: Minimum requirements.
   a. Steel Rod: Grade C 1008 cold drawn steel rod. Tensile strength of 100 ksi.
   b. Front Rods and Studs: 0.306 -inch diameter.
   c. Back Rods: 0.243 -inch diameter.
   d. Cross Wire Spacing: 1 -inch spacing. 0.120 -inch diameter for one inch spaced standard 20 -inches shelf. 0.105 -inch diameter for one inch spaced standard mesh shelf.
   e. Cross Wire Spacing: 1/2 -inch spacing. 0.0915 -inch diameter for one-half inch spaced tight mesh shelf.
3. Shelving:
   a. Hanging Shelf with Open Slide: 12 -inches deep by length as shown on Drawings.
   b. Storage Shelf: 12 -inches deep by length as shown on Drawings.
4. Mounting Hardware: Manufacturer's standard components including anchor clips, end brackets, angled support braces and end caps, including the following:
   a. Side Wall Bracket: As required. Shelf side wall interface.
   b. Support Brace: Maximum 42 -inches and every open end Anchor Back Clips.
   c. Fasteners, clips, caps and touch-up all as required.
   d. Down Back Clips.

D. Finish:
1. Electrostatic applied oven cured epoxy at all surfaces to 3 mil to 5 mil thickness.
   a. Color: Pure White

E. Configurations: (Gen 9)
1. Studio “A” Guestroom Wire Shelves: (Drawing 420)
   a. One (1) shelf to be provided full width of closet mounted at 68 -inches above finished floor. Hanging rod to be located under open section of shelf.
      1) Shelf Depth: 12 -inches.
   b. Parts List: The following is a parts list for this configuration. List shall be verified by Contractor to comply with actual room dimensions. Provide all other accessory components as required for complete installation.

Closet 1 (Up to 48 -inches Wide)

Quantity	Part Number	Description
5	1430-6620-11	Versa-Clip w/ Tri-Loc II Anchor - White
2	1430-6621-11	Side Wall Bracket w/Tri-Loc II Anchor - White
1	1430-6623-11	Tri-Loc II Anchor - White
1	1430-6651-11	Double End Cap - White
1	1430-6659-11	12 -inch Support Brace - White

4	1430-6684-11	Small Ventilated End Cap - White
4	1430-6686-11	Large Ventilated End Cap - White
(1) 4’	1710-1212-11	12 -inch D Open Slide Shelf -White

2. Connector Studio Guestroom Wire Shelves: (Drawing 420a)
   a. One (1) shelf to be provided full width of closet mounted at 68 -inches above finished floor. Hanging rod to be located under open section of shelf.
      1) Shelf Depth: 12 -inches.
   b. Parts List: The following is a parts list for this configuration. List shall be verified by Contractor to comply with actual room dimensions. Provide all other accessory components as required for complete installation.

Closet 1 (Up to 55 -inches Wide)

Quantity	Part Number	Description
6	1430-6620-11	Versa-Clip w/ Tri-Loc II Anchor - White
2	1430-6621-11	Side Wall Bracket w/Tri-Loc II Anchor - White
1	1430-6623-11	Tri-Loc II Anchor - White
1	1430-6651-11	Double End Cap - White
1	1430-6659-11	12 -inch Support Brace - White
4	1430-6684-11	Small Ventilated End Cap - White
4	1430-6686-11	Large Ventilated End Cap - White
(1) 5’	1710-1212-11	12 -inch D Open Slide Shelf -White

3. Accessible Studio “A” Guestroom Wire Shelves: (Drawing 421)
   a. Two (2) shelves to be provided full width of closet mounted at 48 -inches and 58 -inches above finished floor. Hanging rod to be located under open section of bottom shelf.
      1) Shelf Depth: 12 -inches.
   b. Three (3) additional 12 -inches wide stacked shelves located to one side of closet below bottom shelf.
      1) Storage Shelves to be located at the following intervals: 12 -inches, 24 -inches, and 36 –inches.
      2) Shelf Depth: 12 -inches.
   c. Parts List: The following is a parts list for this configuration. List shall be verified by Contractor to comply with actual room dimensions. Provide all other accessory components as required for complete installation.

Closet 1 (Up to 55 -inches Wide)

Quantity	Part Number	Description
(3) 1’	1210-1212-11	12 -inch D Storage Shelf - White
(1) 4’	1210-1212-11	12 -inch D Storage Shelf - White
14	1430-6620-11	Versa-Clip w/ Tri-Loc II Anchor - White
7	1430-6621-11	Side Wall Bracket w/Tri-Loc II Anchor - White
1	1430-6651-11	Double End Cap - White
5	1430-6665-11	Adjustable Pole Clip- White
2	1430-6671-11	Base Cap - White
1	1430-6673-11	84 -inch Support Pole- White
28	1430-6684-11	Small Ventilated End Cap - White
12	1430-6686-11	Large Ventilated End Cap - White
(1) 4’	1710-1212-11	12 -inch D Open Slide Shelf -White

4. Studio “C” Guestroom Wire Shelves: (Drawing 422)
   a. One (1) shelf to be provided full width of closet mounted at 68 -inches above finished floor. Hanging rod to be located under open section of shelf.
      1) Shelf Depth: 12 -inches.
   b. Parts List: The following is a parts list for this configuration. List shall be verified by Contractor to comply with actual room dimensions. Provide all other accessory components as require for complete installation.

Closet 1 (Up to 48 -inches Wide)

Quantity	Part Number	Description
5	1430-6620-11	Versa-Clip w/ Tri-Loc II Anchor - White
2	1430-6621-11	Side Wall Bracket w/Tri-Loc II Anchor - White
1	1430-6623-11	Tri-Loc II Anchor - White
1	1430-6651-11	Double End Cap - White
1	1430-6659-11	12 -inch Support Brace - White
4	1430-6684-11	Small Ventilated End Cap - White
4	1430-6686-11	Large Ventilated End Cap - White
(1) 4’	1710-1212-11	12 -inch D Open Slide Shelf -White

5. One Bedroom – In-Line Guestroom Wire Shelves: (Drawing 423)
   a. One (1) shelf to be provided full width of closet mounted at 68 -inches above finished floor. Hanging rod to be located under open section of shelf.
      1) Shelf Depth: 12 -inches.
   b. Parts List: The following is a parts list for this configuration. List shall be verified by Contractor to comply with actual room dimensions. Provide all other accessory components as required for complete installation.

Closet 1 (Up to 60 -inches Wide)

Quantity	Part Number	Description
7	1430-6620-11	Versa-Clip w/ Tri-Loc II Anchor - White
2	1430-6621-11	Side Wall Bracket w/Tri-Loc II Anchor - White
1	1430-6623-11	Tri-Loc II Anchor - White
1	1430-6651-11	Double End Cap - White
1	1430-6659-11	12 -inch Support Brace - White
4	1430-6684-11	Small Ventilated End Cap - White
4	1430-6686-11	Large Ventilated End Cap - White
(1) 5’	1710-1212-11	12 -inch D Open Slide Shelf -White

6. One Bedroom – End Unit Guestroom Wire Shelves: (Drawing 425)
   a. One (1) shelf to be provided full width of closet mounted at 68 -inches above finished floor. Hanging rod to be located under open section of shelf.
      1) Shelf Depth: 12 -inches.
   b. Parts List: The following is a parts list for this configuration. List shall be verified by Contractor to comply with actual room dimensions. Provide all other accessory components as required for complete installation.

Closet 1 (Up to 48 -inch Wide)

Quantity	Part Number	Description

6	1430-6620-11	Versa-Clip w/ Tri-Loc II Anchor - White
2	1430-6621-11	Side Wall Bracket w/Tri-Loc II Anchor - White
1	1430-6623-11	Tri-Loc II Anchor - White
1	1430-6651-11	Double End Cap - White
1	1430-6659-11	12 -inch Support Brace - White
4	1430-6684-11	Small Ventilated End Cap - White
4	1430-6686-11	Large Ventilated End Cap - White
(1) 4'	1710-1212-11	12 -inch D Open Slide Shelf -White

7. One Bedroom – End Unit - Accessible Guestroom Wire Shelves: (Drawing 426)
   a. Two (2) shelves to be provided full width of closet mounted at 48 -inches and 58 -inches above finished floor. Hanging rod to be located under open section of bottom shelf.
      1) Shelf Depth: 12 -inches.
   b. Three (3) additional 12 -inches wide stacked shelves located to one side of closet below bottom shelf.
      1) Storage Shelves to be located at the following intervals: 12 -inches, 24 -inches, and 36 -inches.
      2) Shelf Depth: 12 -inches.
   c. Parts List: The following is a parts list for this configuration. List shall be verified by Contractor to comply with actual room dimensions. Provide all other accessory components as required for complete installation.

Closet 1 (Up to 38 -inches Wide)

Quantity	Part Number	Description
(2) 1'	1210-1212-11	12 -inch D Storage Shelf - White
(1) 4'	1210-1212-11	12 -inch D Storage Shelf - White
12	1430-6620-11	Versa-Clip w/ Tri-Loc II Anchor - White
6	1430-6621-11	Side Wall Bracket w/Tri-Loc II Anchor - White
1	1430-6651-11	Double End Cap - White
4	1430-6665-11	Adjustable Pole Clip- White
2	1430-6671-11	Base Cap - White
1	1430-6673-11	84 -inch Support Pole- White
22	1430-6684-11	Small Ventilated End Cap - White
10	1430-6686-11	Large Ventilated End Cap - White
(1) 4'	1710-1212-11	12 -inch D Open Slide Shelf -White

8. Two Bedroom – Optional Guestroom Wire Shelves: (Drawing 427)
   a. One (1) shelf to be provided full width of closet mounted at 68 -inches above finished floor. Hanging rod to be located under open section of shelf.
      1) Shelf Depth: 12 -inches.
   b. Parts List: The following is a parts list for this configuration. List shall be verified by Contractor to comply with actual room dimensions. Provide all other accessory components as required for complete installation.

Closet 1 (Up to 48 -inches Wide)

Quantity	Part Number	Description
6	1430-6620-11	Versa-Clip w/ Tri-Loc II Anchor - White
2	1430-6621-11	Side Wall Bracket w/Tri-Loc II Anchor - White
1	1430-6623-11	Tri-Loc II Anchor - White

1	1430-6651-11	Double End Cap - White
1	1430-6659-11	12 -inch Support Brace - White
4	1430-6684-11	Small Ventilated End Cap - White
4	1430-6686-11	Large Ventilated End Cap - White
(1) 4’	1710-1212-11	12 -inch D Open Slide Shelf -White

Closet 2 (Up to 60 -inches Wide)

Quantity	Part Number	Description
7	1430-6620-11	Versa-Clip w/ Tri-Loc II Anchor - White
2	1430-6621-11	Side Wall Bracket w/Tri-Loc II Anchor - White
1	1430-6623-11	Tri-Loc II Anchor - White
1	1430-6651-11	Double End Cap - White
1	1430-6659-11	12 -inch Support Brace - White
4	1430-6684-11	Small Ventilated End Cap - White
4	1430-6686-11	Large Ventilated End Cap - White
(1) 5’	1710-1212-11	12 -inch D Open Slide Shelf -White

9. Two Bedroom – Accessible Guestroom Wire Shelves: (Drawing 428)
   a. Two (2) shelves to be provided full width of closet mounted at 48 -inches and 58 -inches above finished floor. Hanging rod to be located under open section of bottom shelf.
      1) Shelf Depth: 12 -inches.
   b. Three (3) additional 12 -inches wide stacked shelves located to one side of closet below bottom shelf.
      1) Storage Shelves to be located at the following intervals: 12 -inches, 24 -inches, and 36 -inches.
      2) Shelf Depth: 12 -inches.
   c. Parts List: The following is a parts list for this configuration. List shall be verified by Contractor to comply with actual room dimensions. Provide all other accessory components as required for complete installation.

Closet 1 (Up to 36 -inches Wide)

Quantity	Part Number	Description
(2) 1’	1210-1212-11	12 -inch D Storage Shelf - White
(1) 3’	1210-1212-11	12 -inch D Storage Shelf - White
12	1430-6620-11	Versa-Clip w/ Tri-Loc II Anchor - White
6	1430-6621-11	Side Wall Bracket w/Tri-Loc II Anchor - White
1	1430-6651-11	Double End Cap - White
4	1430-6665-11	Adjustable Pole Clip- White
2	1430-6671-11	Base Cap - White
1	1430-6672-11	70 -inch Support Pole- White
22	1430-6684-11	Small Ventilated End Cap - White
10	1430-6686-11	Large Ventilated End Cap - White
(1) 3’	1710-1212-11	12 -inch D Open Slide Shelf -White

Closet 2 (Up to 65 -inches Wide)

Quantity	Part Number	Description
(2) 1’	1210-1212-11	12 -inch D Storage Shelf - White
(1) 5’	1210-1212-11	12 -inch D Storage Shelf - White
18	1430-6620-11	Versa-Clip w/ Tri-Loc II Anchor - White

6	1430-6621-11	Side Wall Bracket w/Tri-Loc II Anchor - White
2	1430-6623-11	Tri-Loc II Anchor - White
1	1430-6651-11	Double End Cap - White
4	1430-6665-11	Adjustable Pole Clip- White
2	1430-6671-11	Base Cap - White
1	1430-6672-11	70 -inch Support Pole- White
28	1430-6684-11	Small Ventilated End Cap - White
12	1430-6686-11	Large Ventilated End Cap - White
(1) 5’	1710-1212-11	12 -inch D Open Slide Shelf -White

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's published instructions, square and plumb, secured rigidly in position.

1. Layout scheduled components prior to installation to verify wall to wall and floor to ceiling heights, widths, plumb and flatness of surfaces.
2. Prepare anchor locations and select anchor types using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

- END OF SECTION -

- SECTION 10 5723.19 -

WOOD CLOSET AND UTILITY SHELVING (COURTYARD)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. **COURTYARD**:
      a. Guest room coat racks.

1.3 RELATED REQUIREMENTS

A. Pertinent Sections specifying Volatile Organic Compound (VOC) Content Restrictions.

B. Section 01 6116 “Volatile Organic Compound (VOC) Restrictions”.

C. Section 09 2216 “Non-Structural Metal Framing”.

D. Section 09 2900 “Gypsum Board”.

1.4 REFERENCES

A. “Phoenix Building Construction Code”, International Building Code 2006, with City of Phoenix administrative provisions and amendments.

1.5 SUBMITTALS

A. General: Submit in accordance with Section 01 3300.

B. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

C. Product Data: For each type of product indicated, demonstrate compliance with specified attributes.

D. VOC Submittals:

1. Product Data – VOC Limits: For adhesives sealants, fillers and primers, documentation including printed statement of VOC contents, comply with limits specified in Section 01 6116.

E. Submit "Letter of Conformance" in accordance with Section 01 3300 with the following supporting data:

Provide manufacturer's technical data and installation instructions for each item of equipment. Provide setting drawings, templates, instructions, and directions for installation of anchorage devices in other work.

1.6 QUALITY ASSURANCE

A. Provide products of the same manufacturer for each type of unit and for units exposed in the same area.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of Section 01 6000.

B. Do not deliver equipment to site until rooms in which they are to be installed are ready to receive them.

C. Store packages to prevent physical damage or wetting.

D. Pack accessories individually in a manner to protect accessory and its finish.

E. Maintain protective covers on all units until final clean-up.

F. Protection:

1. Protect adjacent or adjoining finished surfaces and work from damage during installation of work of this Section.

1.8 WARRANTEE

A. Work of this Section shall be jointly guaranteed by the manufacturer and the installer for a period of one year after final payment. Any material or workmanship that is judged defective during this period shall be replaced at no cost to the Owner.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Limits for adhesives sealants, fillers and primers. Comply with limits specified in Section 01 6116.

2.2 GUEST ROOM COAT RACKS (COURTYARD)

A. Avendra, LLC Preferred Manufacturers:
   1. None.

B. Approved Manufacturers:
   1. Beverly Coat Hanger Co., Inc., (415-550-0105)
      a. Standard Rooms: Custom Design: "Keyway 815 Series Closet Units"
      b. Accessible Rooms (2 Level): Custom Design: "Keyway 815 ADA Series Closet Units"
   2. Tubular Engineering & Sales Co. (800-532-1020)
      a. Standard Rooms: "JF Series Wood Coat Rack with Hardwood Top Bars"
      b. Accessible Rooms (2 Level): "JF-ADA Series Wood Coat Rack with Hardwood Top Bars"
   3. Magnuson Group (800-342-5725)
      a. Standard Rooms: "MC-HWA Series Wood Hospitality Coat Racks"
      b. Accessible Rooms (2 Level): "MC-HWA-2L-ADA Series Wood Hospitality Coat Racks"

C. Size: As shown on Drawings.

D. Include 10 “Non-Theft” Mini open hook wood hangers finished to match rack, 4 for skirts and 6 for suits.

E. Color and Finish: Cherry Finish as approved by Owner’s Representative to match FF&E.

PART 3 - EXECUTION

3.1 PREPARATION

A. Deliver inserts and rough-in frames to job site and in appropriate time for building-in. Provide templates and rough-in measurements as required.

B. Before starting work, notify Owner’s Representative in writing of any conflicts detrimental to installation or operation of units.

C. Verify with Owner’s Representative exact location of units.

3.2 INSTALLATION - GENERAL

A. Install units and accessories, in accordance with manufacturer's printed instructions.

B. Use concealed fastenings wherever possible.

C. Install true, plumb, and level, securely and rigidly anchored to substrate in accordance with manufacturer's instructions for each item and each type of substrate construction.

D. Fasteners for all units mounting to be theft-resistant.

E. Set storage shelving unit plumb, level, and square. Do not secure to adjacent walls. Adjust for rigidity.

3.3 INSTALLATION - SPECIALTIES

A. Guest Room Coat Racks:

1. Install in accordance with manufacturer's published instructions, square and plumb, secured rigidly in position.
2. Install with wood screws or toggle bolts. Cap recessed screw holes with matching wood plugs.

- END OF SECTION -

- SECTION 10 7316 -

CUSTOM STEEL CANOPIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following exterior building mounted assemblies incorporating custom steel fabrication including all, labor, materials, equipment and services necessary to complete the assembly and attachment to building as shown in the Architectural and Structural drawings, including, but not limited to the following:

1. Custom fabricated steel Canopies
   a. Flat profile (Canopy A)
   b. Curved profile (Canopy B)
2. Refer to Architectural and Structural Drawings.

1.3 RELATED REQUIREMENTS

A. Pertinent Sections specifying sealants or referencing this Section for sealant products and Execution Requirements.

B. Section 01 6116 “Organic Volatile Compound (VOC) Restrictions”.

C. Section 01 7400 “Construction Site Cleaning”

D. Section 04 2000 “Concrete Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.

E. Section 05 0605 “Welded Stud Anchors”

F. Section 05 0810 “Galvanized Finishes on Steel””

G. Section 05 0900 “Anchors and Fasteners”

H. Section 05 1200 "Structural Steel” Refer to and coordinate with for items including, but not limited to;

1. Exterior Canopies – framing and attachment to building structure, metal decking, steel channels, etc.

I. Section 05 1213 “Architecturally-Exposed Structural Steel (AESS) Framing” for steel welding and finishing for steel canopies

J. Section 05 5000 “Metal Fabrications”

K. Section 07 5419 “Polyolefin-Chloride (PVC) Roofing” for rigid insulation and roofing assembly

L. Section 07 9200 “Joint Sealants”

M. Section 07 9213 “Exterior Façade Sealants”

N. Section 08 4113 "Aluminum-Framed Entrances and Storefronts" for coordinating finish among aluminum fenestration units on the building exterior.

O. Section 08 4413 "Glazed Aluminum Curtain Walls"

P. Section 09 9600 “High Performance Coatings” for preparation, priming with compatible products and finish paint coatings.

Q. Division 22 for roof drains.

1.4 REFERENCES

A. “Phoenix Building Construction Code”, International Building Code 2006, with City of Phoenix administrative provisions and amendments.

B. ASTM International, American Society and Material Testing:
   1. Standards as herein specified in body of specification

C. AWS D1.6 / D1.6M, “Structural Welding Code – Stainless Steel

D. National Ornamental & Miscellaneous Metals Association (NOMMA) Guideline 1, www.nomma.org

1.5 ACTION SUBMITTALS

A. Submit under provisions of Section 01 3300 “Submittal Procedures”.

B. Product Data: For each type of product indicated, demonstrate compliance with specified attributes.

C. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

D. Shop Drawings: Show fabrication and installation details for glass canopy assembly, metal fabrications and components.
   1. Include plans, elevations, sections, and details of metal fabrications and their connections.
      a. Show anchorage and accessory items.

2. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
3. Shop drawings shall indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevation, and details where applicable. Indicate welded connections using standard AWS welding symbols. Indicate net weld lengths.
4. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
5. Indicate coordinating with other trades.
6. Include details of all supports and data to show provisions for vertical and horizontal expansion and deflections.

E. Structural Calculations: Prior to fabrication of the canopy assembly, submit design calculations prepared by a Licensed Engineer in the state the project is being constructed.
1. Engineer shall provide a written sealed letter stating that the system components conform to the structural performance requirements specified.

F. Samples
1. Spider fitting assembly with swivel fittings, bolts and accessories.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer.

B. Where installed metal fabrications are indicated to comply with certain design loadings, include structural computations, material properties, and other information needed for structural analysis that has been signed and sealed by the qualified professional engineer who was responsible for the preparation.

C. Welding certificates.

1.7 CLOSEOUT SUBMITTALS

A. Submit under provisions of Section 01 7700.

B. Warranty: Submit specified warranty.

1.8 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.9 COORDINATION

A. Coordinate installation of anchorages for metal fabrications.
   1. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry.
   2. Deliver such items to Project site in time for installation.

B. Coordinate installation of steel weld plates, backing, angles and all other components that will be installed in building exterior walls that are specified in this Section or shown in drawings, required for this work, but under the scope of another Section.
   1. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry or secured to steel structure or steel components.
   2. Deliver such items to Project site in time for installation.

1.10 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements of Section 01 6000 “Product Requirements”.

B. Deliver all parts ready for erection.

1.11 PROJECT CONDITIONS

A. Field Measurements:
   1. Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.

1.12 WARRANTY

A. Manufacturer Warranty: Provide a five **(5)** year warranty for the design integrity, weather ability and durability of the; custom steel fabricated canopies and components.

B. Installer Warranty: Warrant the installation for a period of five **(5)** years for installation and repairs or failures.
   1. Prove written requirements for notification of installer and terms for maintaining warranty provisions in accordance with owner’s rights in Division 1 of the specifications.

C. Provide manufacturers and installer’s certificates that all work is in accord with reviewed shop drawings and specifications and is free from defects in materials and workmanship.

D. Defective materials and workmanship is hereby defined to include failure to perform as specified, degradation of painted surfaces, attachment component failure and deterioration of construction in excess of that to be expected under normal weathering.
   1. Failure of operating parts to function normally, deterioration or discoloration of finishes in excess of normal weathering and aging, and failure to fulfill other specified performance requirements.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Limits for adhesives sealants, fillers and primers. Comply with limits specified in Section 01 6116.

B. VOC Limits for all primers and coatings: Comply with limits specified in Section 01 6116.

C. Delegated Design: Including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 FERROUS MATERIALS

A. Galvanized finishes on steel:

1. Refer to Section 05 0810 “Galvanized Finishes on Steel”

B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 304.

D. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.

E. Steel Bolts, Nuts, and Washers: ASTM A307.

F. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304.

G. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.

H. Welding Materials: AWS D1.1; type required for materials being welded.

I. Galvanizing: Hot-dip process ASTM A123 typical and ASTM A153 for threaded fasteners performed after fabrication into largest practical section. Weight of coating not less than 2 oz. per sq. ft. of surface. Where damaged, repair surface with one coat of hot process galvanizing repair compound, "Galvalloy", Galvweldalloy", or approved equal.

1. Refer to Section 05 0810 “Galvanized Finishes on Steel

J. Primer: Provide primers that comply with Section 09 9600 “High Performance Coatings”.

2.3 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

D. Comply with Section 09 9600 “High-Performance Coatings”

2.4 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
a. Refer to Section 09 9600 “High-Performance Coatings”

C. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Refer to Section 09 9600 “High-Performance Coatings”

2.5 FASTENERS

A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls.
1. Select fasteners for type, grade, and class required.

B. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593 (ASTM F 738M); with hex nuts, ASTM F 594 (ASTM F 836M); and, where indicated, flat washers; Alloy Group 2 (A4).

C. Stainless steel Plain Washers: Round, ASME B18.22.1 (ASME B18.22M).

D. Stainless steel Lock Washers: Helical, spring type, ASME B18.21.1 (ASME B18.21.2M).

2.6 MISCELLANEOUS MATERIALS

A. Refer to Section 05 5000 “Metal Fabrications”

B. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

C. Galvanizing: Hot-dip process ASTM A123 typical and ASTM A153 for threaded fasteners performed after fabrication into largest practical section. Weight of coating not less than 2 oz. per sq. ft. of surface.

D. Zinc Repair Solder: For hot zinc galvanizing repair.

1. Refer to Section 05 0810 “Galvanized Finishes on Steel”

E. Primer: Cold applied “site or shop” touch up for galvanized finishes to be field painted:
1. Refer to Section 05 0810 “Galvanized Finishes on Steel”

F. Galvanizing Repair Paint: Where galvanizing is damaged, repair surface with one coat of Galvanizing Repair Paint:
1. Refer to Section 05 0810 “Galvanized Finishes on Steel”
2. Refer to Section 09 9600 “High-Performance Coatings”

G. Galvanized Repair Paint: Cold applied / site touch up:
1. Refer to Section 05 0810 “Galvanized Finishes on Steel”
2. Refer to Section 09 9600 “High-Performance Coatings”

H. Dissimilar Materials: Separate dissimilar surfaces in contact with or in close proximity to non-compatible metals, concrete masonry, or plaster with neoprene gasket; or other approved means.

2.7 FABRICATION, GENERAL

A. Custom Canopy Metal Surfaces, General:
1. Provide materials with smooth, flat surfaces, unless otherwise indicated.
2. For metal fabrications in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
   a. Refer to Section 05 1213 “Architecturally-Exposed Structural Steel (AESS) Framing”

B. Shop Assembly: Preassemble items in the shop to greatest extent possible.
1. Disassemble units only as necessary for shipping and handling limitations.
2. Use connections that maintain structural value of joined pieces.
3. Clearly mark units for reassembly and coordinated installation.

C. Provide for anchorage of type indicated; coordinate with supporting structure.

D. Allow for thermal movement resulting from the following maximum change (range) in ambient temperature in the design, fabrication, and installation of installed metal assemblies to prevent buckling, opening up of joints, and overstressing of welds and fasteners. Base design calculations on actual surface temperatures of metals due to both solar heat gain and nighttime sky heat loss.
1. Temperature Change (Range): 100 deg F.

E. Fabricate joints, seams and other connections in a manner to exclude water.

F. Form metal fabrications from materials of size, thickness, and shapes indicated but not less than that needed to comply with performance requirements indicated.
1. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support.
2. Use type of materials indicated or specified for various components of each metal fabrication.

G. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

H. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

I. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

J. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible.
   1. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated.
   2. Locate joints where least conspicuous.
   3. Comply with Section 05 1213 “Architecturally-Exposed Structural Steel (AESS) Framing”

K. Weld corners and seams continuously to comply with the following:
   1. Comply with Section 05 1213 “Architecturally-Exposed Structural Steel (AESS) Framing”
   2. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   3. Obtain fusion without undercut or overlap.
   4. Remove welding flux immediately.
   5. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
   6. All framing will be welded and assembled as possible in a controlled shop environment.
   7. All welded connections will be performed by a SME or AWS certified welder with a minimum of 3 years experience.

L. Ease exposed edges to a radius of approximately 1/32 -inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

M. Cut, drill, and punch metals cleanly and accurately.
   1. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated.
   2. Remove sharp or rough areas on exposed surfaces.

N. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

O. Shear and punch metals cleanly and accurately.
   1. Remove burrs.

2.8 MISCELLANEOUS STEEL TRIM

A. Refer to Section 05 5000 “Metal Fabrications”

B. Unless otherwise indicated, fabricate units from structural steel shapes, plates, and bars of profiles shown with continuously welded joints, and smooth exposed edges.
   1. Miter corners and use concealed field splices.

C. Provide cutouts, fittings, and anchorages as required to coordinate assembly and installation with other work.

D. Galvanize miscellaneous steel trim.

E. Prime and finish paint items in accordance with "High-Performance Coatings" typically, unless specified and/or indicated to be left as galvanized finish.

2.9 SYSTEM PERFORMANCE REQUIREMENTS

A. The custom steel canopy, as erected, shall meet or exceed the following structural and weather resistance requirements as demonstrated by engineering calculations.

B. Design Performance: Design supports and canopy assembly to withstand all design live load.
   1. Wind Load:
      a. Refer to Structural drawings
   2. Uplift Wind Load:
      a. Refer to Structural drawings

C. Deflection of Structure: Allow for deflection of structural members supporting the loads of the canopy to the span of the structural member divided by 240.

D. Thermal Movements: Design to accommodate expansion and contraction resulting from normal air temperature range of 120 degrees F, solar heat gain, and nighttime re-radiation.

2.10 MANUFACTURER

A. Manufacturers: Subject to compliance with requirements.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide; custom steel fabricated assembly with fittings and accessories by manufacturers as herein listed in body of this specification.

2.11 CANOPY (“A”) – EXTERIOR (SOUTHEAST CORNER) - CUSTOM FABRICATED HORIZONTAL ASSEMBLY WITH SINGLE PLY ROOFING ASSEMBLY AND DRAINAGE

A. General:
   1. Description:
      a. Exterior custom fabricated horizontal steel framed Canopy incorporating; HSS steel beams, steel channels, steel decking, steel fascia angle, steel hanging rod support assembly, wall brackets, canopy brackets, single ply roofing assembly over deck sheathing and rigid insulation with through wall drain and scuppers.
      b. Attachment:
         1) Assembly is secured to building structure and suspended off building wall above
      c. Canopy Finish: Primed and painted galvanized steel assembly

1) High Performance painted steel assembly
a) Refer to Section 09 9600 “High-Performance Coatings”

d. Color:
1) Custom as provided by Architect

2. Refer to drawings including those indicating the Canopies.
a. See the following, but not limited to;
1) Structural Drawings, including but not limited to; S1.2 and S4.2
2) Architectural Drawings, including but not limited to; A1.2, A1.3, A3.4 and A8.11.

B. Canopy Steel Assembly:
1. Perimeter frame:
a. Steel channel and bent steel plate
b. Refer to Architectural and Structural drawings
2. Fascia:
a. Steel channel and bent steel plate
b. Refer to Architectural and Structural drawings
3. Intermediate framing:
a. Main canopy structure and attachment to building structure
1) HSS Tube steel
2) Refer to Architectural and Structural drawings
2) Refer to Architectural and Structural drawings
4. Decking:
a. Steel decking
1) Refer to Structural Drawings
b. Sheathing
1) Refer to Architectural Drawings

C. Cover assembly
1. Single play roofing over roof deck substrate board sheathing over Steel decking
a. Single Ply: Refer to Section 07 5419 “Polyvinyl-Chloride (PVC) Roofing”
b. Sheathing: Refer to Section 07 5419 “Polyvinyl-Chloride (PVC) Roofing”
c. Insulation: Refer to Section 07 5419 “Polyvinyl-Chloride (PVC) Roofing”
1) Uniform thickness
2) Tapered
d. Steel decking
1) Refer to Structural Drawings
2) Refer to Section 05 3100 “Steel Decking”
e. Drainage:
1) Side mounted through wall drain
a) Refer to Architectural Drawings
b) Refer to Plumbing Drawings
c) Refer to Division 22

D. Suspension assembly:
   1. Hanging Tension rod assembly:
      a. Mfgr:
         1) STA-LOK® www.satlock.com
      b. General:
         1) Components:
            a) Steel rods with integral fork ends
            b) Clevis pin
         2) Refer to Architectural and Structural drawings
      c. Tie Rod (threaded rods):
         1) Material: Stainless steel C-1035, A-36
         2) Type: Rod with Forks each end
         3) Model: F34 Fork to Fork System
         4) Length: Full length unless over 9 metres and then equal lengths with Rod Connector at mid sdpan
         5) Diameter:
            a) 1 –inch unless approved otherwise
         6) Accessories: Rod Connectors
            a) Size: To fit Tie Rod
            b) Finish: Same as Tie Rod
         7) Finish:
            a) Architect shall select from one of the following: 240 Grit (Satin) or Polished
         8) Threads: Right or Left Hand threads
         9) Standard: ASTM F1145-92
      d. Clevises: See Tie Rod
      e. Turnbuckles: Built into Tie Rod for adjustment
      f. Rod Ends: Part of Tie Rod assembly
      g. Clevis Pins - Headed:
         1) Material: Stainless steel,
         2) Finish: Match Tie Rod
   2. Canopy Brackets:
      a. Type: Hot dipped galvanized steel plate assembly drilled to accommodate steel rod clevis and pin for hanging rod assembly
      b. Finish:
         1) Painted custom color in accordance with Section 09 9600 “High-Performance Coatings”
   3. Wall Brackets:
      a. Type: Galvanized steel HSS tube steel and plate assembly secured to building structure with drilled plate to accommodate steel rod clevis and pin for hanging rod assembly
      b. Finish:
         1) Painted custom color in accordance with Section 09 9600 “High-Performance Coatings”

2.12 CANOPY ("B") – EXTERIOR - CUSTOM FABRICATED CURVED ASSEMBLY

A. General:
1. Description:
a. Exterior custom fabricated curved steel framed Canopy incorporating; HSS steel beams, steel channels, steel decking, steel fascia angle, steel hanging rod support assembly, wall brackets, canopy brackets, single ply roofing assembly over deck sheathing and rigid insulation.
b. Attachment:
1) Assembly is secured to building structure and suspended off building wall above
c. Canopy Finish: Primed and painted galvanized steel assembly
1) High Performance painted steel assembly
a) Refer to Section 09 9600 "High-Performance Coatings"
d. Color:
1) Custom as provided by Architect
2. Refer to drawings including those indicating the Canopies.
a. See the following, but not limited to;
1) Structural Drawings, including but not limited to; S1.2 and S4.2
2) Architectural Drawings, including but not limited to; A1.2, A1.3, A3.4 and A8.11.

B. Canopy Steel Assembly:
1. Perimeter frame:
a. Steel channel and bent steel plate
b. Refer to Architectural and Structural drawings
2. Fascia:
a. Curved Steel channel and bent steel plate
b. Refer to Architectural and Structural drawings
3. Intermediate framing:
a. Main canopy structure and attachment to building structure
1) HSS Tube steel
2) Refer to Architectural and Structural drawings
2) Refer to Architectural and Structural drawings
4. Decking:
a. Steel decking
1) Refer to Structural Drawings
b. Sheathing
1) Refer to Architectural Drawings

C. Cover assembly
1. Single play roofing over roof deck substrate board sheathing over Steel decking
a. Single Ply: Refer to Section 07 5419 "Polyvinyl-Chloride (PVC) Roofing"

b. Sheathing: Refer to Section 07 5419 “Polyvinyl-Chloride (PVC) Roofing”
c. Insulation: Refer to Section 07 5419 “Polyvinyl-Chloride (PVC) Roofing”
   1) Uniform thickness
   2) Tapered
d. Steel decking: Curved profile
   1) Refer to Structural Drawings
   2) Refer to Section 05 3100 “Steel Decking”

D. Suspension assembly:
   1. Same as Canopy “A”

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
   1. Cast Aluminum: Heavy coat of bituminous paint.
   2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for operable partitions securely to and rigidly brace from building structure.

C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

D. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.

1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.3 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 9 painting Sections.

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780

3.4 SCHEDULE

A. Provide and install items shown on Drawings with anchorage and attachment necessary for installation. The following Schedule lists principal items only. Refer to drawing details for items not specifically scheduled.

1. Miscellaneous plates or angles not attached to structural steel; complete with anchorage for embedment.
2. Refer to Part 1 SUMMARY

- END OF SECTION -

- SECTION 10 7500 -

FLAGPOLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Outrigger wall mounted flagpoles.
   2. Flags.

1.3 RELATED REQUIREMENTS

A. Pertinent Sections specifying Volatile Organic Compound (VOC) Content Restrictions.

B. Section 01 6116 “Volatile Organic Compound (VOC) Restrictions”.

C. Section 03 3000 “Cast-in-Place Concrete” for concrete footings for flagpoles if not specified in this Section.

D. Section 05 5000 “Metal Fabrications”.

E. Division 26 Section for Exterior Lighting.

1.4 REFERENCES

A. “Phoenix Building Construction Code”, International Building Code 2006, with City of Phoenix administrative provisions and amendments.

1.5 SUBMITTALS

A. General: Submit in accordance with Section 01 3300.

B. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

C. Product Data: For each type of product indicated, demonstrate compliance with specified attributes.

D. VOC Submittals:
1. Product Data – VOC Limits: For adhesives sealants, fillers and primers, documentation including printed statement of VOC contents, comply with limits specified in Section 01 6116.

E. Submit "Letter of Conformance" in accordance with Section 01 3300 with the following supporting data:
1. Product Data: For each type of flagpole required. Include installation instructions.
2. Shop Drawings: Show general layout, jointing, grounding method, and anchoring and supporting systems. Include details of foundation system for ground-set poles.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain each flagpole as a complete unit from a single manufacturer, including fittings, accessories, bases, and anchorage devices.

B. Certify that pole will withstand 90 mph winds with 8 -feet by 12 -feet flag.

C. Design Data:
1. The engineering design of the flagpole foundation is the manufacturer's responsibility. Submit design analysis calculations.
2. Shop drawings and calculations shall be signed and stamped by a structural engineer licensed in the state where project is located.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of Section 01 6000.

B. General: Spiral wrap flagpoles with heavy kraft paper or other weathertight wrapping and enclose in a hard fiber tube or other protective container.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Limits for adhesives sealants, fillers and primers. Comply with limits specified in Section 01 6116.

2.2 SYSTEM DESCRIPTION

A. Performance Requirements:
1. Structural Performance: Provide flagpoles capable of withstanding the effects of wind loads as determined according to the building code in effect for this Project or NAAMM FP 1001, "Guide Specifications for Design Loads of Metal Flagpoles," whichever is more stringent.
2. Base flagpole design on maximum standard-size flag suitable for use with pole or flag size indicated, whichever is more stringent.

2.3 MANUFACTURERS

A. Avendra, LLC Preferred Manufacturers:
   1. None

B. Approved Manufacturers:
   1. American Flagpole Company, www.americanflagpole.com (855-530-4078)
   2. ACME / Lingo Flagpole Co., www.acmelingo.com (800-260-1897)
   3. Baartol Co., Inc. (800-537-4143)
   4. Concord Industries, Inc. (800-527-3902)
   5. Eder Flagpole Co. (A Division of Eder Flag Manufacturing Company, Inc.). (800-558-6044)
   6. Ewing Flagpoles (716-833-3278)
   7. Michigan Flagpole, Inc., The Flagpole Co., www.michiganflagpole.com (800-805-9728)

2.4 FLAGPOLES

A. Outrigger wall mounted Flagpole:
   1. General:
      a. Pole Construction:
         1) General: Construct pole assemblies and ship to Project site in one piece, if possible. If more than one piece is necessary, provide snug-fitting precision joints with self-aligning, internal splicing sleeve arrangement for weathertight, hairline field joints.
         2) Provide building attached Outrigger Flagpoles in locations shown on drawings.
      b. Aluminum Flagpoles Construction: Fabricate from seamless, extruded tubing complying with ASTM B241 alloy 6063-T6, having a tensile strength not less than 30,000 psi with a yield point of 25, 000 psi. Heat treat after fabrication to comply with ASTM B597, temper T6.
         1) Provide cone-tapered aluminum flagpoles, per manufacturer's standard rate of taper.
   2. Assembly Construction:
      a. Type: External Single Stationary – Rope Halyard – Wall Mount.
      b. Mfgr: ACME / Lingo Flagpole Co., www.acmelingo.com(800-260-1897)
      c. Series: Outrigger
      d. Material: Aluminum
      e. Angle: 45 degree
      f. Catalog No: OSS8B4X
      g. Base: (Anchorage Style) 0104-45 degrees
      h. Pole:
         1) Material: Aluminum
         2) Sections: One (1)
         3) Overall Length: 8 –feet
         4) Butt diameter: 4 –inches
         5) Top diameter: 2 1/2 -inches

6) Wall thickness: 0.125 –inches

2.5 FITTINGS

A. Outrigger wall mounted Flagpole:
1. Finial Ball (Ornament):
a. Size: 4 –inch diameter - Manufacturer's standard flush-seam ball
b. Finish: Gold anodized.
2. External Halyard assembly:
a. Cast aluminum Stationary Truck, tapped for 1/2 -inch -13NC threads with stainless steel set screws and one (1) aluminum pulley
b. Halyard, #10 (5/16 –inch diameter) braided polypropylene rope.
c. 3/8 –inch – 16NC stainless steel eyebolt and swivel double pulley
3. Halyard Flag Snaps: Provide 2 stainless steel swivel snap hooks with neoprene covers per halyard.
4. Cleat: One 9 –inch cast aluminum with 1/4 -inch – 20NC flat head stainless steel self drilling screws.
a. Field installed
5. Attachment:
a. Wall anchorage kits, quantity for specific flagpole.
1) Stainless steel 3/4 -inch – 10NC x required length to secure through backing
2) Stainless steel sleeves to run fastener screw through.

2.6 FINISHES

A. General:
1. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.

B. Outrigger wall mounted Flagpole:
1. Powder Coated Finish: Thermo-set polyester Powder coated finish, with a minimum thickness of 1 1/2 mils. Application shall be in a closed loop automated powder coating system to insure uniformity and quality of finish.
a. Powder paint – Custom color as provided by Architect

C. Anodic finish for Finial (Ornament:
1. Gold: AA-M32C22A43 (Mechanical Finish: medium satin; Chemical finish; etched, medium matte, anodic Coating: Architectural Class 1, impregnated color coating 0.018 mm or thicker) complying with AAMMA 611: gold color.

2.7 FLAGS

A. Basis of Design:
   1. Mfgr: American Flagpole Company, www.americanflagpole.com or other meeting design requirements.
   2. Size: 3 –feet by 5 –feet
   3. Material: Nylon
   4. Quantity: One (1) each
   5. Flags:
      a. American Flag
      b. State of Arizona
      c. Marriott, Residence Inn
      d. Marriott, Courtyard

PART 3 - EXECUTION

3.1 PREPARATION

A. Outrigger wall mounted Flagpole
   1. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, including foundation; accurate placement, pattern, orientation of anchor bolts, and other conditions affecting performance of the Work.
   2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FLAGPOLE INSTALLATION

A. General: Install flagpoles where shown and according to Shop Drawings and manufacturer's written instructions.

B. Outrigger wall mounted Flagpole
   1. Install wall mounted bracket in desired location with stainless steel anchor bolts into wall structure.
      a. Shim outrigger base plate and adjust until plate is plumb.
   2. Place bracket cover onto flagpole shaft and slide shaft into the sleeve of the bracket.
      a. Secure with stainless steel set screws.
   3. Slide base cover into place over wall bracket and fasten with stainless steel set screws.
   4. Install sealant around aluminum base plate.

- END OF SECTION -

- SECTION 10 8213 -

EXTERIOR GRILLES AND SCREENS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Custom fabrication and erection of Fixed, steel framed Equipment Screen assembly with;
      a. Louver manufacturer's standard Equipment Screen assembly to be attached to structural steel posts and angles.

B. Refer to Section 05 1200 "Structural Steel" for structural framing supporting assembly.

1.3 RELATED REQUIRMENTS

A. Pertinent Sections specifying Volatile Organic Compound (VOC) Content Restrictions.

B. Section 01 6116 "Organic Volatile Compound (VOC) Restrictions".

C. Section 01 7419 "Cleaning and Construction Waste Management".

D. Section 01 8113 "Sustainable Design Requirements".

E. Section 05 0605 "Welded Stud Anchors".

F. Section 05 0810 "Galvanized Finishes on Steel" for galvanized finish and repair of galvanized treatment after fabrication".

G. Section 05 0900 "Anchors and Fasteners"

H. Section 05 1200 "Structural Steel".

I. Section 05 5000 "Metal Fabrications".

J. Section 07 5419 "Polyolefin-Chloride (PVC) Roofing".

K. Section 07 6213 "Sheet Metal Flashing for Moisture Protection".

L. Section 08 9000 "Louvers & Vents".

M. Section 09 9600 “High Performance Coatings” for preparation, priming with compatible products and finish paint coatings.

N. Pertinent Sections specifying sealants or referencing this Section for sealant products and Execution Requirements.

O. Pertinent sections specifying structural framing and blocking for support anchorage.

P. Pertinent sections specifying roofing and flashing systems requiring coordination for watertight and weatherproof installation.

Q. Pertinent sections specifying mechanical equipment.

1.4 REFERENCES

A. “Phoenix Building Construction Code”, International Building Code 2006, with City of Phoenix administrative provisions and amendments.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, demonstrate compliance with specified attributes.

B. Submit under provisions of Section 01 3300 “Submittal Procedures”.

C. Shop Drawings: For fabrications, assembly and accessories.
   1. Include plans, elevations, sections, and details of metal fabrications and their connections.
      a. Show anchorage and accessory items.
   2. Provide templates for anchors and bolts specified for installation under other Sections.
   3. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   4. Shop drawings shall indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
      a. Include erection drawings, elevation, and details where applicable.
      b. Indicate welded connections using standard AWS welding symbols. Indicate net weld lengths.
   5. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   6. Provide details and coordinate with all roof membrane penetrations.
   7. Provide details for all attachment to roof deck/structure.
   8. Show frame profiles and blade profiles, angles, and spacing.

D. Where installed metal fabrications are indicated to comply with certain design loadings, include structural computations, material properties, and other information needed for structural analysis that has been signed and sealed by the qualified professional engineer who was responsible for the preparation.

E. Samples: Following initial color selection, submit samples of selected metal color consisting of actual finish material applied to specified metal substrate.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

C. Research/Evaluation Reports: For post-installed anchors, from ICC-ES.

D. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

1.7 CLOSEOUT SUBMITTALS:

A. Submit under provisions of Section 01 7700.

B. Warranty: Submit specified warranty.

1.8 QUALITY ASSURANCE

A. Standards and References: (Latest Edition unless otherwise noted).

B. Building codes as herein listed and indicated in drawings.

C. American Society for Testing and Materials (ASTM) Specifications as listed in the Section.

D. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel".

E. Provide structural design calculations stamped by a structural engineer registered to practice in the state in which this project is located.

F. Welding Standards: Comply with AWS D1.1 “Structural Welding Code Steel”.

G. Qualifications:
   1. Structural Engineer Qualifications: Registered to practice in the state in which this project is located.
   2. Manufacturer Qualifications: Minimum five years experience in producing metal framed equipment screens.
   3. Welder Qualifications: Current AWS Certificates for welding processes required.

1.9 COORDINATION

A. Coordinate installation of anchorages for metal fabrications.
   1. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry.

2. Deliver such items to Project site in time for installation.

B. Coordinate installation of steel weld plates and angles for casting into concrete that are specified in this Section but required for work of another Section.
1. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry.
2. Deliver such items to Project site in time for installation.

1.10 DELIVERY, STORAGE AND HANDLING

A. Deliver all parts ready for erection; store in close proximity to final locations.

1.11 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.

1.12 WARRANTY

A. Special Warranty:
1. Contractor's Extended Warranty: two (2) years covering complete framing system installation.
2. Refer to Part 2 MATERIALS for other warranties.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Limits for adhesives sealants, fillers and primers. Comply with limits specified in Section 01 6116.

B. VOC Limits for all primers and coatings: Comply with limits specified in Section 01 6116.

C. Design: Design louvers, including comprehensive engineering analysis by a qualified engineer, using structural performance requirements and design criteria indicated.

D. Structural Performance: Assemblies shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of components, noise or metal fatigue or flutter, or permanent damage to fasteners and anchors.
1. Wind Loads: Determine loads based on a uniform pressure as indicated in structural drawings, but not less than of 25 lb./sq. ft. / 100 MPH equivalent, acting inward or outward.

E. Design: Design louvers, including comprehensive engineering analysis by a qualified engineer, using structural performance requirements and design criteria indicated.

2.2 MATERIALS - ROOF EQUIPMENT SCREEN

A. General:
1. Description:
a. Architectural steel framework Equipment Screen with Continuous Louvers.

B. Structure:
1. Structural Steel Assembly:
a. Components:
1) Columns: Refer to Drawings
a) Main: HSS, Tube Steel
b) Roof penetration: Structural Pipe (round)
2) Beams: Refer to Drawings
a) Horizontal framework HSS, Tube Steel,
3) Angles:
a) Refer to Drawings.
b) Steel angles secured to steel framework for attachment of Louver assembly.
4) Miscellaneous components:
a) Refer to Drawings.
b) Steel Plates
c) Steel Shims
b. Sizes: Refer to drawings and details
c. Fastening:
1) Steel Framework Assembly: Fully welded watertight
2) Secure to roof structure, refer to Drawings and Structural Drawings.
d. Finish:
1) Raw materials shall be Hot-dip galvanized.
2) All structural framework shall be shop primed and field touch up primed after assembly and field painted, refer to Section 09 9600 “High-Performance Coatings”
e. Color:
1) Match color of louvers unless indicated otherwise.
2. Wall panels – Louver Screen System:
a. Application: Louvers set within steel structure
b. Louvers:
1) Mfgr:
a) **AIROLITE**, www.airolite.com
2) Model: **ENCB609 Horizontal Screen Inverted Blade screen** assembly; or a comparable screen system product by one of the following:
a) Greenheck, EES-401 Horizontal Screen Inverted Blade, http://www.greenheck.com/products/category/5
b) Airstream Products Div., Penn Ventilator Co., Inc.
c) Arrow United Industries.
d) Construction Specialties, Inc. (C/S)

e) Reliable Metal Products.

f) Ruskin Mfg. Div., Phillips Industries, Inc.

3) Type: Horizontal Stationary Extruded Aluminum Screen with Inverted Blades and Hidden Mullions

4) Blade Type: Inverted horizontal blades spaced approximately 5 –inches o.c.

5) Blade material: 6063-T5 extruded aluminum

6) Blade Thickness:

a) As required to comply with structural performance requirements, but not less than 0.081 -inch for blades and 0.081 -inch for frames.

7) Screen louver depth: 4 -inch.

8) Mullions: None

9) Perimeter Frame: None

10) Support System: (Vertical)

a) Factory installed 2.25 –inch deep extruded aluminum “Z” supports that are mounted to rear of louver blades and full height of screen.

11) Support Angles: (Horizontal)

a) Factory installed 2 –inch by 2 –inch by 0.25 –inch by 2.5 –inch long aluminum clip angles secured to back of vertical “Z” supports for attachment to subframe structure.

12) Blade Support Brackets: Aluminum support brackets at attachment points of “Z” supports.

a) Aluminum stiffeners as required by Screen louver manufacturer.

13) Construction:

a) Extruded aluminum blades.

b) Mechanically secured horizontal clips to “Z” supports.

14) Fasteners:

a) 1/4 -inch by 1 –inch long 18-8 stainless steel hex head bolt, nut and washers in natural mill finish as installed by manufacturer to secure horizontal angle clips to “Z” supports.

b) #10 by 0.75 –inch long 18-8 stainless steel type AB Point, Torx Pan head SMS in natural mill finish as installed by manufacturer to secure closure components.

c. Finish / Color:

1) 2 – coat Factory 70% Kynar 500 / Hylar 5000 AAMA 2605 – Dry film thickness of 1.2mil. finish with ten (10) year finish warranty.

a) Custom color as proved by Architect

d. Screen Size:

1) Size to fit extent of screen assembly for continuous louver layout

e. Performance Requirements:

1) Free Area: Not less than 8.23 sq.ft. (51.4 percent) for 48-inch wide by 48-inch high louver.

2) Class rating: A

f. Options / Accessories:

1) Factory fabricated miter for outside corners**.**

2) Jamb closure welded to blades for exposed ends

3) Expansion closure between sections of screen

2.3 FABRICATION, GENERAL

A. Assemblies shall integrate with roofing systems where they penetrate.

B. Metal Surfaces, General:
1. Provide materials with smooth, flat surfaces, unless otherwise indicated.
2. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

C. Form metal fabrications from materials of size, thickness, and shapes indicated but not less than that needed to comply with performance requirements indicated.
1. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support.
2. Use type of materials indicated or specified for various components of each metal fabrication.

D. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

E. Allow for thermal movement resulting from the following maximum change (range) in ambient temperature in the design, fabrication, and installation of installed metal assemblies to prevent buckling, opening up of joints, and overstressing of welds and fasteners. Base design calculations on actual surface temperatures of metals due to both solar heat gain and nighttime sky heat loss.
1. Temperature Change (Range): 100 deg F.

F. Shop Assembly: Preassemble items in the shop to greatest extent possible.
1. Disassemble units only as necessary for shipping and handling limitations.
2. Use connections that maintain structural value of joined pieces.
3. Clearly mark units for reassembly and coordinated installation.

G. Cut, drill, and punch metals cleanly and accurately.
1. Remove burrs and ease edges to a radius of approximately 1/32 -inch (1 mm) unless otherwise indicated.
2. Remove sharp or rough areas on exposed surfaces.

H. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

I. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

J. Weld corners and seams continuously to comply with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
5. Watertight assembly.

K. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible.
1. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated.
2. Locate joints where least conspicuous.

L. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water.
1. Provide weep holes where water may accumulate.

M. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

N. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

O. Provide for anchorage of type indicated; coordinate with supporting structure.
1. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

P. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 –inch by 1-1/2 inches (3.2 mm by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 -inches (200 mm) from ends and corners of units and 24 -inches (600 mm) o.c., unless otherwise indicated.

Q. Shear and punch metals cleanly and accurately. Remove burrs.

R. Ease exposed edges to a radius of approximately 1/32 -inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

S. Provide for anchorage of type indicated; coordinate with supporting structure.
1. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

2.4 FERROUS MATERIALS

A. Refer to Section 05 5000 “Metal Fabrications” and as herein noted for steel and stainless steel

2.5 NONFERROUS METALS

A. Refer to Section 05 5000 “Metal Fabrications” and as herein noted for aluminum, bronze and nickel.

B. Aluminum Extrusions: ASTM B 221M, Alloy 6063-T5.

C. Aluminum Sheet: ASTM B 209M, Alloy 3003 with temper as required for forming.

D. Fasteners: Use types and sizes to suit unit installation conditions.
   1. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.

E. Trim: Same material and finish as louver panels; smooth surface, configuration as shown on Drawings.

2.6 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

D. Factory finish on components as herein specified.

E. Comply with Section 09 9600 “High-Performance Coatings”

2.7 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize all items to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
   1. Refer to Section 05 0810 “Galvanized Finishes on Steel”
   2. Refer additionally to Section 05 5000 “Metal Fabrications”
   3. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

2.8 FASTENERS

A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
   1. Provide stainless-steel fasteners for fastening wall panels into framing.
   2. Provide stainless-steel fasteners for fastening aluminum.
   3. Provide stainless-steel fasteners for fastening stainless steel.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593 (ASTM F 738M); with hex nuts, ASTM F 594 (ASTM F 836M); and, where indicated, flat washers; Alloy Group 2 (A4).

D. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
   1. Hot-dip galvanized or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

E. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

F. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

G. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
   1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
   2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

H. Eyebolts: ASTM A 489.

I. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).

J. Lag Screws: ASME B18.2.1 (ASME B18.2.3.8M).

K. Plain Washers: Round, ASME B18.22.1 (ASME B18.22M).

L. Lock Washers: Helical, spring type, ASME B18.21.1 (ASME B18.21.2M).

M. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 –inches by 7/8 -inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 -inches (75 mm) long at not more than 8 -inches (200 mm) o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.9 ROUGH HARDWARE

A. Furnish bent, or otherwise custom-fabricated, bolts, plates, anchors, hangers, dowels, and other miscellaneous steel and iron shapes as required for framing and supporting materials, and for anchoring or securing to concrete or other structures.

B. Fabricate items to sizes, shapes, and dimensions required.

2.10 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Galvanizing: Hot-dip process ASTM A123 typical and ASTM A153 for threaded fasteners performed after fabrication into largest practical section. Weight of coating not less than 2 oz. per sq. ft. of surface.

C. Zinc Repair Solder: For hot zinc galvanizing repair.
   1. Refer to Section 05 0810 “Galvanized Finishes on Steel”

D. Where galvanizing is damaged, repair surface with one coat of Galvanizing Repair Paint:
   1. Refer to Section 05 0810 “Galvanized Finishes on Steel”

E. Cold applied / site touch up Paint:
   1. Refer to Section 05 0810 “Galvanized Finishes on Steel”

F. Cold applied / site touch up Primer for galvanized finishes to be field painted:
   1. Refer to Section 05 0810 “Galvanized Finishes on Steel”

G. Primer: A “shop or field” compliant rust inhibitive primer/finish for painting of ferrous metal, structural and miscellaneous steel for interior dry exposure. Also suitable over galvanized steel and organic zinc-rich coatings in wet exposures. A water-borne equivalent to “Standard Alkyd Shop Primer”.
   1. Surface Preparation: SP3 Power Tool Cleaning. Where jobsite exposure is expected to exceed 6 months, SSPC–SP6 Commercial Blast Cleaning is required.
   2. Material: Refer to Section 09 9600 “High-Performance Coatings”

H. Dissimilar Materials: Separate dissimilar surfaces in contact with or in close proximity to non-compatible metals, concrete masonry, or plaster with neoprene gasket; or other approved means.

I. Expansion Bolts: Hilti "Kwik Bolt III" Expansion Anchor Bolts, galvanized unless otherwise indicated.

J. Non-shrink Grout: Master builders 928 or equal.

K. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

L. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

M. Nonshrink, Metallic Grout: Factory-packaged, ferrous-aggregate grout complying with ASTM C 1107, specifically recommended by manufacturer for heavy-duty loading applications.

N. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

O. Concrete: Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates upon which work will be installed. Verify that support blocking is in proper location. Coordinate screen locations to avoid conflict with locations or service clearances of mechanical units provided by other sections

B. Coordinate with responsible entity to perform corrective work on unsatisfactory substrates.

C. Commencement of work by installer is acceptance of substrate.

3.2 INSTALLATION

A. Protect roof membrane from damage during erection of screens.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications.
   1. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

C. Fit exposed connections accurately together to form hairline joints.
   1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
   2. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

D. Field Welding: Comply with the following requirements:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

E. Fastening to In-Place Construction:
   1. Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction.
   2. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

F. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

G. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
   1. Touch up galvanized surfaces which will be left exposed.

2. Touch up galvanized surfaces which will be painted after confirmation on repair paint compatibility.
   a. Refer to Section 09 9600 “High Performance Coatings”.

H. Follow manufacturer’s instructions for installing components where applicable.

I. Locate and place equipment screens level, plumb, and at indicated alignment with adjacent work.

J. Use concealed anchorages where possible.
1. Provide stainless steel washers fitted to screws where required to protect metal surfaces and to make a weather-tight connection.

K. Do not obstruct required service clearances to mechanical equipment.

L. Base clearance above roof: 12 –inches unless indicated otherwise in drawings
1. Coordinate with shop drawings.

M. Repair damaged finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory and refinish entire unit or provide new units.

N. Erection Tolerances:
1. Vertical Face of Panel: 1/4 -inch maximum in 10 -feet (6 mm maximum in 3 mm) variation from designated angle.
2. Horizontal Top Line of Panel: Level within 1/4 -inch maximum in 10 -feet (6 mm maximum in 3 mm).

O. Louvers:
1. Refer to Drawings.
2. Install in accordance with louver manufacturers recommendations.
3. Install with stainless steel fasteners.

- END OF SECTION -

DIVISION 11 – EQUIPMENT

TABLE OF CONTENTS

- SECTION 11 2300 -

COMMERCIAL LAUNDRY AND DRY CLEANINGING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Included: The extent of Commercial Laundry and Dry Cleaning Equipment work is shown on the drawing.

B. Refer to Appendix D for Laundry Equipment Cut Sheets.

1.3 RELATED REQUIREMENTS / WORK

A. Refer to other sections of the project specifications for mechanical and electrical services and for the connection of foodservice equipment to mechanical and electrical systems.

B. Mechanical and Electrical Work: Refer to Division 22 and Division 26 sections of the project specifications for mechanical and electrical services and for the connection of equipment to mechanical and electrical systems. Except as otherwise indicated, and except for work integral with fabricated items of equipment, the work covered by this section does not include ductwork, external piping and vents including concealed drains and traps, and electrical work including conduit, wiring, switches, disconnects, electrical devices and general lighting.

C. Plumbing Work: Where plumbing trim and fittings including faucets, drains, vacuum breakers, quick-disconnect assemblies and valves are indicated as part of equipment items, such trim or fittings shall be furnished under this section for installation under Division 22 sections

D. “Phoenix Building Construction Code”, International Building Code 2006, with City of Phoenix administrative provisions and amendments.

1.4 SUBMITTALS

A. Shop Drawings and Connection Plans: Submit two sets of all shop drawings and connection plans for approval. After approval, furnish Cad files, and up to seven sets of corrected shop drawings and connection plans for distribution to the various trades on the project.

B. Shop Drawings of custom-fabricated items of equipment sections and details and shall include all dimensions, details of construction, details of reinforcement, details and locations of wall backing, built-in components and accessories, and details of installation and relation of the equipment to adjoining and related work which requires cutting or close fitting. Show elevations and layouts at 1/2 -inch scale, sections at 1-1/2 -inch scale, and details at 3 -inch scale.

C. Connection plans shall show roughing-in and mechanical services required for each item of equipment. Show roughing-in layouts at 1/4 -inch scale. Show all mechanical roughing-in including sleeves and conduits for electrical, water, gas, steam, refrigeration, ventilation, condensate drain lines, air supply and exhaust connections, with complete characteristics (voltage, phase, size, gpm, cfm, static pressure, etc.), for each item of equipment included under this section, whether furnished under this section or furnished by Owner; characteristics of all Owner furnished equipment shall be verified by the Owner. All rough-in points shall be fully dimensioned and shall make allow-rough-in points shall be fully dimensioned and shall make allowances for traps, switches and other final connection requirements.

D. Connection plans shall also include electrical convenience outlets and floor drains which occur in areas to insure proper coordination.

E. Operation and Maintenance Manuals: Furnish two sets of all operating and maintenance manual, including parts lists and recommended spare parts lists, covering each item of mechanically operated equipment furnished under this section, each set being neatly bound in a hardback loose-leaf binder. Include in each manual a list of authorized service agencies, with addresses and telephone numbers, for all items of standard manufacture equipment including built-in components of custom-fabricated equipment.

1.5 QUALITY ASSURANCE

A. Work covered by this section shall be performed by skilled mechanics who regularly engage and specialize in work of the character required by this section and who have successfully installed projects of size and quality comparable to this and who have a minimum of 5 years of experience in similar work.

B. Standard of Quality: Standard equipment made on a production basis is specified here in by manufacturer and catalog number and establishes the "standard of quality" required by these specifications.

C. NSF Standards: Comply with the National Sanitation Foundation standards and criteria which are applicable to each item of equipment. Except as otherwise indicated provide NSF "Seal of Approval" label on all manufactured items and on major items of shop-fabricated equipment.

D. UL Standards: Except as otherwise indicated, provide electrical components and component assemblies for each item of equipment which bear either "recognized markings" as indicated in UL Listings of the "Recognized Component Index", or a UL Label, to show compliance with UL Standards as applicable.

E. Requirements of Regulatory Agencies: Obtain all necessary permits and licenses required and necessary for the performance of the work included in this section. Post all notices required by law and comply with all laws, ordinances and regulations bearing on the conduct of the work required under this section. Obtain inspection certificate on any work upon which an inspection certificate by local authorities, National Board of Fire Underwriters or any other governing body is required.

1.6 WARRANTY

A. Guarantee all new equipment covered under this section, including materials, parts, and workmanship, against inadequate performance and defects for a period of one (1) calendar year after final acceptance of the work. Repair or replace free of charge any work, equipment, parts, materials and workmanship which becomes defective during the guarantee period except to the extent it has been subjected to abuse, misuse, or accidental damage.

B. Provide written guarantee signed by the contractor and installer, and all manufacturer's standard guarantees, neatly bound in a hardback binder.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless steel shall be AISI Type 302/304 stainless steel (ASTM A-167) of the hardest annealed temper which can be properly fabricated, and with No. 4 directional polish on exposed side and No. 2 finish on unexposed side.

B. Stainless steel tubing shall be seamless or welded of gauge specified and of true roundness. Seamless tubing shall be thoroughly and correctly annealed, picked and ground smooth. Welded tubing shall be thoroughly heat treated, properly quenched to eliminate precipitation, drawn true to size and roundness and polished to match stainless steel sheets.

C. Steel structural members used for framing shall be hot rolled or cold formed steel members of the shapes, sizes and weights indicated, carbon steel unless stainless steel is indicated.

D. Where galvanized finish is indicated, provide members with hot-dipped zinc coating complying with ASTM A-123, applied after fabrication.

E. Copper tubing shall be type L, conforming to ASTM B-88, with brazed or solder-joint copper, brass or bronze fittings conforming to ANSI B16.18 or B16.22.

2.2 MATERIALS

A. Sealants: Provide liquid elastomeric sealants complying with either FS TT-S-00227E for self-curing 2-component sealant or FS-TT-S00230C for moisture-curing single component sealant; non sag grade for vertical joints, mildew resistant, non-solvent release, rapid-cure (not more than 7 days at 50 percent relative humidity for full-cure 1/4" deep sealant bead); of the type which forms a smooth tight-skinned surface promptly after placing, and cures to a Shore A hardness of not less than 45 for joints subject to foot traffic, 30 for other joints.

B. Sealant Backer Rod: Compressible polyethylene rod stock; sized larger than joint width to provide a firm convex base for placement of sealants.

C. Gaskets: Provide solid or hollow (but not cellular) molded units of neoprene or polyvinyl chloride; light gray, not less than 40 Shore A hardness, shaped to match joints including sanitary "T" shape for horizontal joints, either self-adhesive or suitable for adhesive application, or prepared for mechanical anchorage.

D. Sound-deadening: Heavy-bodied resinous coasting, filled with granulated cork or other resilient material, compounded for permanent, non-flaking adhesion to metal in a 1/8" thick coating.

E. Electrical Materials: Provide standard materials, devices and components are recommended by the manufacturer/fabricator, selected and installed in accordance with NEMA Standards and recommendations; and as required for safe and efficient use and operation of the equipment, without objectionable noise, vibration and sanitation problems.

F. Controls and Signals: Provide recognized commercial grade signals, "on-off" push buttons or switches, and other speed and temperature controls as required for operation of each item, complete with pilot lights and permanent signs and graphics to assist the user of each item. Provide stainless steel cover plates at controls and signals.

G. Power characteristics: Refer to Division 26 specifications for project power characteristics. Also, refer to individual equipment requirements for loads and ratings.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Check all dimensions at the jobsite which will affect and govern fabrication of equipment, including means of ingress and delivery into the building.

B. Rough-in Work: The installer of equipment must examine the rough-in mechanical and electrical services by others, and the installation of floors, walls, columns and ceilings by others, and conditions under which the work is to be done; and must verify dimensions of the services and substrates before fabricating the work. Notify the Contractor in writing of unsatisfactory locations and dimensions of other work and of unsatisfactory conditions for the proper installation of equipment. Do not proceed with the fabrication and installation until unsatisfactory dimensions and conditions have been corrected in a manner acceptable to the Installer.

3.2 INSTALLATION

A. Supervision: The installer of the equipment shall provide a competent foreman or supervisor who shall remain on the job during the entire time of the installation of equipment covered by the section. Foreman or supervisor shall meet with and work in close harmony with other trades with regard to connections and installation.

B. Service Line and Equipment Connection:
   1. Refer to Division 22 Sections for piping connections and piping systems.
   2. Refer to Division 26 Sections for electrical work including equipment connections.

C. Mechanical work specifically included under this section shall be done in strict accordance with other sections of the specifications which set forth standards for this type of work.

D. Setting the Equipment: Uncrate, assemble, level and repair any damaged or abraded surfaces. Set each item of non-mobile and non-portable equipment, including custom-fabricated items, in its final location, permitting the various trades to take necessary measurements for connection of the service lines; move the equipment sufficiently to permit the installation of such service lines, after which the equipment shall be realigned level and plumb with final erection as shown on the

drawings. Anchor to supporting substrate where indicated and where required for sustained operation use without shifting or dislocation.

E. Complete field assembly joints in the work (joints which cannot be completed in the shop) by welding, bolting and gasketing, or similar methods as indicated. Grind welds smooth and restore finish.

F. Treat enclosed spaces (inaccessible after equipment installation) by covering horizontal surfaces with powered borax at a rate of 4 ounces per square foot.

G. Install closure plates and trim strips where required, with joints coordinated with units of equipment. Trim is not an acceptable substitute for accuracy and neatness, and when trim is required and acceptable in lieu of rejection of items of equipment, it is the equipment Installer's responsibility to provide the same at no extra cost. Where trim is required, it shall be installed in an approved manner with concealed fasteners.

H. Install sealants and gaskets all around each unit to make joints airtight, waterproof, vermin-proof and sanitary for cleaning purposes. In general, make sealed joints not less than 1/8 -inch wide, and stuff with baker rod to shape sealant bead properly, at 1 –foot 4 -inch depth. Shape exposed surfaces of sealant or gaskets to form a sanitary cove of not less than 3/8 -inch radius, with edges flush with faces of materials at joints. Provide sealant-filled or gasketed joints up to 3/4 -inch wide, metal closure strips for wide joints, with sealant application each side of strips. Anchor gaskets mechanically or with adhesive to prevent displacement.

I. Keep the premises free from the accumulation of waste materials and rubbish associated with this work, and at the completion of the work remove all rubbish and implements, leaving the area broom clean.

J. Provide and maintain coverings and other approved protection for the finished surfaces and other parts of equipment subject to damage during the work and after erection. After completion of installation, and completion of other major work in food service areas, remove protective coverings, if any, and clean food service equipment, internally and externally. Restore exposed and semi-exposed finishes to remove abrasions and other damages; polish exposed metal surfaces; touchup painted surfaces. Replace work which cannot be successfully restored.

3.3 TESTING, STARTUP AND INSTRUCTIONS

A. Test each item of operational equipment to demonstrate that it is operating properly, and that controls and safety devices are functioning. Repair or replace equipment which is found to be defective in its operation, including units which are below capacity or operating with excessive noise or vibration.

B. Instruct Owner's operating personnel in the proper operation and maintenance procedures for each item of operational equipment. Demonstrations shall be by authorized representatives of the manufacturers and shall be scheduled to permit adequate time by each representative to thoroughly indoctrinate the owner's operating personnel at each item of equipment.

C. Final Cleaning: After testing and startup and before the time of substantial completion, clean and equipment, and leave ready for

3.4 LAUNDRY EQUIPMENT SCHEDULE

A. Provide and/or install the following items of Commercial Laundry and Dry Cleaning Equipment, complete in every respect, including testing and demonstration, as indicated on the drawings and as specified herein and in accordance with the requirements specified hereinbefore to the extent said requirements apply thereto.

1. Refer to the drawings and schedules for quantities, locations and contract status of equipment covered by this section.
2. Refer to Appendix D.

ITEM NO 0-001 LINT EXTRACTOR, LAUNDRY

Quantity Req'd.: 1
Manufacturer: Energenics
Model No.: AF-7

The dryer exhaust shall be equipped with an automatically cleaned, one stage dry lint filter with the following capacity and construction:

1. The filter shall be sized to clean *insert model cfm rating cfm exhaust air with a measured resistance of no more than .3" W.C. at anytime during the dryer cycle.

2. The body of the filter shall be constructed of Class A fire retardant fiberglass meeting U.S. Navy QPL 21607, Grades 1 and 2, Class A with an ultraviolet protective coating.

3. The Filter media shall be a high temperature polyester monofilament fabric capable of removing 98% of all particles larger than 160 microns, collecting over 98% of the lint (by weight).

4. The lint filter shall have the ability to automatically release lint from the screen by gravity and deposit into a storage bag for easy disposal

5. The Lint Filter shall have no control interconnection to the dryer resulting in 100% independent operation from the dryer.

6. The lint filter shall be completely without electrical utility connection thus allowing full operation without utilities.

7. Popular Options: Fusible link spray head for fire suppression, and Side Discharge for horizontal exhaust.

ITEM NO 0-002 TRASH RECEPTACLE

Quantity Req'd.: 1
Manufacturer: Rubbermaid
Model No.: 2632

Waste Receptacle, general purpose waste, with lid, approximately 30-gallon capacity, high-impact rubber construction.

ITEM NO 0-003 SHELVING UNIT

Quantity Req'd.: 1 LOT
Manufacturer: Metro Equipment Corporation
Model No.: Super Erecta Chrome

Sizes as shown on drawings joined with “S” hooks where possible

Provide unit with the following:

- Tubular shelves with load capacity of 1500 lbs.
- 72" high.
- Four tiers high.

ITEM NO 0-004 HEATED ROLL IRONER

Quantity Req'd.: 1
Manufacturer: Unimac
Model No.: UD20F098G

Heated Roll Flatwork Finisher, 20" Diameter Roll x 98" Finishing Width, Front Return, Gas Heated, 208/60/1.

ITEM NO 0-005 LAUNDRY BASKET

Quantity Req'd.: 11
Manufacturer: Luxor
Model No.: H12

ITEM NO 0-006 FOLDING TABLE

Quantity Req'd.: 3
Manufacturer: Custom Fabricated Assembly
Model No.: Custom Stainless

Work Table, Open Base,14 gage stainless steel top with square turn down edges, 30" wide top, without splash, 60" long, pipe frame base, w/fixed s/s undershelves, stainless steel frame, on 5” casters

ITEM NO 0-007 UTILITY SINK

Quantity Req'd.: 1
Manufacturer: Custom Fabricated Assembly
Model No.: Custom Stainless

14 gage stainless steel .Size as shown on drawing, 14” deep sink tubs, complete with faucet and 3 ½” basket drains.

ITEM NO 0-008 EYE WASH STATION

Quantity Req'd.: 1
Manufacturer: Speakman
Model No.: SE 582

ITEM NO 0-009 WASHER-EXTRACTOR

Quantity Req'd.: 3
Manufacturer: Unimac
Model No.: UX100 PV

UniMac 100# Soft mount Washer; 480/60/3; 300 G-force; Inverter Driven Motor; 41 Cycle Programmable Microprocessor, Graphic Display with Words and Icons, Dual Drains; Through the Door Spray Rinse.

ITEM NO 0-012 FLOOR DRAIN GRATE

Quantity Req'd.: 1
Manufacturer: Built into concrete slab w/ “Chemgrate” removable grate
Model No.: Custom-Built in by G.C.

See detail.

ITEM NO 0-015 TUMBLER-DRYER, LAUNDRY

Quantity Req'd.: 4
Manufacturer: Unimac
Model No.: UT120RUF6
UniMac 120# Tumbler; Natural Gas Heat, 200-208/240/60/3; UniLinc 41 Cycle Programmable Control, Graphic Display, Reversing Cylinder. OPTidry included at no additional cost. OPTidry overdry

ITEM NO 4-216 WASHER, COIN OP

Quantity Req'd.: 4
Manufacturer: Speed
Model No.: SFNBCFSP112TW01

Vended Frontload ADA Washer: Front Controls, MDC Control, 6 Speed, Stainless Steel 120/60/1. Coin Box & Key Kit Required (CK042) {Formerly SWFT71WN}.

ITEM NO 4-217 DRYER,STACKED, COIN OP

Quantity Req'd.: 4
Manufacturer: Speed
Model No.: SSGT09WF

Vended Stack Gas Heat Dryers {2 Cylinders}, 120/60/1, MDC Control, Galvanized Cylinders, Solid Door. Requires 2 Coin Box & Key Kits

ITEM NO 4-218 FOLDING COUNTER

Quantity Req'd.: 2
Manufacturer: Custom Fabricated Assembly
Model No.: Custom-Millwork

Size as shown on drawing constructed with marine plywood and covered with LP. Provide with intermediate shelves and locking doors. Verify color with Interior Designer.

ITEM NO 4-219 TRASH RECEPTACLE

Quantity Req'd.: 1
Manufacturer: Rubbermaid
Model No.: 2632
Waste Receptacle, general purpose waste, with lid, approximately 30-gallon capacity, high-impact rubber construction.

3.5 ADJUSTING

A. Adjust equipment and apparatus to ensure proper working order and conditions.

B. Remove and replace equipment creating excessive noise or vibration.

3.6 CLEANING

A. Remove masking or protective covering from stainless steel and other finished surfaces.

B. Wash and clean equipment.

C. Polish glass, plastic, hardware, accessories, fixtures, and fittings.

- END OF SECTION -

- SECTION 11 24 23 -

WINDOW CLEANING EQUIPMENT

EXTERIOR BUILDING MAINTENANCE (EBM) EQUIPMENT

FAÇADE ACCESS EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. These performance specifications shall be read in conjunction with the 100% Façade Access Design Development drawings, revision 5, dated 02/28/2014, that are part of the construction documentation for this trade package, specifically sheets with “FA” prefix.

B. Provide all design, engineering, materials, manufacturing and installation labor required to deliver a complete EBM and Façade Access system necessary to provide access to all façade elements outlined on the Façade Access drawings. This project will result in an overall system complete with the following equipment and professional documentation:

1. 5^{TH} FLOOR ROOF LEVEL –

    a. FIXED EQUIPMENT

        1. One (1) - Horizontal Life Line System(s)

2. ROOF LEVEL –

    a. FIXED EQUIPMENT

        1. Twenty-Two (22) – Davit Pedestals

    b. PORTABLE EQUIPMENT

        1. Two (2) - Davits – High Profile
        2. Two (2) - Portable Sockets
        3. One (1) - Powered Platform (Modular with 2 Powered Baskets)

3. BUILDING FAÇADE EQUIPMENT

    a. FIXED EQUIPMENT

1. One Hundred and Fifty Six (156) - Intermittent Stabilization Anchors (ISA)

4. DOCUMENTATION

    a. Original Equipment Manufacturer (OEM) Operations and Maintenance (O&M) Manuals
    b. Demonstration of equipment

1.2 WORK EXCLUDED

A. The following are regulatory and operational project requirements not included in this section:
    1. Guardrail systems.
    2. Fixed ladders and other related access equipment.
    3. Electronic two-way communication devices.
    4. Electrical power receptacles and wiring as identified on drawings.
    5. Water supply hose bibs as identified on drawings.
    6. Waterproofing, flashings, etc.
    7. Reinforcing of the building structure.
    8. Operating Procedures Outline Sheet (OPOS).

1.3 RELATED SECTIONS

A. Division 1 General Requirements
B. Division 3 Concrete
C. Division 5 Metals

1.4 REGULATORY COMPLIANCE

A. All design, engineering, materials, equipment, system performance, inspection and testing, use and written work product to comply with and be performed in compliance with the following applicable regulatory codes and standards. Special consideration shall be given to procuring the most recent revision of said codes and standards. This is in addition to any other pertinent local, state and federal requirements having jurisdiction. Any conflicting codes or standards affecting this work shall be presented to the Project Consultant for determination and course of action.

    1. ANSI / IWCA I-14.1 Window Cleaning Safety Standard
    2. Federal Occupational Safety and Health Act (OSHA): OSHA Part 1910, paragraph 1910.66 “Power Platforms for Building Maintenance.”
    3. American Society of Mechanical Engineers ASME/ANSI A120.1 “Safety Requirements for Powered Platforms for Building Maintenance”
    4. American Institute of Steel Construction (AISC): AISC “Load and Resistance Factor Design Specification for Structural Steel Buildings”
    5. American Welding Society (AWS): D1.1 “Structural Welding Code, Steel”

1.5 SUBMITTALS

A. Prior to fabricating and construction, submit the following to the General Contractor for review and approval:

    1. Equipment/Materials List: Complete equipment and materials listing, with quantities) of all items proposed for this project.

2. Product Data: Manufacturer specifications and product data sheets of all standard or typical components proposed. The compliance with paragraph 1.4 of this specification is to be clearly noted on all manufacturer specifications and product data sheets.
3. Shop Drawings: Scaled shop drawings showing the layout, details, sections, rigging procedure, drop sequence and related operating procedures. The following shall be included in the shop drawings:
    a. Consideration of any potential physical and operational conflicts with the architectural design elements and with all other division trade work installations and systems as well as proposed resolution/coordination of such conflicts.
    b. Equipment layout plan, elevations, details and sections which clearly illustrate the equipment installation location and methods as well as the rigging procedures and drop sequence that demonstrate an operation system without conflicts with current project conditions, façade elements, site work, etc.
    c. Identification of all equipment component materials, dimensions, sizes, arrangements, thicknesses, finishes, and other data to clearly illustrate the equipment being installed.
    d. Required load capacities of the building structure to which all equipment installations are proposed are to be clearly illustrated for consideration and review of the overall project Structural Engineer.
    e. Identification of “other trade” work designations including but not limited to electrical power requirements and locations of receptacle and water supply hose bib locations.
    f. Professional Engineer wet stamp and signature by a Professional Engineer with a minimum of 5 years of experience in designing window cleaning and related façade access equipment and licensed/registered in the state where the Project is located.
4. Structural Calculations: To be executed on all equipment and components for this Project by a Professional Engineer licensed/registered in the state where the Project is located. The Professional Engineer must have a minimum of 5 years of experience in designing window cleaning and related façade access equipment.
5. Welding Certification: Demonstrating that all field and shop welding complies with the AWS D1.1 and performed by AWS Certified Welder.

B. After fabrication and construction, submit the following to the General Contractor for review and approval:

1. Test results from all Inspections and Tests conducted per paragraph 3.3.
2. Equipment Warranty: Three (3) copies
3. Operation and Maintenance Manual: Three (3) copies, labeled, bound and neatly illustrated documenting the operation and maintenance of the “specific” equipment installed on this Project. Minimum manual requirements are as follows:
    a. Table of Contents
    b. Manufacturer
    c. Equipment Inventory complete with location and serial numbers.
    d. Warnings and Notices.
    e. Illustration of Labels and Notices affixed to permanent and portable equipment.
    f. Inspection Check List (Periodic and Maintenance Inspections).
    g. Inspection Log (Periodic, Maintenance, Daily).
    h. Maintenance procedures.
    i. Operating procedures.
    j. Troubleshooting.
    k. Rescue Plan.
    l. Rigging Access Plan.
    m. Warranty in triplicate.
4. Certificate of Regulation Compliance

1.6 QUALITY ASSURANCE

A. Engineer Qualifications: Registered Professional Engineer licensed to practice in the jurisdiction where the Project is located possessing a minimum of 5 years experience in designing window cleaning and related façade access equipment.
B. Manufacturer Qualifications: Manufacturer's primary trade is the design and manufacturing of window cleaning and related façade access equipment and has been actively engaged in this business for not less than 10 years.
C. Contractor/Installer Qualifications: Installer is required to be employed by manufacturer or provide written approval from manufacturer to install its products.
D. Welder Qualifications: AWS certified within the last 12 months for each type of weld required.
E. Regulatory Compliance: Refer to paragraph 1.4

1.7 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements in Section 01 60 00.
B. Deliver all equipment and material to the project properly packaged according to the manufacturer's packaging requirements in sizes as large as practical.
C. Store materials under cover in a dry and clean location off the ground.
D. Damaged or faulty equipment or materials are to be removed from the project and replaced with acceptable equipment or materials.

1.8 WARRANTY

A. Provide Manufacturer's Warranty for a period of three (3) year(s) to cover the following:

1. Material defects.
2. Workmanship.
3. Installation (self performed)
4. Installation (by other trades)
5. Certification clause of adherence to paragraph 1.4 (Regulatory Compliance)

B. Warranty to be submitted on original certificated document. Three (3) originals to contain wet signatures by the authorizing party.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Equipment Manufacturers:

1. Sky-Rider Equipment Company, Inc.
   1181 N. Blue Gum Street
   Anaheim, CA 92806
   (714) 632-6890; Contact: Martin Villegas (714) 412-6231 (cell) - martin@sky-rider.com

2. Tractel Ltd. – Swingstage Division
   1615 Warden Avenue
   Toronto, Ontario, CANADA M1R 2T3
   (800) 465-4738; Contact: Allen Kanarek (626) 893-2873 (cell) - allen@tractelswingstage.com

3. Skymaster Inc.

17837 Maclaren St.
City of Industry, CA 91744
(626) 913-8125; Contact: Ray Dominice – skymasterinc@verizon.net

4. Spider, a division of SafeWorks, LLC
   365 Upland Drive
   Seattle, WA 98188
   (877) 774-3370;

5. XS Platforms, North America
   30 Bellarmine Ct.
   Chico, CA 95928
   (530) 343-1400; Contact: Phil Shumway – philshumway@xsplatforms.com

6. Or equivalent. NOTE: Strict adherence to paragraph 1.6 above will be required of any proposed equivalent manufacturer.

2.2 CONTRACTORS / INSTALLERS

A. Contractor / Installer Qualifications:

1. California Projects: All equipment is to be installed by a manufacturer or contractor possessing a current and valid Scaffold Inspection and Testing Agency (SIT) designation by the California Department of Industrial Relations, Division of Occupational Safety and Health.
2. Installer is required to be employed by manufacturer or provide written approval from manufacturer to install its products and have a minimum of 5 years experience in the installation of this and related equipment.

2.3 DESIGN REQUIREMENTS

A. The complete Building Maintenance Equipment system including individual components and overall functionality is to be designed by or under the direction of a Professional Engineer registered in the state where the project is located. Duties and responsibilities include verification that all components supplied comply with the applicable portions of paragraph 1.4 above.

B. In addition to compliance with the design requirements of the various regulatory standards cited in paragraph 1.4, special attention shall be given to the following:

1. All loads transferred to the building structure by the equipment in this section are to be clearly called out on the drawings and calculations and submitted for review to the overall Project Structural Engineer for review and consideration of any required additional reinforcing of the structure.
2. A minimum safety factor of four (4) is to be designed into all equipment in this section. Exceptions to this are the following:
   a. Wire Rope: the minimum safety factor shall be ten (10).
   b. Tie-Back Anchors: 5000 pound anchorage and assembly strength for loads applied in any direction without any permanent deflection.
   c. Horizontal / Catenary Lines: the minimum safety factor shall be two (2).
3. All parapets or building component upon which safety line are resting to be designed with consideration of the dynamic loading from the potential shock loading of a fall arrest incident.

2.4 COMPONENTS

A. Davit Pedestals: Furnish and install the appropriate number of pedestal assemblies for each type of portable socket assembly required by the application at the specific roof level and elevation that are designed, engineered and fabricated to the standards and regulations cited in this specification including but not limited to the following:

1. Pedestals shall be designed, fabricated and installed with the top plate level and plumb.
2. The distance of the davit pedestal to the finished roof shall be no less than 4" and no more than 10". Consideration shall be given to the sloping of the roofing system.

B. Horizontal Life Line: Furnish and install horizontal life lines that are intended to provide continuous tie off fall protection. The system must be designed, engineered and fabricated to the standards and regulations cited in this specification including but not limited to the following:

1. The horizontal life line must be designed to support two times the intended load while taking into account the auxiliary load on all points of attachment.

C. Davits – High Profile: Furnish and install the appropriate davit system for the application required at the specific roof level and elevation that are designed, engineered and fabricated to the standards and regulations cited in this specification including but not limited to the following:

1. The overall length of the boom section shall not be more than that required to position the centerline of the wire rope hang point at no more 24" from the outer most face of the building façade elements and/or as limited or shown in the Façade Access drawings.
2. All davits shall be provided with a rating plate bearing the manufacturer's name, a high voltage warning prohibiting use near power lines, the davit's rated load, and the davit's total assembled weight.
3. All davits specified shall be designed with either top rotation or bottom rotation mechanisms to allow for the easy roof docking of the suspended platform or work basket where applicable.
4. The maximum allowable horizontal force required to initiate rotating movement while the work platform/basket is suspended shall be no more than 40 pounds.
5. All davits specified for roof rigging shall be provided with a permanent lever mechanism to allow work platform occupants to easily rotate the davit required in roof rigging.
6. Any davit component weighing more than 80 pounds shall be provided with a means to transport the component from location to location. Such means shall maintain the center of gravity required to prevent the component from overturning during transport
7. Any complete davit assembly weighing more than 140 pounds shall be provided with a mechanical means to lift the davit into position.
8. All davits specified for roof rigging shall have the boom section of the davit accommodated with a suspension line trolley and positive locking mechanism required to position the suspension point at any point along at least half of the boom reach. Where applicable, a secondary hanger shall be provided for 2 line or F type platforms.
9. Suspension line trolleys locking mechanisms shall be designed to withstand the live loading of the work platform at the locking mechanism so as to prevent the load on the trolley from overcoming the locking mechanism in real world conditions.
10. All davits accommodated with suspension trolleys shall be designed with consideration of the absolute requirement to maintain a true and level boom at any point of the boom's rotating range while the under normal operating load.
11. All davits accommodated with rotating booms shall be provided with a boom rotation locking mechanism. This locking mechanism shall be of sufficient design to prevent the boom section from becoming unlocked during use. Special attention shall be given to spring actuated boom rotating locks.
12. All wheels used in transport assemblies incorporated into or provided with this equipment shall have solid rubber wheels. Pneumatic wheels will not be accepted.

D. Portable Sockets: Furnish and install the appropriate number of portable socket assemblies for each type of davit required by the application at the specific roof level and elevation that are designed, engineered and fabricated to the standards and regulations cited in this specification including but not limited to the following:

1. Portable sockets shall be designed to provide plumb davit working conditions.
2. All portable socket assemblies shall be provided with pivoting sockets that will allow the insertion or removal of a davit at a position of not more that 35 degrees above the horizontal roof.
3. The portable socket shall allow for the complete davit assembly to be inboard of the building face being served while being raised and lowered.
4. The portable socket assembly shall be provided with a means to positively lock the davit assembly to the socket assembly while in operation.
5. The portable socket assembly shall be provided with a means to positively lock this assembly to the permanent pedestal while in operation.
6. All portable socket assemblies shall be designed with wheels to allow ready movement from pedestal to pedestal.
7. All portable sockets shall not require lifting to mate with the pedestal. Consideration shall be given to the sloping of the roofing system.
8. All wheels used in transport assemblies incorporated into or provided with this equipment shall have solid rubber wheels. Pneumatic wheels will not be accepted.
9. Any safety line tieback anchors incorporated into the portable socket assembly shall engineered to provide a minimum of 5000# load capacity independently and as part of the overall davit, socket and pedestal assembly.

E. Power Platform: Furnish and assemble a power platform for the application required that serves each roof level and elevation that is designed, engineered and fabricated to the standards and regulations cited in this specification including but not limited to the following:

1. The power platform shall be F-Type with two wire ropes per hoist; equipped with a primary and secondary wire rope support system.
2. The 500-pound capacity stage, when assembled for two-davit support, shall be of "truss type" construction and shall be electrically powered as described below. With a requirement for a safe and efficient maintenance operation, the manufacturer shall determine a) the optimal stage length, depending upon the drop and rigging accessibility, and b) the potential need for modular construction, permitting the segmented platform to pass around roof obstacles.
3. The platform shall be electrically powered by 208V, “utilization rating”, 3-phase power and shall be suitable for operation on 30 amp. circuit breaker with twist-lock plugs for the power outlets. Electric cords that exceed 250 feet in length shall incorporate reinforced core cable.
4. The rated capacity of hoisting motors shall not exceed the capacity of its supporting davit.
5. Adjustable tie-in lanyards are required for each end of the stage. Each lanyard shall have a minimum capacity of 600 pounds in any outward direction.
6. Upper/tie-in lanyard, overload, and slack wire limits.
7. Lower obstruction mechanisms with electric interlock to halt downward travel of stage. Photo electric eyes are prohibited for use as the lower limit on modular platforms unless each module is equipped with its own pair of photo electric eyes. The obstruction, lower limit, system shall deploy and halt the downward travel when the platform encounters an irregular shaped object and/ or when it encounters a level lower surface such as a skylight.
8. Power cord collection bin mounted on the stage’s exterior.
9. Two de-mountable water containers, of 8 gallon cap., each constructed of fiberglass, stainless steel, UV rated polyethylene, or other equivalent material; and with provisions for attachment anywhere along the length of the stage's handrails.

10. Non-marking, non-scuffing, building face rollers (permitting the stage to maintain contact with building face), constructed of spongy polyurethane, 5 inch diameter, minimum, with sliding adjustable mountings to the stage for lateral adjustment.
11. Stowage tie downs for the stage.
12. Trolley line (dog line) affixed (at a height of 42 inches) to the stage's back rail and to the stage's structure. One double acting rope grab shall be attached to the dog line, for each occupant, to which a five-foot long energy-absorbing lanyard (by others) is attached as part of the fall arrest system.
13. All caster wheels shall be of a diameter large enough (6” minimum) to manually travel the platform with minimal effort across the roof pavers provided without getting stuck. Wheels shall be solid rubber. Pneumatic wheels will not be accepted.
14. Portable anemometer to be mounted on the work platform.
15. Fire extinguisher.
16. Each removable stage section shall be equipped with: wheels, handrail height "dog line", and pins that permit the sections to be quickly assembled into any of the required stage length combinations. All walking surfaces (decking) shall be slip proof, under wet & dry conditions.
17. Each operating station shall be provided with a means of interrupting the power supply to all hoist motors to stop any further powered ascent or descent of the platform.
18. Devices shall be included in the control system for the equipment that will provide protection against electrical overloads, three-phase reversal and phase failure. The control system shall have a separate method, independent of the direction control circuit, for breaking the power circuit in case of an emergency or malfunction.
19. Traction hoists shall provide a secondary wire rope system with automatic overspeed sensor and safety brake to stop and hold the platform if an overspeed condition is detected in the primary hoist rope. A primary, mechanical brake shall be applied automatically to the hoist motor shaft whenever power is not being conducted to the hoist motor. Application of power to the hoist motor shall automatically release this brake. A secondary, mechanical brake, acting directly on the hoist’s sheave or wire rope shall be automatically applied if the downward platform speed exceeds 140% of rated speed. A slack wire shutoff shall be provided to halt electrical power to the hoist motor is tension is removed from the support rope.
20. An automatic detector shall be provided for each suspension point that will interrupt power to all hoisting motors for travel in the "down" direction, and apply the primary brakes if any suspension wire rope becomes slack. A continuous-pressure rigging-bypass switch designed for use during rigging is permitted. This switch shall only be used during rigging.
21. Cables shall be protected against damage resulting from over-tensioning or from other causes.
22. Additionally, an independent hour meter shall be provided for each traction hoist, to record and display its time in operation, not plug in time.
23. The primary and secondary wire rope, constructed of 5/16 inch (minimum) diameter, drawn galvanized XXIPS, IWRC wire, compatible with the hoist and as recommended by the hoist manufacturer, shall be tagged and collected in stage mounted powered wire winders and they shall be protected from obstructions and damage in general, during all phases of the operation. The upper end of each wire rope shall be fitted with a forged hook and safety latch, eliminating the use of a shackle to connect the wire rope to the trolley.
24. Power Wire winders shall have torque limiting devises that spools cables independently from each other. The breaking surface of the torque limiting device shall bear on steel surfaces. Furnish a full-length waterproof stage cover of 16-ounce neoprene impregnated nylon with underside tie fittings at 5 feet (maximum) intervals. All seams shall be sealed with double stitched Dacron. The "reflective silver" colored cover, when installed shall fully envelop the stage with a snug fit.

F. Intermittent Stabilization Anchors (ISA): Furnish and install the appropriate number of ISA assemblies for each type of substrate required by the application at the specific elevation that are designed, engineered and fabricated to the standards and regulations cited in this specification.

PART 3 - EXECUTION

3.1 EXAMINATION

A. All affected and affecting work areas, installations, etc. shall be examined to ensure physical conditions and other related conditions are adequate for the subsequent installation.

B. Consideration of any potential physical and operational conflicts with the architectural design elements and with all other division trade work installations and systems shall be made as well as proposed resolution/coordination of such conflicts be developed.

3.2 INSTALLATION

A. All installations shall be performed in accordance with all original design drawings, shop drawings, approved submittals, manufacturer specifications and applicable regulatory governmental compliance.

B. Coordination with other division trade work installations is mandatory.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections: The following inspections and tests shall be conducted on components and installed equipment to ensure compliance with this specification and full operational functionality of the overall system. Any material, equipment functionality and operational deficiencies noted as a result of these inspections and tests shall be corrected and re-inspected/tested to verify compliance with this specification.

1. All inspection criteria, operational testing procedures and load test prescriptions to be obtained by the original equipment manufacturer, in writing, prior the conduction any of the following tests.
2. Tie-Back Anchors: Each loop to be tested in a manner as prescribed by the manufacturer to a load no less than 50% of its design load capacity but no more than 2500 pounds.
3. Suspension Equipment (Davits, Outriggers, Carriages, etc.): Full live load and operational tests under the maximum live loading conditions over the complete range of the overall system.
4. Catenary Lines / Horizontal Life Lines: Each wire rope line shall be tested when fabricated in the shop or in the field to a load no less than 50% of its design load capacity.

B. All test results shall be recorded and submitted according to paragraph 1.5.

3.4 CERTIFICATION

A. Provide a written Certificate of Regulation Compliance for all components and equipment installed under this specification certifying the following:

1. All components and equipment have been manufactured and installed according to all Project regulations and applicable regulatory jurisdiction.
2. The components and equipment has been inspected and tested according to the provisions in paragraph 3.3 and have successfully passed.
3. The system is operational and ready for owner turnover.
4. Certificate of Regulation Compliance to be dated and signed by a qualified representative of the contractor/manufacturer.

3.5 DEMONSTRATION

A. Only once the complete system has been installed, inspected and tested, and a Certificate of Compliance has been issued, a demonstration of said equipment is to be arranged with the General Contractor and Owner at a time that is mutually agreeable. The following conditions shall apply to the demonstration of the equipment:

1. The demonstration event shall not be used to satisfy the requirements of part 3.3 of this specification.
2. The demonstration shall include, but is not limited to, the following:
    a. One functional demonstration of each type of equipment at every unique building/rigging condition where that type of equipment occurs.

B. Instruction, as needed, shall be provided to Owner representatives during the demonstration.

- END OF SECTION 11 24 23 -

- SECTION 11 2513.01 -

REGISTRATION EQUIPMENT (COURTYARD)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. **COURTYARD**:
      a. Deposit boxes.
      b. Employees depository safe.

1.3 RELATED REQUIREMENTS

A. Pertinent Sections specifying Volatile Organic Compound (VOC) Content Restrictions.

B. Section 01 6116 “Volatile Organic Compound (VOC) Restrictions”.

C. Section 05 5000 “Metal Fabrications“.

D. Section 06 1053 “Miscellaneous Rough Carpentry”.

E. Section 06 1000 “Rough Carpentry“.

F. Section 09 2216 “Non-Structural Metal Framing”.

G. Section 09 2900 “Gypsum Board”.

H. Section 11 2513 Registration Equipment” for Courtyard components.

I. Section 12 3000 (“Architectural Woodwork“.

1.4 REFERENCES

A. “Phoenix Building Construction Code”, International Building Code 2006, with City of Phoenix administrative provisions and amendments.

B. 36 CFR 1191 - Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities; Final Rule; Federal Register, July 26, 1991; updated 2010.

1.5 SUBMITTALS

A. General: Submit in accordance with Section 01 3300.

B. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

C. Product Data: For each type of product indicated, demonstrate compliance with specified attributes.

D. VOC Submittals:
1. Product Data – VOC Limits: For adhesives sealants, fillers and primers, documentation including printed statement of VOC contents, comply with limits specified in Section 01 6116.

E. Submit "Letter of Conformance" in accordance with Section 01 3300 with the following supporting data:
1. Product Data: Mark each copy to identify applicable products, characteristics, models, options and other supplemental data to clearly communicate information specific to this project.

1.6 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements of Section 01 6000.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Limits for adhesives sealants, fillers and primers. Comply with limits specified in Section 01 6116.

2.2 DEPOSIT BOXES

A. Avendra, LLC Preferred Manufacturers:
1. None

B. Approved Manufacturers:
1. “Model No. CSP-18/2”; Corporate Security Products (301-251-0960)
2. “Model No. CSP-17”; Corporate Security Products (301-251-0960)
3. Approved substitution by Hamilton Safe (513-874-3733)
4. Approved substitution by Diebold, Incorporated. (800-999-3600)
5. Approved substitution.

C. Configuration: Architect to select from the following:
1. Model CSP-17:
a. 12 Openings: 5 -inch by 5 –inch
1) 4 openings: 5 -inch by 10 –inch
2) 1 opening: 10 -inch by 10 -inch.
2. Model CSP-18/2: Two(2) Stacked Modules:
a. Top Module: 21-3/4 -inch W by 20-7/8 -inch H x 24 -inch D with;
1) 4 openings 5 -inch H x 10 -inch W and;
2) 8 openings 5 -inch x 5 -inch.
b. Bottom Module: 21-3/4 -inch W x 20-3/4 -inch H x 24" D with;
1) 4 openings 5 -inch x 5 –inch
2) 1 opening 10 -inch x 10 –inch
3) 1 opening 20-3/8 -inch H x 10-3/8 -inch W with horizontal slot and anti-fish baffle.

D. Overall Dimensions: Architect to select from the following:
1. Model CSP-17: 32-1/2 -inch W x 21 -inch H x 24 -inch D
2. Model CSP-18/2: 21-3/4 -inch W x 41-5/8 -inch H x 24 -inch D

E. Door Face Material: Polished Aluminum with Stamped Numbers

F. Case and Case Edge Finish: Black

2.3 EMPLOYEES DEPOSITORY SAFE

A. Avendra, LLC Preferred Manufacturers:
1. None

B. Approved Manufacturers:
1. "Model No. KR-2116-F, Rev. A"; Corporate Security Products (301-251-0960)
2. Hamilton Safe (513-874-3733)
3. Diebold, Incorporated. (800-999-3600)
4. Approved substitution.

C. Size, outside measurement (verify with manufacturer's submittal).
1. Height: 25-1/4 -inches
2. Width: 16-1/2 -inches
3. Depth: 23 -inches (add 2 -inches for handle)
4. Coordinate size and locations with Drawings
5. Provide combination lock with three locking bolts
6. Provide four-compartment coin rack

D. "B" rated door with single lock bolt.

E. DP Hopper style cash drop, 2 –inch x 10 -inch x 8 –inch.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with equipment manufacturer's instructions.

B. Coordinate with approved shop drawings for millwork and Section 12 3000 - Architectural Woodwork.

- END OF SECTION -

- SECTION 11 2513.02 -

REGISTRATION EQUIPMENT (RESIDENCE INN)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. RESIDENCE INN:

a. Deposit boxes.

b. Employees depository safe.

B. Related Sections:

1. Pertinent Sections specifying Volatile Organic Compound (VOC) Content Restrictions.
2. Section 01 6116 “Volatile Organic Compound (VOC) Restrictions”.
3. Section 05 5000 “Metal Fabrications“.
4. Section 06 1053 “Miscellaneous Rough Carpentry”.
5. Section 06 1000 “Rough Carpentry“.
6. Section 09 2216 “Non-Structural Metal Framing”.
7. Section 09 2900 “Gypsum Board”.
8. Section 11 2513 Registration Equipment” for Courtyard components.
9. Section 12 3000 “Architectural Woodwork“.

1.3 REFERENCES

A. “Phoenix Building Construction Code”, International Building Code 2006, with City of Phoenix administrative provisions and amendments.

B. 36 CFR 1191 - Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities; Final Rule; Federal Register, July 26, 1991; updated 2010.

1.4 SUBMITTALS

A. Submit "Letter of Conformance" in accordance with Section 01 3300 with the following supporting data:

1. Product Data: Mark each copy to identify applicable products, characteristics, models, options and other supplemental data to clearly communicate information specific to this Project.

1.5 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements of Section 01 6000.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Limits for adhesives sealants, fillers and primers. Comply with limits specified in Section 01 6116.

2.2 DEPOSIT BOXES

A. Avendra, LLC Preferred Manufacturers:
   1. None

B. Approved Manufacturers:
   1. “Model No. RIS-17”; Corporate Security Products (301-251-0960)
   2. Approved substitution by Hamilton Safe (513-874-3733)
   3. Approved substitution by Diebold, Incorporated (800-999-3600)
   4. Approved Substitution

C. Configuration:
   1. 12 Openings: 5 -inch by 5 –inch
   2. 4 openings: 5 -inch by 10-3/8 –inch
   3. 1 opening: 10-1/8 -inch by 10-3/8 -inch with slot.

D. Overall Dimensions: 20-7/8 –inch High by 32-5/8 -inch Wide by 24 –inch Deep

E. Door Face Material: Polished Aluminum with Stamped Numbers

F. Case and Case Edge Finish: Black

G. Hinges: Polished Brass

H. Provide one large box behind Guest Registration desk with anti-fish baffle; provide drop slot feature.

2.3 DEPOSIT BOXES

A. Avendra, LLC Preferred Manufacturers:
   1. None

B. Approved Manufacturers:
   1. “Model No. CSP-17”; Corporate Security Products (301-251-0960)
   2. Hamilton Safe (513-874-3733)
   3. Diebold, Incorporated. (800-999-3600)
   4. Approved Substitution

C. Configuration:
   1. 12 Openings: 5 -inch by 5 –inch
   2. 4 openings: 5 -inch by 10-3/8 –inch
   3. 1 opening: 10-1/8 -inch by 10-3/8 -inch with slot.

D. Overall Dimensions: 20-7/8 –inch High by 32-5/8 -inch Wide by 24 –inch Deep

E. Door Face Material: Polished Aluminum with Stamped Numbers

F. Case and Case Edge Finish: Black

G. Hinges: Polished Brass

2.4 EMPLOYEES DEPOSITORY SAFE

A. Avendra, LLC Preferred Manufacturers:
   1. None

B. Approved Manufacturers:
   1. "Model No. KR-2116-F, Rev. A” - Corporate Security Products (301-251-0960)
   2. Hamilton Safe (513-874-3733)
   3. Diebold, Incorporated. (800-999-3600)
   4. Approved substitution.

C. Size, outside measurement (verify with manufacturer's submittal).
   1. Height: 25-1/4 -inches
   2. Width: 16-1/2 -inches
   3. Depth: 23 -inches (add 2 -inches for handle)
   4. Coordinate size and locations with Drawings
   5. Provide combination lock with three locking bolts
   6. Provide four-compartment coin rack

D. "B" rated door with single lock bolt.

E. Rotary style cash drop

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with equipment manufacturer's instructions.

B. Coordinate with approved shop drawings for millwork and Section 12 3000 - Architectural Woodwork.

- END OF SECTION -

- SECTION 11 3100.01 -

RESIDENTIAL APPLIANCES (COURTYARD)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. COURTYARD:
      a. Guest Room and Employee Lounge Appliances:
         1) Microwave Oven – Undercounter.
         2) Microwave Oven – Undercabinet.
         3) Refrigerator – Undercounter.
         4) Refrigerator with Ice Maker.
         5) Dishwasher.
         6) Disposal.

1.3 RELATED REQUIREMENTS

A. Section 09 2216 “Non-Structural Metal Framing”

B. Section 12 3000 “Architectural Woodwork”.

C. Section 10 2800.01 “Toilet, Bath, and Laundry Accessories” (COURTYARD)

D. Section 10 2800.01a “Toilet and Bath Accessory Matrix” (COURTYARD)

E. Section 10 2800.02 “Toilet, Bath, and Laundry Accessories” (RESIDENCE INN)

F. Section 10 2800.02a “Toilet and Bath Accessory Matrix” (RESIDENCE INN)

G. Section 11 3100.02 “Residential Appliances (Residence Inn)” for Residence Inn appliances

H. Division 22 Sections: Plumbing Fixtures and Equipment.

I. Division 26 Sections: Basic Electrical Materials and Methods.

J. Food Service & Laundry Equipment Product Manual.

1.4 REFERENCES

A. “Phoenix Building Construction Code”, International Building Code 2006, with City of Phoenix administrative provisions and amendments.

B. Uniform Plumbing Code (UPC) 2006 with City of Phoenix administrative provisions and amendments.

C. International Mechanical Code with City of Phoenix administrative provisions and amendments.

D. National Electrical Code / NFPA 70 2008, with City of Phoenix administrative provisions and amendments.

E. National Fire Protection Association (NFPA) Publications:
1. 70 "National Electric Code"

F. US Environmental Protection Agency (EPA)/US Department of Energy Program:
1. ENERGY STAR Performance Rating System

1.5 SUBMITTALS

A. General: Submit in accordance with Section 01 3300.

B. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

C. Product Data: For each type of product indicated, demonstrate compliance with specified attributes.

D. Submit “Letter of Conformance” in accordance with Section 01 33 00 (01330) indicating specified items selected for use in project with the following supporting data.
1. Product Data: For each appliance type required indicating compliance with requirements, include complete operating and maintenance instructions for each appliance.
2. Appliance Schedule: Submit schedule of appliances, using the same room designations on Drawings.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is an authorized representative of the residential appliance manufacturer for installation of appliances required for this Project.

B. Source Limitations: Obtain residential appliances through one source.

C. Electrical Appliances: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

D. UL and NEMA Compliance: Provide electrical components required as part of residential appliances that are listed and labeled by UL and that comply with applicable NEMA standards.

E. Deliver appliances only after utility rough-in is complete and construction in the spaces to receive appliances is substantially complete and ready for installation.

F. ENERGY STAR Performance Rating: Where indicated, provide ENERGY STAR qualified products that meet the energy efficiency requirements set forth in ENERGY STAR product specifications.

1.7 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements of Section 01 6000.

1.8 PROJECT CONDITIONS

A. Coordinate the work with location and placement of utilities. Coordinate characteristics of utilities with requirements of residential appliances.

PART 2 - PRODUCTS

2.1 PRODUCTS

A. Products: Subject to compliance with requirements, provide one of the appliances indicated for each designation in the Residential Appliance Schedule at the end of Part 3.

2.2 MANUFACTURERS - COURTYARD (AS IDENTIFIED IN THE RESIDENTIAL APPLIANCE SCHEDULE)

A. Avendra, LLC Preferred Manufacturers:
   1. None.

B. Approved Manufacturers:
   1. GE Appliances Sales (800-770-4651).
   2. Absocold Corp. (800-843-3714).
   3. Whirlpool Corporation (800-551-5146 x 6767).

2.3 FINISHES

A. Exterior Finish: Provide manufacturer's standard factory-applied exterior finish, impervious to cleaning materials commonly used on kitchen appliances, over cleaned and pretreated steel sheet.
   1. Color and Gloss: As indicated by manufacturer's designations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for plumbing, mechanical, and electrical services, with Installer present, to verify actual locations of services before residential appliance installation.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with manufacturer's written instructions.

B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and rough openings are completely concealed.

C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

D. Utilities:
   1. Refer to Division 22 for plumbing requirements.
   2. Refer to Division 26 for electrical requirements.

3.3 ADJUSTING AND CLEANING

A. Test each item of residential appliances to verify proper operation. Make necessary adjustments.

B. Verify that accessories required have been furnished and installed.

C. Remove packing material from residential appliances and leave units in clean condition, ready for operation.

PART 4 - RESIDENTIAL APPLIANCE SCHEDULE

4.1 APPLIANCES - GUEST ROOMS AND EMPLOYEE LOUNGE

A. Microwave Oven - (X-603):
   1. Refer to the Interior Design Specification Manual.
   2. Location:
      a. Guestrooms
   3. EPA/DOE ENERGY STAR Labeled: No

B. Refrigerator - Undercounter (X-900):
   1. Refer to the Interior Design Specification Manual.
   2. Location:

a. Guestrooms

3. EPA/DOE ENERGY STAR Labeled: Yes

C. Dishwasher - 24-inch (K13):

1. Description:
   a. Built-In Dishwasher; 5 cycles / 34 options; Power Scrub Wash System
2. Locations:
   a. Employee Lounge
3. Product:
   a. “Model No.GSD4060NSS”; GE Appliance Sales
      1) EPA/DOE ENERGY STAR Labeled: Yes
4. Size (W x D x H):
   a. GE: 24-inch x 25-3/4-inch x 34-inch
5. Electrical:
   a. 120V; 60 Hz; 6.2A
6. Color:
   a. Stainless Steel / Black

D. Disposal (K21):

1. Description:
   a. 1/3 Horsepower Motor, 1725 RPM; Line Cord Power Connection; Sound Insulation Package
2. Locations:
   a. Employee Lounge
3. Product:
   a. “Model No. GFC325T”; GE Appliance Sales
      1) EPA/DOE ENERGY STAR Labeled: No
   b. “Whirlpool Model No. GC1000pE”; Whirlpool Corporation
      1) EPA/DOE ENERGY STAR Labeled: No.
4. Size (W x H):
   a. GE: 5-3/16-inch x 12-11/16-inch
   b. Whirlpool: 6-5/8-inch x 11-3/8-inch
5. Electrical:
   a. 120V; 60Hz; 15A
   b. Wall switch control (by others) with 6' long cord and male plug.
6. Color:
   a. N/A

E. Microwave Oven – Undercabinet (K35):

1. Description:
   a. GE: 1.0 Cu. Ft Capacity Undercabinet Mounted Microwave Oven; 800 watts; turntable; 10 power levels.
   b. Whirlpool: 0.7 Cu. Ft Capacity Undercabinet Mounted Microwave Oven; 700 watts; turntable; 10 power levels.
2. Locations:

a. Employee Lounge

3. Product:
   a. "JEM25DMBB with JXA019K Mounting Kit"; GE Appliance Sales
      1) EPA/DOE ENERGY STAR Labeled: No
   b. "MT4078SPB"; Whirlpool Corporation
      1) EPA/DOE ENERGY STAR Labeled: No
4. Electrical:
   a. 120V; 60Hz; 11.5A; 1300 Watts
5. Size (W x D x H):
   a. GE: 23-25/32-inch x 12-9/32-inch x 11-3/16-inch
   b. Whirlpool: 18-inch x 12-3/8-inch x 11-inch
6. Color:
   a. Black on Black

F. Refrigerator with Ice Maker (K70):
1. Description:
   a. No-Frost Refrigerator with Factory Installed Icemaker Kit
   b. Provide 10-feet -0-inch additional copper tubing coiled behind unit to allow maintenance. Use 90 degree elbow brass fitting to attach copper tubing to allow coiled copper to lie flat against back of unit.
2. Location:
   a. Employee Lounge
3. Product:
   a. 18.0 Cu. Ft. "Model No. GTK18IBXBS w/IM4A Icemaker Kit"; GE Appliance Sales
      1) EPA/DOE ENERGY STAR Labeled: Yes
   b. 17.5 Cu. Ft. Model No. W8RXEGMWS w/Icemaker"; Whirlpool Corporation
      1) EPA/DOE ENERGY STAR Labeled: Yes
4. Size (W x D x H):
   a. GE: 29-1/2-inch x 30-1/4-inch x 66-1/8-inch
   b. Whirlpool: 28-inch x 30-3/8-inch x 68-inch
5. Electrical:
   a. 120V; 60Hz; 15A.
6. Color:
   a. Clean Steel w/ Black Case

- END OF SECTION -

- SECTION 11 3100.02 -

RESIDENTIAL APPLIANCES (RESIDENCE INN)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. RESIDENCE INN:
a. Cooktops:
1) Ceran-Glass Type.
2) Glass Type
b. Ranges:
1) Glass Ceramic Top Type.
c. Microwave Ovens:
1) Over the Range Mounted.
2) Countertop Mounted.
d. Refrigerator with Ice Maker
e. Disposals.
f. Dishwashers:
1) 24 -inch Unit.
2) 18 -inch Unit.
g. Built-in Barbeque at Patio.

1.3 RELATED REQUIREMENTS

A. Section 09 2216 “Non-Structural Metal Framing”.

B. Section 12 3000 “Architectural Woodwork”.

C. Section 10 2800.01 “Toilet, Bath, and Laundry Accessories” (COURTYARD).

D. Section 10 2800.01a “Toilet and Bath Accessory Matrix” (COURTYARD).

E. Section 10 2800.02 “Toilet, Bath, and Laundry Accessories” (RESIDENCE INN).

F. Section 10 2800.02a "Toilet and Bath Accessory Matrix" (RESIDENCE INN).

G. Section 11 3100.01 "Residential Appliances (Courtyard)" for Courtyard appliances.

H. Division 22 Sections: Plumbing Fixtures and Equipment.

I. Division 26 Sections: Basic Electrical Materials and Methods.

J. Food Service & Laundry Equipment Product Manual.

1.4 REFERENCES

A. "Phoenix Building Construction Code", International Building Code 2006, with City of Phoenix administrative provisions and amendments.

B. Uniform Plumbing Code (UPC) 2006 with City of Phoenix administrative provisions and amendments.

C. International Mechanical Code with City of Phoenix administrative provisions and amendments.

D. National Electrical Code / NFPA 70 2008, with City of Phoenix administrative provisions and amendments.

E. National Fire Protection Association (NFPA) Publications:
1. 70 "National Electric Code"

F. US Environmental Protection Agency (EPA)/US Department of Energy Program:
1. ENERGY STAR Performance Rating System.

1.5 SUBMITTALS

A. General: Submit in accordance with Section 01 3300.

B. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

C. Product Data: For each type of product indicated, demonstrate compliance with specified attributes.

D. Submit "Letter of Conformance" in accordance with Section 01 3300 and with the following supporting data:
1. Product Data: For each appliance type required indicating compliance with requirements, include complete operating and maintenance instructions for each appliance.
2. Appliance Schedule: Submit schedule of appliances, using the same room designations on Drawings.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is an authorized representative of the residential appliance manufacturer for installation of appliances required for this Project.

B. Source Limitations: Obtain residential appliances through one source.

C. Electrical Appliances: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

D. UL and NEMA Compliance: Provide electrical components required as part of residential appliances that are listed and labeled by UL and that comply with applicable NEMA standards.

E. Deliver appliances only after utility rough-in is complete and construction in the spaces to receive appliances is substantially complete and ready for installation.

ENERGY STAR Performance Rating:

1. Where indicated, provide ENERGY STAR qualified products that meet the energy efficiency requirements set forth in ENERGY STAR product specifications.

1.7 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements of Section 01 6000.

1.8 PROJECT CONDITIONS

A. Coordinate the work with location and placement of utilities.
1. Coordinate characteristics of utilities with requirements of residential appliances.

PART 2 - PRODUCTS

2.1 PRODUCTS

A. Products: Subject to compliance with requirements, provide one of the appliances indicated for each designation in the Residential Appliance Schedule at the end of Part 3.

2.2 MANUFACTURERS– RESIDENCE INN (AS IDENTIFIED IN THE APPLIANCE SCHEDULE)

A. Avendra, LLC Preferred Manufacturers:
1. None

B. Approved Manufacturers:
1. GE Appliances Sales (800-770-4651)
2. Broan-NuTone LLC, A Nortek Company (800-558-1711)
3. Kenyon International, Inc.
   a. Contact: Suzanne Owens (860-664-4906)
4. Whirlpool Corporation (800-551-5146 x 6767)
5. KitchenAid Home Appliances, a Whirlpool Brand (800-551-5146 x 6767)
6. Viking Range Corporation (662-455-1200)
7. Vermont Castings, a Brand of Monessen Hearth Systems Co. (800-867-0454)

2.3 FINISHES

A. Exterior Finish: Provide manufacturer's standard factory-applied exterior finish, impervious to cleaning materials commonly used on kitchen appliances, over cleaned and pretreated steel sheet.
   1. Color and Gloss: As indicated by manufacturer's designations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for plumbing, mechanical, and electrical services, with Installer present, to verify actual locations of services before residential appliance installation.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with manufacturer's written instructions.

B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and rough openings are completely concealed.

C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

D. Utilities:
   1. Refer to Division 22 for plumbing requirements.
   2. Refer to Division 26 for electrical requirements.

3.3 ADJUSTING AND CLEANING

A. Test each item of residential appliances to verify proper operation. Make necessary adjustments.

B. Verify that accessories required have been furnished and installed.

C. Remove packing material from residential appliances and leave units in clean condition, ready for operation.

PART 4 - RESIDENTIAL APPLIANCE SCHEDULE

4.1 APPLIANCES

A. Dishwasher - 18-inch (K10):
   1. Description:

a. Standard Wash System with 4 Wash Levels and Food Disposer; Variable Cycles and Options.

2. Location:
   a. Studio A
   b. Connector Studio
   c. Studio A – Accessible
   d. Studio C
   e. One Bedroom – Inline
   f. One Bedroom – End Unit
   g. One Bedroom – End Unit - Accessible
   h. Queen Queen - Optional
   i. Queen Queen – Accessible
3. Product:
   a. “Spacemaker Model No.GSM1860NSS”; GE Appliance Sales
      1) EPA/DOE ENERGY STAR Labeled: Yes
      2) ADA Compliant: Yes
   b. “Model No. DU018DWTB W/Silver Panel No. W10234437”; Whirlpool Corporation
      1) EPA/DOE ENERGY STAR Labeled: Yes
      2) ADA Compliant: Yes
4. Size (W x D x H):
   a. GE: 18" x 22-1/2" x 32-1/2" minimum/35” maximum
   b. Whirlpool: 18”x 22-1/4" x 32-1/2" minimum/35” maximum
5. Electrical:
   a. 120V; 60Hz; 9.0A
   b. Whirlpool: 120V; 60Hz; 15.0A
6. Color:
   a. Stainless Steel

B. Dishwasher (K12):

1. Description:
   a. Standard Wash System with 2 Wash Levels and Food Disposer; 5 or 7 Cycles.
      1) ADA Compliant: Yes
2. Location:
   a. Employee Lounge
3. Product:
   a. “GE Tall Tub Built-in Model No. GLDA696PSS”; GE Appliance Sales
      1) EPA/DOE ENERGY STAR Labeled: Yes.
      2) ADA Compliant: Yes
   b. “Model No. GU3100XTVS”; Whirlpool Corporation
      1) EPA/DOE ENERGY STAR Labeled: Yes.
      2) ADA Compliant: Yes
4. Size (W x D x H):
   a. GE: 24"x 24" x 32-11/32” minimum/34-1/2” maximum.

b. Whirlpool: 23-7/8” x 24" x 32-1/2" minimum/34-1/2” maximum.

5. Electrical:
   a. GE: 120V; 60Hz; 9.1A
   b. Whirlpool: 120V; 60Hz; 15.0A
6. Color:
   a. GE: Stainless Steel
   b. Whirlpool: Black on Stainless Steel

C. Disposal (K21):

1. Description:
   a. 1/3 Horsepower Motor, 1725 or 2500 RPM; Line Cord Power Connection; Standard Sound Insulation Package
2. Locations:
   a. All Guestrooms
   b. Employee Lounge
3. Product:
   a. “Model No. GFC325V”; GE Appliance Sales
      1) EPA/DOE ENERGY STAR Labeled: No
   b. “Whirlpool Model No. GC1000PE”; Whirlpool Corporation
      1) EPA/DOE ENERGY STAR Labeled: No.
4. Electrical:
   a. 120V; 60Hz; 4.0A
   b. Wall switch control (by others) with 6' long cord and male plug.
5. Size (W x H):
   a. GE: 5-3/16” x 12-11/16"
   b. Whirlpool: 6-5/8” x 11-3/8"
6. Color:
   a. N/A

D. Microwave – Countertop (K32):

1. Description:
   a. 1.1 Cu. Ft Capacity Countertop Microwave Oven; 1100 watts; turntable; 10 power levels.
2. Locations:
   a. Employee Lounge
3. Product:
   a. “Model No.JES1142SPSS”; GE Appliance Sales
      1) EPA/DOE ENERGY STAR Labeled: No
   b. “Model No. WMC11511AS; Whirlpool Corporation
      1) EPA/DOE ENERGY STAR Labeled: No
4. Electrical:
   a. GE: 120V; 60Hz; 13.7A; 1100 Watts
   b. Whirlpool: 120V; 60Hz; 15.0A; 1000 Watts
5. Size (W x D x H):

a. GE: 21-7/32" x 15-11/16" x 11-15/16"
b. Whirlpool: 20-1/4" x 16-1/8" x 12-5/8"

6. Color:
a. GE: Stainless Steel
b. Whirlpool: Black on Stainless

E. Microwave - Over-The-Range / Cooktop (K33):

1. Description:
a. 1.7 Cu. Ft Capacity Over-The-Range Microwave Oven with Recirculating Charcoal Filter Kit; 1000 watts; turntable, removable oven rack; 10 power levels.

2. Locations:
a. Studio A
b. Connector Studio
c. Studio C
d. One Bedroom – Inline
e. One Bedroom – End Unit
f. Queen Queen – Optional
g. SK
h. SKA
i. SKS
j. SQQ
k. SQQA
l. SQQESKS
m. SQQW
n. Typical unless specified otherwise.

3. Product:
a. "Spacemaker Model No. JVM6172SFSS w/JX81J Filter Kit"; GE Appliance Sales
1) EPA/DOE ENERGY STAR Labeled: No
b. "Model No. WMH31017AS"; Whirlpool Corporation
1) EPA/DOE ENERGY STAR Labeled: No

4. Electrical:
a. GE: 120V; 60Hz; 15A; 1600 Watts
b. Whirlpool: 120V; 60Hz; 15A,1000 Watts

5. Size (W x D x H):
a. GE: 29-7/8" x 15" x 16-1/2"
b. Whirlpool: 29-15/16" x 16-1/8" x 17-1/4"

6. Color: Black / Stainless Steel.

F. Microwave – Countertop (K35):

1. Description:
a. 1.0 Cu. Ft Capacity Countertop Microwave Oven; 800 watts; turntable; 10 power levels.

2. Locations:
a. Accessible rooms

3. Product:
   a. "GE Spacemaker II Model No. JEM25DMBB"; GE Appliance Sales
      1) EPA/DOE ENERGY STAR Labeled: No
4. Electrical:
   a. GE: 120V; 60Hz; 11.5A; 1300 Watts
5. Size (W x D x H):
   a. GE: 24" x 19-3/8" x 13-3/4"
   b. Whirlpool: 21-3/4" x 17-1/4" x 13"-
6. Color:
   a. GE: Black on Stainless Steel
   b. Whirlpool: Black on Stainless Steel

G. Cooktop (K41):

1. Description:
   a. Built-In Electric, Beveled edge Ceramic Glass Cooktop, Two 6 1/2 -inch (1200 Watts each) Heating Elements.
2. Locations:
   a. Studio A
   b. Connector Studio
   c. Studio A - Accessible
   d. Studio C
   e. One Bedroom – Inline
   f. One Bedroom – End Unit – Accessible
   g. Queen Queen – Optional
   h. Queen Queen – Accessible
   i. SKS-ADA
   j. SQQW-ADA
3. Product:
   a. Model: Mediteranean B41515 Trimline Unit by KENYON Custom
      1) EPA/DOE ENERGY STAR Labeled: No
4. Size (W x D x H):
   a. Overall: 21 –inches by 12 –inches by 2 5/8 –inch.
   b. Cutout Dim: 20 –inches wide by 10 3/4 -inch deep with 1/4 -inch radius corners
5. Electrical:
   a. 208/240V; 20A
      1) Coordinate withy Electrical Drawings
6. Color:
   a. Black

H. Range Hood (K50):

1. Description:
   a. Two or Three-Speed; Non-Ducted Range Hood with Charcoal Filter; 2850 RPM
2. Locations:

a. Studio A Accessible
b. One Bedroom – End Unit - Accessible
c. Queen Queen – Accessible
d. SKS-ADA
e. SQQW-ADA

3. Product:
   a. “Model No. JN327HBB”; GE Appliance Sales
      1) EPA/DOE ENERGY STAR Labeled: No
   b. "Model No. 413004"; Broan-NuTone LLC
      1) EPA/DOE ENERGY STAR Labeled: No
   c. "Model No. UXT4030AYB"; Whirlpool Corporation
      1) EPA/DOE ENERGY STAR Labeled: No
4. Electrical:
   a. 120V; 2.0A
5. Size (W x D x H):
   a. GE: 29-7/8” x 17-1/2" x 5-1/2”
   b. Broan: 30" x 18-1/2" x 6"
   c. Whirlpool: 30" x 18-11/16" x 5"
6. Color:
   a. Stainless Steel

I. Refrigerator (K60):

1. Description:
   a. Frost Free Top-Freezer Refrigerator; Reversible Door Swing
2. Locations:
   a. Connector Studio
   b. Studio A - Accessible
   c. One Bedroom – End Unit – Accessible.
3. Product:
   a. 10.3 Cu. Ft: “Model No. ARD1031FS”; Absocold
      1) EPA/DOE ENERGY STAR Labeled: Yes.
      2) ADA Compliant: Yes
      3) Note: Absocold requires 60 day lead time for this item.
4. Size (W x D x H):
   a. Absocold: 23-5/8” x 26-3/4” x 58-3/4”
5. Electrical:
   a. 120V; 60 Hz; 15A
6. Color:
   a. Absocold: “Black/Stainless Steel Door

J. Refrigerator (K70) ADA:

1. Description:
   a. Frost Free Top-Freezer Refrigerator with factory installed icemaker; Reversible Door Swing

b. Provide 10’-0” additional copper tubing coiled behind unit to allow maintenance. Use 90 degree elbow brass fitting to attach copper tubing to allow coiled copper to lie flat against back of unit.

2. Locations:
   a. Employee Lounge
3. Product:
   a. 16.5 Cu. Ft. “Model No. GTK17GCEBS”; GE Appliance Sales
      1) EPA/DOE ENERGY STAR Labeled: Yes
      2) ADA Compliant: Yes
   b. 16.0 Cu. Ft. Model No. W6RXNGFWS with Icemaker Kit ECKMF94”; Whirlpool Corporation
      1) EPA/DOE ENERGY STAR Labeled: Yes
      2) ADA Compliant: Yes
4. Size (W x D x H):
   a. GE: 28"x 31”x 64-3/4”
   b. Whirlpool: 28"x 30-3/8"x 66”
5. Electrical:
   a. 120V; 60Hz; 15A
6. Color:
   a. GE: Stainless Steel (CleanSteel) with Black Handle
   b. Whirlpool: Stainless Steel

K. Refrigerator (K71):

1. Description:
   a. Frost Free Top-Freezer Refrigerator with icemaker; Reversible Door Swing
   b. Provide 10'-0" additional copper tubing coiled behind unit to allow maintenance. Use 90 degree elbow brass fitting to attach copper tubing to allow coiled copper to lie flat against back of unit.
2. Locations:
   a. Studio A
   b. Studio C
   c. One Bedroom – Inline
   d. One Bedroom – End Unit
   e. Queen Queen - Optional
   f. Queen Queen – Accessible
3. Product:
   a. 16.5 Cu. Ft. "Model No. GTK17GBEBS with IM4A Icemaker Kit"; GE Appliance Sales
      1) EPA/DOE ENERGY STAR Labeled: Yes
      2) ADA Compliant: Yes
   b. 16.0 Cu. Ft. Model No. W6RXNGFWS with Icemaker Kit ECKMF94"; Whirlpool Corporation
      1) EPA/DOE ENERGY STAR Labeled: Yes
      2) ADA Compliant: Yes
4. Size (W x D x H):
   a. GE: 28"x 31"x 64-3/4"
   b. Whirlpool: 28"x 30-3/8"x 66"
5. Electrical:
   a. 120V; 60Hz; 15A
6. Color:
   a. GE: Stainless Steel (CleanSteel) with Black Handle
   b. Whirlpool: Stainless Steel

- END OF SECTION -

- SECTION 11 4000 -

FOOD SERVICE EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Included: The extent of Foodservice equipment work is shown on the drawings and by schedules and equipment lists associated with either the drawings or this section.

B. Where walk-in refrigerated storage units indicated as part of food service equipment items include remote condensing units, all refrigerant piping and unit cooler drain line piping shall be included as part of the work covered by this section.

1.3 RELATED REQUIREMENTS / WORK

A. Refer to other sections of the project specifications for mechanical and electrical services and for the connection of foodservice equipment to mechanical and electrical systems.

B. Mechanical and Electrical Work: Refer to Division 22 and Division 26 sections of the project specifications for mechanical and electrical services and for the connection of food service equipment to mechanical and electrical systems. Except as otherwise indicated, and except for work integral with fabricated items of equipment, the work covered by this section does not include ductwork, external piping and vents including concealed drains and traps, and electrical work including conduit, wiring, switches, disconnects, electrical devices and general lighting.

C. Plumbing Work: Where plumbing trim and fittings including faucets, drains, vacuum breakers, quick-disconnect assemblies and valves are indicated as part of food service equipment items, such trim or fittings shall be furnished under this section for installation under Division 22 sections. Where walk-in refrigerated storage units indicated as part of food service equipment items include remote condensing units, all electrical service and connection of electrical service to condensing units, unit coolers, alarm systems, interior lights and door heaters shall be included as part of the work covered by Division 26 sections.

1.4 REFERENCES

A. “Phoenix Building Construction Code”, International Building Code 2006, with City of Phoenix administrative provisions and amendments.

1.5 SUBMITTALS

A. Shop Drawings and Connection Plans: Submit two sets of all shop drawings and connection plans for approval. After approval, furnish Cad files, and up to seven sets of corrected shop drawings and connection plans for distribution to the various trades on the project.

B. Shop Drawings of custom-fabricated items of food service equipment sections and details and shall include all dimensions, details of construction, details of reinforcement, details and locations of wall backing, built-in components and accessories, and details of installation and relation of the equipment to adjoining and related work which requires cutting or close fitting. Show elevations and layouts at 1/2" scale, sections at 1-1/2" scale, and details at 3" scale.

C. Connection plans shall show roughing-in and mechanical services required for each item of food service equipment. Show roughing-in layouts at 1/4" scale. Show all mechanical roughing-in including sleeves and conduits for electrical, water, gas, steam, refrigeration, ventilation, condensate drain lines, air supply and exhaust connections, with complete characteristics (voltage, phase, size, gpm, cfm, static pressure, etc.), for each item of food service equipment included under this section, whether furnished under this section or furnished by Owner; characteristics of all Owner furnished equipment shall be verified by the Owner. All rough-in points shall be fully dimensioned and shall make allow-rough-in points shall be fully dimensioned and shall make allowances for traps, switches and other final connection requirements.

D. Connection plans shall also include electrical convenience outlets and floor drains which occur in areas of food service to insure proper coordination.

E. Operation and Maintenance Manuals: Furnish two sets of all operating and maintenance manual, including parts lists and recommended spare parts lists, covering each item of mechanically operated food service equipment furnished under this section, each set being neatly bound in a hardback loose-leaf binder. Include in each manual a list of authorized service agencies, with addresses and telephone numbers, for all items of standard manufacture food service equipment including built-in components of custom-fabricated equipment.

1.6 QUALITY ASSURANCE

A. Work covered by this section shall be performed by skilled mechanics who regularly engage and specialize in work of the character required by this section and who have successfully installed projects of size and quality comparable to this and who have a minimum of 5 years of experience in similar work.

B. Standard of Quality: Standard food service equipment made on a production basis is specified here in by manufacturer and catalog number and establishes the "standard of quality" required by these specifications.

C. NSF Standards: Comply with the National Sanitation Foundation standards and criteria which are applicable to each item of food service equipment. Except as otherwise indicated provide NSF "Seal of Approval" label on all manufactured items and on major items of shop-fabricated equipment.

D. UL Standards: Except as otherwise indicated, provide electrical components and component assemblies for each item of food service equipment which bear either "recognized markings" as indicated in UL Listings of the "Recognized Component Index", or a UL Label, to show compliance with UL Standards as applicable.

E. Requirements of Regulatory Agencies: Obtain all necessary permits and licenses required and necessary for the performance of the work included in this section. Post all notices required by law and comply with all laws, ordinances and regulations bearing on the conduct of the work required under this section. Obtain inspection certificate on any work upon which an inspection certificate by local authorities, National Board of Fire Underwriters or any other governing body is required.

1.7 WARRANTY

A. Guarantee all new equipment covered under this section, including materials, parts, and workmanship, against inadequate performance and defects for a period of one (1) calendar year after final acceptance of the work. Repair or replace free of charge any work, equipment, parts, materials and workmanship which becomes defective during the guarantee period except to the extent it has been subjected to abuse, misuse, or accidental damage.

B. Provide written guarantee signed by the contractor and installer, and all manufacturer's standard guarantees, neatly bound in a hardback binder.

C. Refrigeration Equipment: Guarantee all refrigeration equipment, including evaporator, compressor and condensor components and accessories, against inadequate performance and defective materials and workmanship, including leakage and loss of refrigerant, excessive power consumption, and noticeable increase in noise levels for a period of one (1) calendar year after completion of the installation and startup of the refrigeration system. Repair or replace free of charge any work, equipment, parts, materials or workmanship which become defective during guarantee period, except to the extent it has been subjected to abuse, misuse, or accidental damage. In addition, provide all refrigeration systems incorporated in or furnished with items of food service equipment a one (1) year prepaid service contract and manufacturer's standard five (5) year extended warranty on the compressor. Provide guarantees and service contracts signed by the contractor and installer.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless steel shall be AISI Type 302/304 stainless steel (ASTM A-167) of the hardest annealed temper which can be properly fabricated, and with No. 4 directional polish on exposed side and No. 2 finish on unexposed side.

B. Stainless steel tubing shall be seamless or welded of gauge specified and of true roundness. Seamless tubing shall be thoroughly and correctly annealed, picked and ground smooth. Welded tubing shall be thoroughly heat treated, properly quenched to eliminate precipitation, drawn true to size and roundness and polished to match stainless steel sheets.

C. Steel structural members used for framing shall be hot rolled or cold formed steel members of the shapes, sizes and weights indicated, carbon steel unless stainless steel is indicated.

D. Where galvanized finish is indicated, provide members with hot-dipped zinc coating complying with ASTM A-123, applied after fabrication.

E. Copper tubing shall be type L, conforming to ASTM B-88, with brazed or solder-joint copper, brass or bronze fittings conforming to ANSI B16.18 or B16.22.

2.2 MATERIALS

A. Sealants: Provide liquid elastomeric sealants complying with either FS TT-S-00227E for self-curing 2-component sealant or FS-TT-S00230C for moisture-curing single component sealant; non sag grade for vertical joints, mildew resistant, non-solvent release, rapid-cure (not more than 7 days at 50 percent relative humidity for full-cure 1/4" deep sealant bead); of the type which forms a smooth tight-skinned surface promptly after placing, and cures to a Shore A hardness of not less than 45 for joints subject to foot traffic, 30 for other joints.

B. Sealant Backer Rod: Compressible polyethylene rod stock; sized larger than joint width to provide a firm convex base for placement of sealants.

C. Gaskets: Provide solid or hollow (but not cellular) molded units of neoprene or polyvinyl chloride; light gray, not less than 40 Shore A hardness, shaped to match joints including sanitary "T" shape for horizontal joints, either self-adhesive or suitable for adhesive application, or prepared for mechanical anchorage.

D. Paint and Coatings: Provide the types of painting and coating materials which after drying or curing, are suitable for use in conjunction with food service, and which are durable, nontoxic, non-flaking, mildew resistant and comply with governing regulations for food service.

1. Galvanize Repair Paint: MIL-P-21035
2. Pretreatment: FS-TT-C-490
3. Primer Coating for Metal: FS-TT-P-86, type suitable for baking.

E. Sound-deadening: Heavy-bodied resinous coasting, filled with granulated cork or other resilient material, compounded for permanent, non-flaking adhesion to metal in a 1/8" thick coating.

F. Electrical Materials: Provide standard materials, devices and components are recommended by the manufacturer/fabricator, selected and installed in accordance with NEMA Standards and recommendations; and as required for safe and efficient use and operation of the food service equipment, without objectionable noise, vibration and sanitation problems.

G. Controls and Signals: Provide recognized commercial grade signals, "on-off" push buttons or switches, and other speed and temperature controls as required for operation of each item, complete with pilot lights and permanent signs and graphics to assist the user of each item. Provide stainless steel cover plates at controls and signals.

H. Power characteristics: Refer to Division 26 specifications for project power characteristics. Also, refer to individual equipment requirements for loads and ratings.

2.3 WALK-IN REFRIGERATED STORAGE UNITS

A. Walk-in refrigerated storage units shall be prefabricated field-assembled units of the exact sizes shown on the drawings. Construction shall be prefabricated multiple compartments as shown on the drawings, having common partition walls arranged as shown on the drawings. Refrigerated storage units shall be manufactured in accordance with NSF Standard No. 7, and shall be designed to maintain operating temperatures as shown on the drawings.

B. Wall and Ceiling Panels shall be rigid cellular plastic insulation bonded between two sheet metal faces to form modular structural panels with interlocking joints and integral joint seals. provide preformed corner panels and preformed T-panels where insulated partitions are shown. Where shown, or where necessary for proper support of ceiling, provide internal structural aluminum beams and columns.

C. Panel thickness shall be minimum 4" thick (actual, not nominal). Insulation shall be rigid, closed cell foam, foamed-in-place for bond; shall be UL Listed having a flame spread rating of 25 or less when tested in accordance with ASTM E-84. The insulation shall not expand, bulge, swell or contract from it's original shape and dimension when exposed to temperatures up to 250 degrees F.

D. Panel faces shall be constructed as shown on the drawings or as specified hereinafter under Food Service Equipment Schedule. Where baked enamel finish is indicated, panels shall be factory finished with manufacturer's standard phosphate pre-treatment, baked metal primer paint (rust-inhibiting type), and baked enamel finish, 1.0 mils total dry film thickness, color as specified. Top and bottom caps shall have the same finish as specified for side panels.

E. Joint Fasteners: The prefabricated panel sections shall be fastened with manufacturer's standard hook-plus-draw type concealed joint locking hardware, easily operated from inside unit with allen-wrench or other common tool, for assembly and disassembly of panels at any time. Lock components shall be isolated from panel faces either by insulation or by thermo-break plastic support system. Lock component shall be designed so that draw of lock results in positive compression of joint gaskets. Install snap plugs at all fastener access holes.

F. Panel joint seals shall be manufacturer's standard hollow or solid, but not cellular, gaskets of synthetic rubber, vinyl or other elastomer which will perform permanently under the temperature exposures indicated.

G. Coved Corners: Form wall corner units, partition T-units and floor panels with special integral coved corner units complying with NSF requirements for Seal of Approval.

H. Entrance doors shall be manufacturer's standard insulated refrigerated storage unit doors, of the types indicated, complete with frame hardware and accessories. On each hinged entrance door, including partition doors, provide glazed vision panel not less than 14" wide x 23" high, including not less than 3 sheets of gasket sealed clear tempered glass, separated by sealed air spaces and electrically heated to prevent condensation. Provide pre-wired door units to include inside light fixture (above door) in vapor-tight safety globe, with outside and inside OSHA-type switch and pilot light. Door jambs shall be fitted with low wattage heater strip of magnetically attracting stainless steel. Provide heavy duty reinforced stainless steel threshold plate at each door with anti-sweat heater wire.

I. Lock, Latch and Seal: Provide heavy duty lock/latch systems with integral inside latch-land-safety-release to release both lock and latch. Provide positive contact, magnetic gasketed seal system at jambs and head. Provide automatic hydraulic spring door closure mechanism mounted out of food zone at each door. Provide double contact wiper type gaskets at sill, where magnetic gasket matching jambs cannot be used. On entrance doors of unit, excluding partition doors, provide integral cylinder or disc lock of the replaceable cylinder type; include two nickel-silver keys.

J. Pressure Relief Ports: Provide heated pressure relief port for each insulated compartment of walk-in refrigerated storage units.

K. Electrical: All wiring from evaporator coils, drain line heaters, light fixtures and other electrical components located inside the refrigerated compartments shall be extended to and terminated in a connection box on top of the ceiling panels.

L. Thermometer/Alarm: Provide flush-mounted Digital Thermometer/Alarm combination, programmable design, located at convenient reading height adjacent to each door frame assembly at each compartment. Sensor bulb inside cooler shall be of heat sink design to minimize accidental damage and to reflect accurate temperature.

M. Sleeves: Provide sleeved openings through insulated panels for all refrigerant, drain, or electrical service lines in refrigerated compartment walls or ceiling panels. Sleeves shall be of a size to allow at least 1/2" clearance around insulation of pipes and conduits. Sleeves shall be plastic pipe fitted with plastic flanges inside and out. Sleeves and flanges shall be cemented at wall surfaces to provide strength and vapor seal. After pipes or devices are installed in sleeves, annular spaces shall be closed with glass fiber or foamed-in-place urethane insulation and a nastuc seal applied at each end of sleeve.

N. Closure and Trim: Provide trim strips to close in all vertical areas between edge of walk-in refrigerated storage units and adjacent building walls. Closure panels and trim strips shall be constructed of material to match adjoining wall panels.

O. Curtains: At each entrance door of unit, excluding interior partition doors, install vinyl plastic strip curtains across full width of door opening. Curtain shall consist of rounded edge extruded vinyl strips with center loop design to allow left or right traffic flow.

2.4 REFRIGERATION SYSTEMS

A. Provide and install where shown on plans, all labor, material and equipment necessary to provide rack-type refrigeration systems as listed.

B. Condensing units shall be semi-hermetic type, serviceable in the field; completely sealed units will not be acceptable. Each condensing unit shall be furnished with and shall have installed: liquid line service valve, liquid line sight glass, liquid line drier, liquid line vibration absorber, suction line accumulator, suction filter, suction line vibration absorber, suction line service valve, and oil separator.

C. Refrigerant Piping: Where refrigerant suction line is trapped, use next size smaller pipe in vertical portion of the trap than that indicated, so as to acquire sufficient gas velocity for proper oil return. Where refrigerant lines are buried in concrete floor or in masonry walls, use soft copper tubing in steel conduit, all installed with long radius bends so that tubing can be pulled out and replaced at any time in the event of leak. Suction lines shall be sized to give maximum pressure drop of 2-pounds in medium-temperature systems; 1-pound in low-temperature systems. Liquid lines for medium-temperature systems not installed in electrical type conduit shall be insulated with foamed plastic insulation, in thickness required to prevent condensation, but not less than 1/2"; low-temperature lines shall be insulated with not less than 3/4" thick insulation.

D. Hangers: All horizontal piping shall be properly supported by adjustable hangers, spaced eight (8) feet on center and adjusted to prevent sag and permit proper drainage. Hangers for cold refrigerant lines shall be fastened outside of covering using galvanized steel bands.

E. Condensing Unit Racks and Housings: Condensing units shall be mounted on heavy duty single or multi-tiered racks, as specified, of sufficient strength to support the weight of all

condensing units mounted hereon, constructed in such a manner to facilitate servicing of condensing unit. The rack shall be primed and painted with two coats baked enamel to prevent corrosion. Outdoor units shall be provided with a weatherproof housing equipped with removable panels to permit servicing and adequate ventilation. Mounting rails shall be not less than 3" angles or 4" channels. Entire framework shall be primed with rust-inhibiting primer and painted with two coats enamel.

F. Unit Coolers shall be suspended types with propeller or muliti-blade fans. Each unit cooler shall be self-contained in a suitable metal casing which is standard with the manufacturer. The casing shall be provided with baked enamel or other approved rust-inhibiting finish. The unit coolers shall be quiet in operation and fans shall be directly connected to electric motors having suitable current characteristics and sufficient power for the application.

G. Evaporator coils shall be of nonferrous metal and shall be either extended surface or plain. Each unit cooler shall be furnished and installed with: heat exchanger, liquid line solenoid valve, expansion valve, and suction line P-trap.

H. Coils shall employ an electric, automatic air defrost during the period of refrigeration cutoff. All coils shall be provided with suitable zinc-coated steel or nonferrous drip pans and drains. The controls of unit coolers shall be by means of room thermostats and solenoid valves in the liquid refrigerant lines. Manual switches shall be provided for unit cooler fans. Automatic electric defrost shall be used on units operating in rooms at low-temperatures (minus 10-degrees to plus 34-degrees F.).

I. Electric Defrosting: Each low-temperature system shall include electric heaters, electric defrost timer, drain-pan heater, heating safety thermostat and electrical controls assembled as a unit compatible with the unit cooler. The liquid solenoid valve shall be installed in a manner which will permit it to be controlled thermostatically by the refrigerated area thermostat during normal operation.

J. Condensate drain piping shall be type L hard copper tubing with brass or copper composition fittings jointed with 50-50 lead-tin solder. Drain lines within the refrigerated spaces shall be trapped to prevent air backflow and pitched to adequately drain and minimize fouling. Electric drain line heaters shall be provided at all low-temperature system.

K. Sleeves: Provide sleeved openings through roof and/or walls for all refrigerant or drain lines extending from remote condensing units to refrigerated units. Sleeves shall be of a size to allow at least 1/2" clearance around insulation of pipes and conduits. Sleeves shall be plastic pipe fitted with plastic flanges inside and out. Sleeves and flanges shall be cemented at wall surfaces to provide strength and vapor seal. After pipes or devices are installed in sleeves, annular spaces shall be closed with glass fiber or foamed-in-place urethane insulation and a mastic seal applied at each end of sleeve.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Check all dimensions at the jobsite which will affect and govern fabrication of equipment, including means of ingress and delivery into the building.

B. Rough-in Work: The installer of food service equipment must examine the rough-in mechanical and electrical services by others, and the installation of floors, walls, columns and ceilings by others, and conditions under which the work is to be done; and must verify dimensions of the services and substrates before fabricating the work. Notify the Contractor in writing of unsatisfactory locations and dimensions of other work and of unsatisfactory conditions for the proper installation of food service equipment. Do not proceed with the fabrication and installation until unsatisfactory dimensions and conditions have been corrected in a manner acceptable to the Installer.

3.2 INSTALLATION

A. Supervision: The installer of the food service equipment shall provide a competent foreman or supervisor who shall remain on the job during the entire time of the installation of equipment covered by the section. Foreman or supervisor shall meet with and work in close harmony with other trades with regard to connections and installation.

B. Service Line and Equipment Connection: Refer to Division 22 Sections for piping connections and piping systems. Refer to Division 26 Sections for electrical work including equipment connections.

C. Mechanical work specifically included under this section shall be done in strict accordance with other sections of the specifications which set forth standards for this type of work.

D. Setting the Equipment: Uncrate, assemble, level and repair any damaged or abraded surfaces. Set each item of non-mobile and non-portable equipment, including custom-fabricated items, in its final location, permitting the various trades to take necessary measurements for connection of the service lines; move the equipment sufficiently to permit the installation of such service lines, after which the equipment shall be realigned level and plumb with final erection as shown on the drawings. Anchor to supporting substrate where indicated and where required for sustained operation use without shifting or dislocation.

E. Complete field assembly joints in the work (joints which cannot be completed in the shop) by welding, bolting and gasketing, or similar methods as indicated. Grind welds smooth and restore finish.

F. Treat enclosed spaces (inaccessible after equipment installation) by covering horizontal surfaces with powered borax at a rate of 4 ounces per square foot.

G. Install closure plates and trim strips where required, with joints coordinated with units of equipment. Trim is not an acceptable substitute for accuracy and neatness, and when trim is required and acceptable in lieu of rejection of items of equipment, it is the food service equipment Installer's responsibility to provide the same at no extra cost. Where trim is required, it shall be installed in an approved manner with concealed fasteners.

H. Install sealants and gaskets all around each unit to make joints airtight, waterproof, vermin-proof and sanitary for cleaning purposes. In general, make sealed joints not less than 1/8" wide, and stuff with baker rod to shape sealant bead properly, at 1'4" depth. Shape exposed surfaces of sealant or gaskets to form a sanitary cove of not less than 3/8" radius, with edges flush with faces of materials at joints. Provide sealant-filled or gasketed joints up to 3/4" wide, metal closure strips for wide joints, with sealant application each side of strips. Anchor gaskets mechanically or with adhesive to prevent displacement.

I. Installation Standards: Each item of food service equipment shall be installed in accordance with the requirements of the "Manual on Sanitation Aspects of Installation of Food Service Equipment" published by the National Sanitation Foundation, Ann Arbor, Michigan.

J. Keep the premises free from the accumulation of waste materials and rubbish associated with this work, and at the completion of the work remove all rubbish and implements, leaving the area broom clean.

K. Provide and maintain coverings and other approved protection for the finished surfaces and other parts of equipment subject to damage during the work and after erection. After completion of installation, and completion of other major work in food service areas, remove protective coverings, if any, and clean food service equipment, internally and externally. Restore exposed and semi-exposed finishes to remove abrasions and other damages; polish exposed metal surfaces; touchup painted surfaces. Replace work which cannot be successfully restored.

3.3 TESTING, STARTUP AND INSTRUCTIONS

A. Delay the startup food service equipment until service lines have been tested, balanced, and adjusted for pressure, voltage and similar considerations; and until water and steam lines have been cleaned and treated for sanitation.

B. Test each item of operational equipment to demonstrate that it is operating properly, and that controls and safety devices are functioning. Repair or replace equipment which is found to be defective in its operation, including units which are below capacity or operating with excessive noise or vibration.

C. Instruct Owner's operating personnel in the proper operation and maintenance procedures for each item of operational food service equipment. Demonstrations shall be by authorized representatives of the manufacturers and shall be scheduled to permit adequate time by each representative to thoroughly indoctrinate the owner's operating personnel at each item of equipment.

D. Final Cleaning: After testing and startup and before the time of substantial completion, clean and sanitize food service equipment, and leave ready for use in food service.

3.4 FOODSERVICE EQUIPMENT SCHEDULE

A. Provide and/or install the following items of food service and laundry equipment, complete in every respect, including testing and demonstration, as indicated on the drawings and as specified herein and in accordance with the requirements specified hereinbefore to the extent said requirements apply thereto. Refer to the drawings and schedules for quantities, locations and contract status of equipment covered by this section.

ITEM NO 0-018 HIGH TEMP. ALARM
Quantity Req'd.: 2

Included with cold storage rooms. See catalog sheet

ITEM NO 1-019 REMOTE BEER SYSTEM

Quantity Req'd.: 1
Manufacturer: Perlick Corp
Model No.: CENTURY SYSTEM

Draft Beer System, Remote, recirculating type, air-cooled refrig. system, six flavors, 1/3 HP, with single pump, baked enamel exterior finish. Installed in complete working order to dispensing head at bar.

ITEM NO 1-020 REMOTE CONDENSING UNIT, FREEZER

Quantity Req'd.: 1
Manufacturer: Airdyne
Model No.: WSL20E3

Refrig. System, Remote Compressor/Condenser, designed for indoor installation, water-cooled condenser, with painted steel housing. To be mounted on roof of walk-in cooler/freezer. See section 2.03 and refrigeration drawings.

ITEM NO 1-021 REMOTE CONDENSING UNIT, COOLER

Quantity Req'd.: 1
Manufacturer: Airdyne
Model No.: WSM10E3

Refrig. System, Remote Compressor/Condenser, designed for indoor installation, water-cooled condenser, with painted steel housing. To be mounted on roof of walk-in cooler/freezer. See section 2.04 and refrigeration drawings.

ITEM NO 1-022 WALK-IN FREEZER

Quantity Req'd.: 1
Manufacturer: RMI
Model No.: Custom

Refrigerated Storage Unit, Walk-in, low-temperature (-10F), size as shown, for installation in floor depression, stucco aluminum interior & exterior, 8'-6" overall height (nominal). See section 2.03

ITEM NO 1-023 WALK-IN COOLER

Quantity Req'd.: 1
Manufacturer: RMI
Model No.: Custom

Refrigerated Storage Unit, Walk-in, medium-temperature (34F), size as shown, for installation in floor depression, stucco aluminum interior & exterior, 8'-6" overall height (nominal). See section 2.03

ITEM NO 1-024 EVAPERATOR COIL, FREEZER

Quantity Req'd.: 1
Manufacturer: AIRDYNE
Model No.: LET090BEK
See section 2.04 and refrigeration drawings

ITEM NO 1-025 EVAPORATOR COIL

Quantity Req'd.: 1
Manufacturer: Airdyne
Model No.: ADT090AEK Evaporator Coil, med-temp (+34F), low profile design, air-defrost type, aluminum/plastic housing. See section 2.04 and refrigeration drawings

ITEM NO 1-026 BEER KEG RACK

Quantity Req'd.: 1
Manufacturer: Perlick Corp
Model No.: FOUR KEG

ITEM NO 1-027 SHELVING UNIT

Quantity Req'd.: LOT
Manufacturer: Metro Equipment Corporation
Model No.: METROSEAL, 4-TIER
Sizes as shown on drawings joined with “S” hooks where possible

Provide unit with the following:

- Tubular shelves with load capacity of 1500 lbs.
- 72" high.
- Four tiers high.

ITEM NO 1-028 ICE MAKER

Quantity Req'd.: 2
Manufacturer: Scotsman
Model No.: C1030SW-32
Water cooled. Provide with bin adapter for item 1-029, Ice Bin

ITEM NO 1-029 BIN, ICE DISPENSING, W/ TRANSPORT CARTS

Quantity Req'd.: 1
Manufacturer: Follett Corp
Model No.: DEV2250SG-72-75

Ice Bin, w/top-hinged front-opening door, approx. 2250-lb ice storage capacity, for top-mounted ice maker, all stainless steel finish standard with two 150# “SmartCart 75” ice transport carts .

ITEM NO 1-030 FILTER SYSTEM, ICE MACHINES

Quantity Req'd.: 1
Manufacturer: Scotsman Ice
Model No.: SSM3-P
Water Filter, Ice Machines, triple cartridge, dual media cartridge, sediment, cyst, and bacteria reduction, NSF 53.

ITEM NO 1-031 FLOOR DRAIN GRATE

Quantity Req'd.: 1
Manufacturer: Custom Fabricated Assembly
Model No.: Custom Stainless steel

Floor Drain Grate Assembly, floor drain-trough style, with stainless steel bar-type grating, length and width as shown on drawings, all stainless steel construction. See detail

ITEM NO 1-032 ICE TRANSPORT CART

Quantity Req'd.: 3

Manufacturer: Follett Corp
Model No.: 150# “SmartCart 75”

ITEM NO 1-033 CABINET, HEATED

Quantity Req'd.: 5
Manufacturer: Crescent Metal
Model No.: 130-1836D

Cabinet, Mobile Heated, non-insulated with removable heater assembly, corrugated pan support slides for 18" x 26" tray, slides on approximately 1-1/2" centers, welded tubular aluminum frame, aluminum panels.

ITEM NO 1-034 WORK TABLE

Quantity Req'd.: 1
Manufacturer: Custom Fabricated Assembly
Model No.: Custom Stainless

Work Table, 30” X 102”, Open Base, stainless steel top with square turn down edges, 6” high back splash.

ITEM NO 1-035 SHELF, WALL-MOUNTED

Quantity Req'd.: 1
Manufacturer: Custom Fabricated Assembly
Model No.: Custom-Fabrication

Shelf, Wall-Mounted, solid flat design with rear turn-up, stainless steel construction, width as shown, length as shown on drawings, mounted on heavy-duty shelf brackets.

ITEM NO 1-038 CART, BUSSING

Quantity Req'd.: 3
Manufacturer: Cambro Mfg Co
Model No.: BC235-131

ITEM NO 1-039 HAND SINK, W/SOAP & TOWEL DISP

Quantity Req'd.: 1
Manufacturer: Advance Inc.
Model No.: 7-PS-82

Hand Sink, wall model, 10" x 14" sink compartment, all stainless steel construction, with swing spout faucet, soap and towel dispenser.

ITEM NO 1-040 SHELVING UNIT

Quantity Req'd.: 1 LOT
Manufacturer: Metro Equipment Corporation
Model No.: Super Erecta, Chrome
-
Sizes as shown on drawings joined with “S” hooks where posible

Provide unit with the following:

- Tubular shelves with load capacity of 1500 lbs.
- 72" high.
- Four tiers high.
  - Tubular shelves with load capacity of 1500 lbs.
  - 72" high.
  - Four tiers high.

ITEM NO 1-041 BULK C02 CONTAINER

Quantity Req'd.: 1
Manufacturer:
Model No.: BY PERVEYOR

ITEM NO 1-042 FILTER SYSTEM, FOUNTAIN BEVERAGE

Quantity Req'd.: 1
Manufacturer: 3M
Model No.: BEV130

ITEM NO 1-043 BEVERAGE LINE CONDUITS

Quantity Req'd.: 1 LOT
By Electrician
See Electrical

ITEM NO 1-044 CARBONATOR

Quantity Req'd.: 1
Manufacturer: Cornelius Co.
Model No.: 416424000 (By Purveyor)

Carbonator, open base design. Filter water through item # 1-041, water filter.

ITEM NO 1-045 BAG-IN-BOX RACK

Quantity Req'd.: 1
Manufacturer: The Cornelius Company
Model No.: BIB.10005 (By Purveyor)

Shelving Unit, Modular, wire shelves, stainless steel, width as shown, mounted on adjustable sanitary feet.

ITEM NO 1-046 SHELVING UNIT

Quantity Req'd.: LOT
Manufacturer: Metro Equipment Corporation
Model No.: Super Erecta, Chrome -
-
Sizes as shown on drawings joined with “S” hooks where posible
Provide unit with the following:

- Tubular shelves with load capacity of 1500 lbs.
- 72" high.
- Four tiers high.

ITEM NO 1-048 WASTE RECPTICAL

Quantity Req'd.: 1
Manufacturer: Rubbermaid
Model No.: FG295700

ITEM NO 1-049 BACK BAR

Quantity Req'd.: 1
Manufacturer: Custom Fabricated Assembly
Model No.: Custom-Millwork

See Interior Designer drawings for details

ITEM NO 1-050 COFFEE BREWER

Quantity Req'd.: 1
Manufacturer: Wilbur Curtis
Model No.: GEM-12

Coffee Brewer, high capacity brewing system, twin brewing heads, adjustable brewing capacity, all stainless steel construction. Provide with water filtration system.

ITEM NO 1-052 OVEN, MICROWAVE/CONVECTION, COMBI

Quantity Req'd.: 1
Manufacturer: TurboChef
Model No.: NGC-1280-1 (TORNADO 2)

Oven/Steamer Combination, Counter Model, , countertop model, , all stainless steel interior and exterior finish.

ITEM NO 1-053 DROP-IN, DISH DISPENSERS, UNHEATED

Quantity Req'd.: 2
Manufacturer: EAGLE
Model No.: 359102

Drop-In, Dish Dispensers, Unheated. Verify dish sizes with owner.

ITEM NO 1-054 WARMER, FOOD, ELECTRIC

Quantity Req'd.: 1
Manufacturer: Hatco Corp.
Model No.: GMFFL

ITEM NO 1-055 REFRIGERATOR SLEEVE FOR COLD OPENING

Quantity Req'd.: 1
Manufacturer: Custom Fabricated Assembly
Model No.: Custom Stainless

16 Ga. Stainless steel, ell-shaped sleeve for installation in top cold opening in item # 1-058, Sandwich prep Refrigerater. Attach cold opening lid hardware to sleeve.

ITEM NO 1-056 WARMER, FOOD, ELECTRIC

Quantity Req'd.: 1
Manufacturer: Wells Mfg Co
Model No.: SMPT

ITEM NO 1-057 P.O.S. PRINTER

Quantity Req'd.: 1
Manufacturer: TBD
Model No.: TBD

ITEM NO 1-058 REFRIGERATOR, SANDWICH/SALAD PREP

Quantity Req'd.: 1
Manufacturer: True Food Serv
Model No.: TSSU-60-16 ADA

Field laminate door faces and edges. Verify laminate finish with Interior Designer

ITEM NO 1-059 DISPENSING HEAD, DRAFT BEER, ICED

Quantity Req'd.: 1
Manufacturer: Perlick Corp
Model No.: 4044-4B

DISPENSING HEAD, DRAFT BEER, ICED PANTHER TOWER four flavors.

ITEM NO 1-060 ESPRESSO MACHINES, SEMI AND/OR SUPER

Quantity Req'd.: 1
Manufacturer: SIMONELLI
Model No.: APPIA 1 GROUP (***Verify make and model # with owner***)

Espresso/Cappucino Machine, semi-automatic, Group 1, compact design, stainless steel finish.

ITEM NO 1-061 FILTER SYSTEM, ESPRESSO MACHINE

Quantity Req'd.: 1
Manufacturer: 3M
Model No.: BREW110-MS

ITEM NO 1-062 BACK BAR REFRIGERATOR

Quantity Req'd.: 1
Manufacturer: True Manufacturing
Model No.: TBB-24GAL-G S

ITEM NO 1-063 BEER LINE CONDUITS

Quantity Req'd.: 1 LOT
By Electrician
See Electrical PLAN

ITEM NO 1-064 TRASH CHUTE AND WASTE RECPTICAL

Quantity Req'd.: 2
Manufacturer: Rubbermaid
Model No.: FG295700
Also included: Drop-in stainless steel scrap chute

ITEM NO 1-065 BAR TOP AND DIE WALL

Quantity Req'd.: 1
Manufacturer: Custom millwork
Model No.: Custom

See Interior Designer's drawings for details.

ITEM NO 1-066 GLASSWASHER

Quantity Req'd.: 1
Manufacturer: Moyer
Model No.: MD240HT (USA ONLY)

Glass Washer, low temperature chemical sanitizing, rotary design, 24" cabinet, counter-clockwise rotation, all stainless steel finish.

ITEM NO 1-067 UNDERBAR BLENDER STATION

Quantity Req'd.: 1
Manufacturer: EAGLE
Model No.: BS14-19

Blender Station, free standing unit, 14"-wide, with dump sink and goose neck faucet, all stainless steel construction.

ITEM NO 1-068 BAR GUN, 8 BUTTON

Quantity Req'd.: 1
Manufacturer: Cornelius Co.
Model No.: By Purveyor

Beverage Dispenser, Carbonated, post-mix type, ice-cooled, undercounter design, with electric valves, eight flavors.

ITEM NO 1-069 BLENDER, BEVERAGE

Quantity Req'd.: 1
Manufacturer: Waring Prod
Model No.: BB150

ITEM NO 1-070 UNDERBAR COCKTAIL UNIT

Quantity Req'd.: 1
Manufacturer: EAGLE
Model No.: BCT36R-19-8

Ice Bin/Cocktail Station, Modular, standard depth, with built-in coldplate, 36" wide x 19" front-to-back, approximately 70-lbs. ice capacity, all stainless steel construction.

ITEM NO 1-071 UNDERBAR WORK BOARD

Quantity Req'd.: 1
Manufacturer: EAGLE
Model No.: WB36-19

Underbar Workboard, free standing design, 36"-long, 19" front-to-back, all stainless steel finish.

ITEM NO 1-072 SPEED RAIL

Quantity Req'd.: 1
Manufacturer: EAGLE
Model No.: 501045

ITEM NO 1-073 UNDERBAR HANDSINK

Quantity Req'd.: 1
Manufacturer: EAGLE
Model No.: HSD12-24

Hand Sink Unit, free standing design, 12"-long, with faucet, soap dispenser and towel dispenser, stainless steel construction including legs.

ITEM NO 1-074 P.O.S. TERMINAL

Quantity Req'd.: 1
Manufacturer: TBD
Model No.: TBD

Cash Register / POS System, Point-Of-Sale computerized type, with CRT display, with cash drawer, plastic finish.

ITEM NO 1-075 KNOCK BOX CHUTE W/ WASTE CAN UNDER

Quantity Req'd.: 1ea
Manufacturer: Rattleware
Model No.: RW2502
Manufacturer: Rubbermaid
Model No.: FG295700

ITEM NO 1-075 PITCHER WASHER

Quantity Req'd.: 1ea
Manufacturer: Espresso parts
Model No.: EPPR6102

ITEM NO 1-077 BAKERY CASE, REFRIGERATED

Quantity Req'd.: 1
Manufacturer: True Food Serv
Model No.: TCGG-36

Laminate sides front and top to match bar. Verify with Interior Designer

ITEM NO 1-078 REACH-IN REFRIGERATOR/FREEZER

Quantity Req'd.: 1
Manufacturer: True Food Serv
Model No.: T-23DT-G

Refrigerator/Freezer, Reach-in, One-Section, Self-Contained Refrig System, stainless steel interior and exterior, standard depth cabinet, glass doors, with exterior dial-type thermometer.

ITEM NO 1-079 REFRIGERATOR, REACH-IN

Quantity Req'd.: 1
Manufacturer: True Food Serv
Model No.: T-49G

Refrigerator, Reach-in Display, Two-Section, Self-Contained Refrig system, stainless steel interior and exterior, standard depth, wide glass doors.

ITEM NO 1-080 MILLWORK COUNTER

Quantity Req'd.: 1
Manufacturer: Custom Fabricated Assembly
Model No.: Custom- millwork

Verify configuration and finish with Interior Designer. size and shape as shown on drawings, overall length as shown on drawings, plastic laminate/plywood top and base.

ITEM NO 1-081 OVEN, MICROWAVE

Quantity Req'd.: 1
Manufacturer: Amana Refrig
Model No.: RFS12TS

Oven, Microwave, single shelf, high voltage, with touch plate controls, side hinged door.

ITEM NO 1-083 SILVERWARE CYLINDERS

Quantity Req'd.: 4
Manufacturer: Cambro
Model No.:

Silverware Cylinders.

ITEM NO 1-084 MILLWORK COUNTER

Quantity Req'd.: 1
Manufacturer: Custom
Model No.: Custom Millwork

Verify configuration and finish with Interior Designer. size and shape as shown on drawings, overall length as shown on drawings, plastic laminate/plywood top and base. See I.D. drawings for details

ITEM NO 2-087 PREP TABLE W/ SINKS

Quantity Req'd.: 1
Manufacturer: Custom Fabricated Assembly
Model No.: Custom-Fabrication

Sink Work Table, “L” shaped, size and shape as shown on drawings. Two compartment sink, stainless steel top, w/raised-V non-spill edges, 8" splash, w/left & right-hand drainboards, stainless steel open frame base three high drawers on each end, and with fixed stainless steel undershelves and table mounted overshelves.

ITEM NO 2-088 TRASH RECEPTACLE

Quantity Req'd.: 1
Manufacturer: Rubbermaid
Model No.: 2632

Waste Receptacle, general purpose waste, with lid, approximately 30-gallon capacity, high-impact rubber construction.

ITEM NO 2-091 WORK TABLE

Quantity Req'd.: 1
Manufacturer: Custom Fabricated Assembly
Model No.: Custom-Stainless

14 gauge stainless steel. Size and shape as shown on drawings with 6” high backsplash and tool drawer

ITEM NO 2-092 SHELF, WALL-MOUNTED

Quantity Req'd.: 1
Manufacturer: Custom Fabricated Assembly
Model No.: Custom-Stainless

Shelf, Wall-Mounted, solid flat design with rear turn-up, stainless steel construction, width as shown, length as shown on drawings, mounted on heavy-duty shelf brackets.

ITEM NO 2-093 MIXER, 20-QUART

Quantity Req'd.: 1
Manufacturer: Hobart Corp.
Model No.: HL200

Mixer, Food, bench style, approx. 20-qt. capacity bowl, three-speed drive with timer, stainless steel bowl, baked enamel housing.

ITEM NO 2-094 RACK, UTILITY

Quantity Req'd.: 4

Manufacturer: Lakeside
Model No.: 8900

Sink Work Table, Two Compartment, stainless steel top, w/raised-V non-spill edges, 8" splash, w/left & right-hand drainboards, stainless steel open frame base, with fixed stainless steel undershelves.

ITEM NO 2-095 WORK TABLE

Quantity Req'd.: 1
Manufacturer: Custom Fabricated Assembly
Model No.: Custom-stainless

Work Table, Open Base,14 gauge stainless steel top with square turn down edges with 6" high backsplash and tool drawer .

ITEM NO 2-096 SLICER

Quantity Req'd.: 1
Manufacturer: Hobart Corp.
Model No.: 2712

Provide with the following:
High fence
Food chute
Heavy meat grip

ITEM NO 2-097 SHELF, WALL-MOUNTED

Quantity Req'd.: 1
Manufacturer: Custom Fabricated Assembly
Model No.: Custom-stainless

Shelf, Wall-Mounted, solid flat design with rear turn-up, stainless steel construction, width as shown, length as shown on drawings, mounted on heavy-duty shelf brackets.

ITEM NO 2-098 HAND SINK, W/SOAP & TOWEL DISP

Quantity Req'd.: 1
Manufacturer: Advance Inc.
Model No.: 7-PS-82

Hand Sink, wall model, 10" x 14" sink compartment, all stainless steel construction, with swing spout faucet, knee valve,and soap and towel dispenser.

ITEM NO 2-100 CABINET, HEATED

Quantity Req'd.: 6
Manufacturer: Crescent Metal

Model No.: 130-1836D

Cabinet, Mobile Heated, non-insulated with removable heater assembly, corrugated pan support slides for 18" x 26" tray, slides on approximately 1-1/2" centers, welded tubular aluminum frame, aluminum panels.

ITEM NO 2-101 SHELVING UNIT FOR POTS & PANS

Quantity Req'd.: 1
Manufacturer: Metro Equipment Corporation
Model No.: Super Erecta
-
Size as shown on drawing
Provide unit with the following:

- Tubular shelves with load capacity of 1500 lbs.
- 72" high.
- Four tiers high.
- 5” locking casters

.

ITEM NO 2-102 POT SINK, 3 COMPARTMENT

Quantity Req'd.: 1
Manufacturer: Custom Fabricated Assembly
Model No.: Custom stainless

Sink, Three Compartment, stainless steel, w/left & right-hand drainboards, sink sizes as shown on drawings, 14" deep, with faucets, lever waste w/ overflows, 8" high splash, s/s open frame base, rear and side crossrails, und undershelves on each end.

ITEM NO 2-103 POT RACK, WALL-MOUNTED

Quantity Req'd.: 1
Manufacturer: Custom Fabricated Assembly
Model No.: Custom stainless

Pot Rack, Wall-Mounted, double bar design, length as shown on drawings, with stainless steel double hooks, constructed of 1/4" x 2" stainless steel.

ITEM NO 2-105 FIRE SUPPRESSION SYSTEM

Quantity Req'd.: 1
Manufacturer: Ansul
Model No.: included with exhaust hood

Fire Suppression System, dry chemical system, w/mechanically operated control head, wall-mounted tank assembly, chrome-plated fittings and pipe.

ITEM NO 2-106 EXHAUST HOOD W/ WALL FLASHING

Quantity Req'd.: 1
Manufacturer: Captive Aire
Model No.: CUSTOM

Exhaust Hood, wall-mounted canopy style, exhaust only, removable baffle-type filters, all stainless steel finish. See hood drawings. Provide and install 20 gauge s/s wall flashing.

ITEM NO 2-107 FRYER BATTERY, DEEP FAT, GAS, and W/FILTER

Quantity Req'd.: 1
Manufacturer: Pitco, Inc.
Model No.: 2-SG14C-S/FD

Fryer Battery, Deep Fat, Gas W/Filter.
Provide with 36” flex gas hose with quick disconnect and restraint device.

ITEM NO 2-108 FRYER, DUMP STATION

Quantity Req'd.: 1
Manufacturer: Pitco, Inc.
Model No.: BNB-E14SS

Fryer, Dump Station.

ITEM NO 2-109 REFRIGERATOR, SHORTY COOK TOP

Quantity Req'd.: 1
Manufacturer: True Food Serv
Model No.: TRCB-110

Refrigerated Cabinet, "Lowboy", three-section, with drawers, stainless steel exterior and interior, with side-mounted self-contained refrig system.

ITEM NO 2-110 GRIDDLE, GAS

Quantity Req'd.: 1
Manufacturer: Jade Range
Model No.: JGT-2436

Griddle, Counter Unit, Gas-Fired, polished smooth grill plate, approximately 36"-wide x 24"-deep grill area, throttling type thermostat controls, all stainless steel exterior finish.
Provide with 36” flex gas hose with quick disconnect and restraint device

ITEM NO 2-111 SIX BURNER HOT PLATE

Quantity Req'd.: 1
Manufacturer: Jade Range
Model No.: JHP--636
Provide with 36” flex gas hose with quick disconnect and restraint device

ITEM NO 2-112 BROILER, UNDER-FIRED/GAS

Quantity Req'd.: 1
Manufacturer: Jade Range
Model No.: JB-36

Broiler, Counter Char-Type, Gas-Fired, with ceramic briquettes, fixed top grid, cast iron grid assembly, stainless steel front and sides.
Provide with 36” flex gas hose with quick disconnect and restraint device

ITEM NO 2-113 HIGH SPEED BROILER W/ OVEN

Quantity Req'd.: 1
Manufacturer: Jade Range
Model No.: JSHBI-36H

Broiler, Deck-Type, Gas-Fired, two radiant decks, convection oven base, all stainless steel exterior finish, on 6” casters.
Provide with 36” flex gas hoses with quick disconnect and restraint device

ITEM NO 2-115 COMBI-OVEN STEAMER

Quantity Req'd.: 1
Manufacturer: Rational
Model No.: CMP 62G CMPGG MOBILE

Oven, Convection, Gas-Fired, double-deck, standard depth, electronic controls, with 7" high legstand, stainless steel front, sides, and top.
Provide with 36” flex gas hoses with quick disconnect and restraint device

ITEM NO 2-116 TILT SKILLET, ELECTRIC

Quantity Req'd.: 1
Manufacturer: Groen
Model No.: BPP-40E/TDO

Tilting Skillet, Electric, 40-gallon capacity, open leg frame base, standard with electric tilt mechanism, all stainless steel.

ITEM NO 2-117 WATER FILTRATION SYSTEM

Quantity Req'd.: 1
Manufacturer: 3M
Model No.: DF290-CL

WATER FILTRATION SYSTEM for 2-115, and 2-120. Wall Mounted.

ITEM NO 2-118 FLOOR DRAIN GRATE

Quantity Req'd.: 1
Manufacturer: Custom Fabricated Assembly
Model No.: Custom-stainless
Floor Drain Grate Assembly, floor drain-trough style, with stainless steel bar-type grating, length and width as shown on drawings, all stainless steel construction. See detail

ITEM NO 2-120 CONVECTION STEAMER/ KETTLE

Quantity Req'd.: 1
Manufacturer: Groen
Model No.: HY-6SG36TDC/3-20

Steamer, Convection, Gas-Fired, two compartments, 36" cabinet base, six 12"x 20"x 2.5" deep pans/compartment, Gas-Fired Steam Generator, all stainless steel exterior & interior finish.

ITEM NO 2-122 CHEF'S COUNTER

Quantity Req'd.: 1
Manufacturer: Custom Fabricated Assembly
Model No.: Custom-stainless

Chef's Counter, details of construction as shown on drawings, 14 gauge stainless steel top, stainless steel open front cabinet base, with sink and faucet as shown.

ITEM NO 2-123 REFRIGERATOR, UNDERCOUNTER, COMPACT

Quantity Req'd.: 1
Manufacturer: Delfield Co.
Model No.: UCD4448N

Refrigerated Cabinet, Undercounter, two-section, with drawers, reach-in, with stainless steel top, stainless steel exterior, vinyl interior, with rear-mounted self-contained refrig. system.

ITEM NO 2-124 DISH STORAGE CABINET

Quantity Req'd.: 1
Manufacturer: Custom Fabricated Assembly
Model No.: Custom-Stainless

Dish Storage Cabinet, details of construction as shown on drawings, 14 gauge stainless steel top, stainless steel open front cabinet base, with double overshelves

ITEM NO 2-125 HAND SINK, W/SOAP & TOWEL DISP

Quantity Req'd.: 1
Manufacturer: Advance Inc.
Model No.: 7-PS-82

Hand Sink, wall model, 10" x 14" sink compartment, all stainless steel construction, with swing spout faucet, knee valve, and soap and towel dispenser.

ITEM NO 2-126 DISH STORAGE CABINET

Quantity Req'd.: 1
Manufacturer: Custom Fabricated Assembly
Model No.: Custom-Fabrication

Dish Storage Cabinet, details of construction as shown on drawings, 14 gauge stainless steel top, stainless steel open front cabinet base, with double overshelves

ITEM NO 2-127 REFRIGERATED BASE W/PAN RAIL

Quantity Req'd.: 1
Manufacturer: Delfield Co.
Model No.: F18RC52

Refrigerated Counter, Pizza Top, two-section, with doors, stainless steel top with refrigerated pan rail, stainless steel exterior and interior, with side-mounted self-contained refrig system.

ITEM NO 2-128 HOT FOOD COUNTER, 2-WELL

Quantity Req'd.: 1
Manufacturer: Delfield Co.
Model No.: F14EI232

Food Well Unit, Counter, Electric, wet or dry operation, two 12" x 20" pans, with infinite-heat type controls, all stainless steel exterior finish, with 6" high legs.

ITEM NO 2-129 FREEZER, UNDERCOUNTER, COMPACT

Quantity Req'd.: 1
Manufacturer: Delfield Co.
Model No.: D4532N

Freezer Cabinet, Undercounter, one-section, with drawers, stainless steel top, stainless exterior, vinyl interior, with rear-mounted self-contained refrig. system.
Custom fabricate 14 ga. s/s top with back splash to match item # 2-128.

ITEM NO 2-130 HEAT LAMP

Quantity Req'd.: 2
Manufacturer: Hatco Corp.
Model No.: GRAH-48

Heat Lamp Assembly, tubular metal heater rod, single heater rod housing, aluminum construction, w/high wattage elements, 48" long housing. Mount under over shelf of #2-126

ITEM NO 2-132 CART, BUSSING

Quantity Req'd.: 3
Manufacturer: Cambro Mfg Co
Model No.: BC235-131

ITEM NO 2-133 ICE BIN WITH SODA TOWER

Quantity Req'd.: 1
Manufacturer: Cornelius Co
Model No.: 1522

Ice Bin With Soda Dispensers, drop-in design w/built-in six-circuit cold plate, approximately 80-pound ice storage capacity, faucet tower with six soda faucets, all stainless steel construction.

ITEM NO 2-134 WAITRESS STAITION

Quantity Req'd.: 1
Manufacturer: Custom Fabricated Assembly
Model No.: Custom Stainless

Size and shape as shown on drawings. 14gauge stainless steel top with utility sink and faucet and drainer for glass filler

ITEM NO 2-135 GLASS AND PICTURE FILLER

Quantity Req'd.: 1
Manufacturer: Fisher
Model No.: 1009

ITEM NO 2-137 SHELF WALL MOUNTED

Quantity Req'd.: 1
Manufacturer: Custom Fabricated Assembly
Model No.: Custom Stainless

Size as shown on drawings

ITEM NO 2-138 COFFEE MAKER, INSULATED SERVER

Quantity Req'd.: 1
Manufacturer: Fetco

Model No.: CBS-52H-20

ITEM NO 2-139 REFRIGERATOR, UNDERCOUNTER

Quantity Req'd.: 1
Manufacturer: True
Model No.: TUC-24CP

ITEM NO 2-140 DOLLY, CUP AND GLASS RACK

Manufacturer: Cambro Mfg Co
Model No.: CDR2020H-151

Dolly, Rack, open frame design with pushhandle, single stack, for 20" x 20" racks.

ITEM NO 2-141 CLEAN DISHTABLES

Quantity Req'd.: 1
Manufacturer: Custom Fabricated Assembly
Model No.: Custom-Stainless

Dishtable, Clean, 14 gauge stainless steel top, ell-shaped, right-to-left, size and shape as shown on drawings. 10" high splash at walls, 3" high rolled rims, stainless steel open frame pipe base, with stainless steel fixed under shelves.

ITEM NO 2-142 WALL SHELF, ELL-SHAPED

Quantity Req'd.: 1
Manufacturer: Custom Fabricated Assembly
Model No.: Custom-Fabrication

Shelf, Wall-Mounted, solid flat design with rear turn-up, stainless steel construction, width as shown, length as shown on drawings, mounted on heavy-duty shelf brackets.

ITEM NO 2-143 WAREWASHER, RACK CONVEYOR

Quantity Req'd.: 1
Manufacturer: Hobart Corp.
Model No.: CL44E-E-RL

Dishwasher, Conveyor Type, high temperature w/built-in booster, approx. 200 racks/hour capacity, all stainless steel finish.

ITEM NO 2-144 SIDE LOADER

Quantity Req'd.: 1
Manufacturer: Hobart Corp.
Model No.: SL23 R-L

Side loader.

ITEM NO 2-145 EXHAUST HOOD

Quantity Req'd.: 1
Manufacturer: Captive Aire
Model No.: CUSTOM

Exhaust Hood, wall-mounted canopy style, exhaust only, removable baffle-type filters, all stainless steel finish. See hood drawings

ITEM NO 2-146 DISPOSER, GARBAGE

Quantity Req'd.: 1
Manufacturer: In-Sink-Erator
Model No.: SS-150-SHORT

Disposer, sink mounted, 7" dia. inlet, with collar adapter for trough installation, 1 1/2-HP motor, stainless steel construction/ CC-202 Control panel.

ITEM NO 2-147 DISHTABLE, SOILED

Quantity Req'd.: 1
Manufacturer: Custom fabrication
Model No.: custom stainless

Soiled dishtable,14 gauge stainless steel w/ disposer sink and silverware soak sink w/ perforated basket, and faucet, and T&S B-0113 PRERINSE. 10" high splash at walls, 3" high rolled rims, stainless steel open frame pipe base, with stainless steel fixed undershelves and glass rack sorting shelf over.
.

ITEM NO 2-148 TRASH RECEPTACLE

Quantity Req'd.: 1
Manufacturer: Rubbermaid
Model No.: 2632

Waste Receptacle, general purpose waste, with lid, approximately 30-gallon capacity, high-impact rubber construction.

ITEM NO 2-149 EYE WASH STATION

Quantity Req'd.: 1
Manufacturer: Speakman
Model No.: SE 582

ITEM NO 2-150 CART, DISH & TRAY

Quantity Req'd.: 3

Manufacturer: Cambro Mfg Co
Model No.: DC1125-110

Cart, Dish & Tray.

ITEM NO 2-151 SHELVING UNIT

Quantity Req'd.: 1 LOT
Manufacturer: Metro Equipment Corporation
Model No.: Super Erecta, Chrome

Sizes as shown on drawing

Provide unit with the following:

- Tubular shelves with load capacity of 1500 lbs.
- 72" high.
- Four tiers high.

ITEM NO 2-152 WORK TABLE

Quantity Req'd.: 1
Manufacturer: Custom Fabricated Assembly
Model No.: Custom-Stainless

Work Table,14gauge stainless top , with square turn down edges, 6” high back splash on rear and right side w/ fixed s/s under shelf.

ITEM NO 2-153 REMOTE CONDENSING UNIT,FREEZER

Quantity Req'd.: 1
Manufacturer: Airdyne
Model No.: WSL15E3

Refrig. System, Remote Compressor/Condenser, designed for indoor installation, water-cooled condenser. See section 2.04 and refrigeration drawings

ITEM NO 2-154 SHELVING UNIT

Quantity Req'd.: LOT
Manufacturer: Metro Equipment Corporation
Model No.: METROSEAL,4-TIER

Sizes as shown on drawing.

Provide unit with the following:

- Tubular shelves with load capacity of 1500 lbs.
- 72" high.
- Four tiers high.

ITEM NO 2-155 EVAPERATOR COIL, FREEZER

Quantity Req'd.: 1

Manufacturer: Airdyne
Model No.: LET065BEK

Evaporator Coil, low-temp (-10F), low profile design, hot gas defrost type, aluminum housing. See section 2.04 and refrigeration drawings

ITEM NO 2-156 WALK-IN COOLER/FREEZER

Quantity Req'd.: 1
Manufacturer: RMI
Model No.: Custom

Refrigerated Storage Unit, Walk-in, multi-compartment, size & temperature as shown, for installation in floor depression, stucco aluminum interior & exterior, 8'-6" overall height (nominal). See section 2.03

ITEM NO 2-157 REMOTE CONDENSING UNIT, COOLER

Quantity Req'd.: 1
Manufacturer: Airdyne
Model No.: WSM10E3

Refrig. System, Remote Compressor/Condenser, designed for indoor installation, water-cooled condenser.

ITEM NO 2-158 EVAPORATOR COIL, COOLER

Quantity Req'd.: 1
Manufacturer: Airdyne
Model No.: ADT090AEK

Evaporator Coil, med-temp (+38F), low profile design, air-defrost type, aluminum/plastic housing. See section 2.04 and refrigeration drawings

ITEM NO 2-159 HIGH TEMP. ALARM

Quantity Req'd.: 2

Included with cold storage rooms. See catalog sheet

ITEM NO 2-160 BUFFET COUNTER

Quantity Req'd.: 1
Manufacturer: Custom Fabricated Assembly
Model No.: Custom Millwork

See Interior designer drawings for details

ITEM NO 2-161 TRASH CHUTE AND WASTE RECPTICAL

Quantity Req'd.: 2
Manufacturer: Rubbermaid
Model No.: FG295700
Also included: Drop-in stainless steel scrap chute

ITEM NO 2-162 SNEEZE GUARD, FULL SERVE/SELF SERVE

Quantity Req'd.: 1
Manufacturer: English
Model No.: AMA-101A 2-TIER

Serving Counter, Cold Food, Verify Design and Configuration with Int. Desgn..

ITEM NO 2-163 DROP-IN, CUP & GLASS RACK DISPENSER

Quantity Req'd.: 2
Manufacturer: Lakeside
Model No.: 973

DROP-IN, DISH DISPENSERS, UNHEATED sub-category, Serving Equipment.

ITEM NO 2-164 COLD BEVERAGE SYSTEM

Quantity Req'd.: 1
Manufacturer: Bunn-o-Matic
Model No.: JDF-2

Beverage Dispenser, Non-Carbonated, single bowl, with two flavors, 1.8-gallons capacity, steel cabinet with vinyl finish, clear lexan bowl and cover.

ITEM NO 2-165 AIRPOT

Quantity Req'd.: 3
Manufacturer: Bunn-o-Matic
Model No.: 36725.0000

Beverage Dispenser, Insulated, 3-gallons capacity, 5" faucet clearance, stainless steel finish.

ITEM NO 2-166 SNEEZE GUARD, FULL SERVE/SELF SERVE

Quantity Req'd.: 1
Manufacturer: English
Model No.: AMA-101A 2-TIER

Serving Counter, Cold Food, Verify Design and Configuration with Int. Desgn..

ITEM NO 2-167 SPARE NUMBER

ITEM NO 2-168 TUREEN/KETTLE,OATMEAL

Quantity Req'd.: 1
Manufacturer: Vollrath Co
Model No.: 72165

ITEM NO 2-168 WATER FILTER

Quantity Req'd.: 1
Manufacturer: 3 M
Model No.: BEV 130

ITEM NO 2-170 BUFFET COUNTER

Quantity Req'd.: 1
Manufacturer: Custom Fabricated Assembly
Model No.: Custom-Millwork

See Interior Design drawings for details

ITEM NO 2-171 DROP-IN, COOKTOP, INDUCTION HEAT

Quantity Req'd.: 4
Manufacturer: Spring
Model No.: SM-651R

Provide with Spring #2172-6/37 Buffet server. See catalog sheet 2-17 A

ITEM NO 2-172 SNEEZE GUARD

Quantity Req'd.: 1
Manufacturer: English
Model No.: M-105 (VFY W/ I.D.)

Serving Counter, Cold Food, Verify Design and Configuration with Int. Desgn..

ITEM NO 2-173 WAFFLE BATTER DISPENSER

Quantity Req'd.: 1
Manufacturer: Server Product
Model No.: CSC-N “BETTER BATTER”

ITEM NO 2-174 DROP-IN, DISH DISPENSERS, UNHEATED

Quantity Req'd.: 2
Manufacturer: EAGLE
Model No.: 359102

Drop-In, Dish Dispensers, Unheated. Verify dish size w/ owner

ITEM NO 2-175 SYRUP DISPENSER
Quantity Req'd.: 1
Manufacturer: Server Product
Model No.: 84190

ITEM NO 2-176 ICE AND WATER STATION
Manufacturer: Delfield
Model No.: 204

TEM NO 2-177 REFRIGERATED COLD PAN
Quantity Req'd.: 1
Manufacturer: Set-N-Serve
Model No.: WM-4

Refrigerated Counter, Cold Pan Top, four-section, stainless steel top with 6" deep cold pan, stainless steel exterior and interior, with under-mounted self-contained refrig system.

ITEM NO 2-178 SNEEZE GUARD
Quantity Req'd.: 1
Manufacturer: English
Model No.: M-105 (VFY W/ I.D.)

Serving Counter, Cold Food, Verify Design and Configuration with Int. Desgn..

ITEM NO 2-179 SNEEZE GUARD, FULL SERVE/SELF SERVE
Quantity Req'd.: 1
Manufacturer: English
Model No.: AMA-101A 2-TIER

Serving Counter, Cold Food, Verify Design and Configuration with Int. Desgn..

ITEM NO 2-180 TOASTER, SLOT-TYPE
Quantity Req'd.: 1
Manufacturer: Toastmaster
Model No.: HT409

Toaster, Pop-Up, four-slice combination bun/bread toaster, stainless steel finish, wide slots, approx. 150 slices/hour capacity, solid-state thermostatic controls with cordset.

ITEM NO 2-181 WAFFLE BAKER, ELECTRIC
Quantity Req'd.: 2
Manufacturer: Star Mfg Co
Model No.: SWB7RB

Waffle Baker, single round waffle grid, teflon-coated cast aluminum grids, thermostatic temperature controls, stainless steel finish.

ITEM NO 3-184 UTILITY CART, QUEEN MARY

Quantity Req'd.: 6
Manufacturer: Useco
Model No.: TR-52-4-AF

Utility Cart, Queen Mary.

ITEM NO 3-185 CABINET, HEATED

Quantity Req'd.: 10
Manufacturer: Crescent Metal
Model No.: 130-1836D

Cabinet, Mobile Heated, non-insulated with removable heater assembly, corrugated pan support slides for 18" x 26" tray, slides on approximately 1-1/2" centers, welded tubular aluminum frame, aluminum panels.

ITEM NO 3-186 DOLLY, DISHRACK

Quantity Req'd.: 1
Manufacturer: Cambro Mfg Co
Model No.: CDR2020H-151

Dolly, Rack, open frame design with pushhandle, single stack, for 20" x 20" racks.

ITEM NO 3-187 REFRIGERATOR/FREEZER, DUAL-TEMP

Quantity Req'd.: 1
Manufacturer: True Food Serv
Model No.: STR1DT-2HS

Refrigerator, Reach-in, , stainless interior and exterior, shallow depth cabinet, narrow full-height doors,.

ITEM NO 3-188 BANQUET BEVERAGE COUNTER

Quantity Req'd.: 1
Manufacturer: Custom Fabricated Assembly
Model No.: Custom-Stainless

Counter, open front cabinet base with apron at top, 30" wide top with rear and both end splashes, overall length as shown on drawings, stainless steel top, stainless steel base.6” legs, glass filler recess, and pantry sink w/ faucet and drain.

ITEM NO 3-189 COFFEE MAKER, INSULATED SERVER, AUTO

Quantity Req'd.: 1
Manufacturer: Fetco
Model No.: CBS-52H-20

Coffee Brewer, fresh brew, automatic design, twin brewer, adjustable brewing capacity, stainless steel finish.

ITEM NO 3-190 SHELF, WALL-MOUNTED

Quantity Req'd.: 1
Manufacturer: Custom Fabricated Assembly
Model No.: Custom-Fabrication

Shelf, Wall-Mounted, solid flat design with rear turn-up, stainless steel construction, width as shown, length as shown on drawings, mounted on heavy-duty shelf brackets.

ITEM NO 3-191 ICE BIN W/SODA TOWER

Quantity Req'd.: 1
Manufacturer: Cornelius Co.
Model No.: 1522

Ice Bin With Soda Dispensers, drop-in design w/built-in six-circuit cold plate, approximately 80-pound ice storage capacity, faucet tower with six soda faucets, all stainless steel construction.

ITEM NO 3-192 GLASS FILLER

Quantity Req'd.: 1
Manufacturer: FISHER
Model No.: 1117-WB

Glass filler

ITEM NO 4-194 BAR TOP & BAR DIE

Quantity Req'd.: 1
Manufacturer: Custom Fabricated Assembly
Model No.: Custom-Millwork

See Interior Designer for details

ITEM NO 4-195 BOTTLE COOLER

Quantity Req'd.: 1
Manufacturer: True Food Serv
Model No.: TD-36-12

Bottle Cooler, flat top, self-contained refrigeration system, deep well design, two sliding doors, nominal length 36" long, all stainless steel exterior.

ITEM NO 4-196 UNDERBAR HANDSINK

Quantity Req'd.: 1
Manufacturer: EAGLE
Model No.: HSD12-19

Hand Sink Unit, free standing design, 12"-long, with faucet, soap dispenser and towel dispenser, stainless steel construction including legs.

ITEM NO 4-197 UNDERBAR WORK BOARD

Quantity Req'd.: 1
Manufacturer: EAGLE
Model No.: WB36-19

Underbar Workboard, free standing design, 36"-long, 21" front-to-back, all stainless steel finish.

ITEM NO 4-198 UNDERBAR COCKTAIL UNIT

Quantity Req'd.: 2
Manufacturer: Generic Equip
Model No.: BC36R-19-8

Ice Bin/Cocktail Station, Free-Standing, standard depth, with built-in coldplate, 36" wide x 21" front-to-back, approximately 70-lbs. ice capacity, all stainless steel construction.

ITEM NO 4-199 BAR GUN, 8 BUTTON

Quantity Req'd.: 2
Manufacturer: Cornelius Co.
Model No.: By Purveyor

Beverage Dispenser, Carbonated, post-mix type, ice-cooled, undercounter design, with electric valves, eight flavors.

ITEM NO 4-200 SPEED RAIL 34"

Quantity Req'd.: 3
Manufacturer: EAGLE
Model No.: 500779

Speed Rail Bottle Holder, approximately 36" long, single rail type, bolted-on, stainless steel construction.

ITEM NO 4-202 BLENDER, BEVERAGE

Quantity Req'd.: 2
Manufacturer: Waring Prod

Model No.: BB150

Blender, Beverage.

ITEM NO 4-203 UNDERBAR BLENDER STATION

Quantity Req'd.: 2
Manufacturer: EAGLE
Model No.: BS14-24

Blender Station, free standing unit, 14"-wide, with dump sink and goose neck faucet, all stainless steel construction.

ITEM NO 4-204 GLASSWASHER

Quantity Req'd.: 1
Manufacturer: Moyer
Model No.: MD240HT (USA ONLY)

Glass Washer, low temperature chemical sanitizing, rotary design, 24" cabinet, counter-clockwise rotation, all stainless steel finish.

ITEM NO 4-205 BACK BAR COUNTER

Quantity Req'd.: 1
Manufacturer: Custom Fabricated Assembly
Model No.: Custom-Millwork

See Interior Designer for details

ITEM NO 4-206 BACK BAR REFRIGERATOR

Quantity Req'd.: 1
Manufacturer: True Food Serv
Model No.: TBB-24GAL-48G-S

Backbar Storage Cabinet, Refrigerated, , self-contained refrigeration system,.

ITEM NO 4-209 P.O.S. TERMINAL

Quantity Req'd.: 1
Manufacturer: TBD
Model No.: TBD

Cash Register / POS System, Point-Of-Sale computerized type, with CRT display, with cash drawer, plastic finish.

ITEM NO 4-210 P.O.S. PRINTER

Quantity Req'd.: 1

Manufacturer: TBD
Model No.: TBD

ITEM NO 4-211 BAG-IN-BOX RACK

Quantity Req'd.: 1
Manufacturer: The Cornelius Company
Model No.: BIB.10005 ByPurveyor

Shelving Unit, Modular, wire shelves, stainless steel, width as shown, mounted on adjustable sanitary feet.

ITEM NO 4-212 CARBONATOR

Quantity Req'd.: 1
Manufacturer: Cornelius Co.
Model No.: 416424000

Carbonator, open base design. By Purveyor

ITEM NO 4-213 BEVERAGE LINE CONDUITS

Quantity Req'd.: 1 LOT
By electrician. See Electrical plan

ITEM NO 4-214 COFFEE BREWER

Quantity Req'd.: 1
Manufacturer: Wilbur Curtis
Model No.: GEM-12

Coffee Brewer, high capacity brewing system, twin brewing heads, adjustable brewing capacity, all stainless steel construction.

ITEM NO 4-215 SHELVING UNIT

Quantity Req'd.: LOT
Manufacturer: Metro Equipment Corporation
Model No.: Super Erecta

Sizes as shown on drawing

Provide unit with the following:

- Tubular shelves with load capacity of 1500 lbs.
- 72" high.
- Four tiers high.

ITEM NO 4-220 HOTEL ICE DISPENCER

Quantity Req'd.: 2
Manufacturer: Scotsman Ice
Model No.: HD-22

One each required on the 6th and 8th floors. See plan.

ITEM NO 4-221 ICE MAKER W/O BIN

Quantity Req'd.: 2
Manufacturer: Scotsman Ice
Model No.: C0322MA-1

Ice Maker, Cube-Style, air-cooled, self-contained condenser, approximately 300-lb capacity/24-hrs, mini-size cube style, all stainless steel finish standard.
One each required on the 6th and 8th floors. See plan.

ITEM NO 4-222 BULK C02 CONTAINER

Quantity Req'd.: 1
Manufacturer: BY PERVEYOR
Model No.:

BULK C02 CONTAINER

3.5 ADJUSTING

A. Adjust equipment and apparatus to ensure proper working order and conditions.

B. Remove and replace equipment creating excessive noise or vibration.

3.6 CLEANING

A. Remove masking or protective covering from stainless steel and other finished surfaces.

B. Wash and clean equipment.

C. Polish glass, plastic, hardware, accessories, fixtures, and fittings.

- END OF SECTION -

- SECTION 11 5213 -

PROJECTION SCREENS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Manually-operated front projection screens.

1.3 RELATED REQUIREMENTS

A. Pertinent Sections specifying Volatile Organic Compound (VOC) Content Restrictions.

B. Section 01 6116 “Volatile Organic Compound (VOC) Restrictions”.

C. Section 06 2000.01 “Finish Carpentry (Courtyard)”.

D. Section 06 2000.02 “Finish Carpentry (Residence Inn)”.

E. Section 09 2216 “Non-Structural Metal Framing”.

F. Section 09 2900 “Gypsum Board”.

G. Section 09 5123 “Acoustical Tile Ceilings”.

1.4 REFERENCES

A. “Phoenix Building Construction Code”, International Building Code 2006, with City of Phoenix administrative provisions and amendments.

1.5 SUBMITTALS

A. General: Submit in accordance with Section 01 3300.

B. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

C. Product Data: For each type of product indicated, demonstrate compliance with specified attributes.

D. VOC Submittals:
1. Product Data – VOC Limits: For adhesives sealants, fillers and primers, documentation including printed statement of VOC contents, comply with limits specified in Section 01 6116.

E. Submit "Letter of Conformance" in accordance with Section 01 33 00 (01330) indicating specified items selected for use in project with the following supporting data:
1. Product Data: For each type of product specified.
2. Submit Shop Drawings clearly indicating screen sizes and layout, method of attachment, accessories, trim profiles details, finish, and manufacturer's installation instructions.

1.6 QUALITY ASSURANCE

A. Single Source Responsibility: Obtain each type of projection screen required from a single manufacturer as a complete unit, including necessary mounting hardware and accessories.

B. Coordination of Work: Coordinate layout and installation of projection screens with other construction supported by, or penetrating through, ceilings, including light fixtures, HVAC equipment, fire suppression system, and partitions.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of Section 01 6000.

B. Do not deliver projection screens until building is enclosed, other construction within spaces where screens will be installed are substantially complete, and installation of screens is ready to take place.

C. Protect screens from damage during delivery, handling, storage, and installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Limits for adhesives sealants, fillers and primers. Comply with limits specified in Section 01 6116.

B. Structural Performance: Engineer structural steel connections required by the Contract Documents to be selected or completed by the fabricator to withstand design loadings indicated.

C. Engineering Responsibility: Engage a fabricator who utilizes a qualified professional engineer to prepare calculations, Shop Drawings, and other structural data for structural steel connections.

2.2 MANUAL-OPERATED WALL PROJECTION SCREEN

A. General: Provide wall or ceiling-mounted projection screen.
   1. Screen to have steel case with flat back and baked enamel finish and fitted with power-coated steel end caps concealing roller ends with integral bearing surface to support roller.

B. Screen: Fabric shall be formed into a pocket holding tubular metal slat. Unit to be furnished with pull cord, metal bumper stops, padded with sponge rubber, and shall be built into case to prevent slat wedging inside case.

C. Material: Fiberglass, Matt White, fire-retardant, and mildew resistant.

D. Accessories:
   1. Fixed Projected Mounting Brackets with a 6 –inch clearance from wall.
      a. Mounting brackets to have (power) powder-coated finish.
   2. Pull Rod: Minimum 38 –inches Long

E. Size:
   1. Nominal screen size 84 –inches H x 84-inches W.

F. Manufacturers: Roller-Operated Screens
   1. "Model B Square Format with Mounting Kit #98035 and 38” Pull Rod #74689"; Da-Lite Screen Company, Inc (800-622-3737)
   2. "Luma Square Format with Mounting Kit #227213 and 48” Operating Pole #227008"; Draper, Inc. (765-987-7999)

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install projection screens at locations indicated in compliance with screen manufacturer's instructions.

B. Install front projection screens within ceiling alcove, with screen cases in position and relationship to adjoining construction as indicated, securely anchored to supporting substrate, and in manner that produces a smoothly operating screen with plumb and straight vertical edges and plumb and flat viewing surfaces when screen is lowered.

3.2 PROTECTION AND CLEANING

A. Protect projection screens after installation from damage during construction. If, despite such protection, damage occurs, remove and replace damaged components or entire unit as required to provide units in their original, undamaged condition.

- END OF SECTION -

- SECTION 11 8226 -

FACILITY WASTE (TRASH) COMPACTORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes;
   1. Self-contained vertical type waste (trash) compactors and containers.

1.3 RELATED REQUIREMENTS

A. Section 03 3000 “Cast-In-Place Concrete”.

B. Division 22 for Floor Drains hoses Bibbs, etc.

C. Division 26 for electrical connections.

1.4 REFERENCES

A. National Waste & Recycling Association, www.environmentalistseveryday.org .

B. ANSI Z245 Standards Development Overview” for accredited Standards Committee on Equipment Technology and Operations for Wastes and Recyclable Materials.
   1. Z245.1 “Mobile wastes and Recyclable Materials Collection, Transportation, and Compaction Equipment - Safety Requirements”
   2. Z245.2 “Stationary Compactors – Safety Requirements for Installation, Maintenance, and Operation.”
   3. Z245.21 “Stationary Compactors – Safety Requirements for Manufacturing and Reconstruction”
   4. Z245.30 “Equipment and Operation for Waste and Recyclable Materials – Waste Containers – Safety Requirements”
   5. Z245.60 “Equipment Technology and Operations for Wastes and Recyclable Materials – Waste Containers”

C. NFPA 82 Standard on Incinerators and Waste and Linen Handling Systems and Equipment, 2014 edition or most current.

1.5 DEFINITIONS

A. WASTEC: "WASTEC Rated Equipment Guide" for detailed definitions of refuse handling equipment., www.environmentalistseveryday.org .

1.6 ACTION SUBMITTALS

A. Product Data: Submit manufacturer's product specifications, performance data sheets and installation instructions.

B. Coordination Drawings: Drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

C. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data. Include plans, elevations, sections, details, service connections and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Equipment access points and required space for equipment service and operation.
3. Setting drawings, templates, and instructions for installing anchor bolts and other anchorages.
4. Wiring Diagrams: For power, signal, and control wiring.
5. Details for work not fully shown by published product data; include rough in dimensions and service connection
6. Required clearances for equipment service and operation.

D. Acceptance Data: From local hauler.

E. Maintenance Data: For waste compactors to include in maintenance manuals. In addition to items specified in Division 1 Section "Submittal Procedures," include the following:

1. Operating and maintenance instructions.
2. Parts inventory list.
3. Purchase source for operating and maintenance materials.
4. Emergency information.
5. Name, address, and telephone number of manufacturer's service representative whose location is nearest to Project site.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Product Certificates: For each type of waste compactor, from manufacturer.

C. Field quality-control reports.

1.8 CLOSEOUT SUBMITTALS

A. Comply with requirements of Section 01770.

B. Operation and Maintenance Data: For waste compactors to include in operation and maintenance manuals.
   1. Manufacturer's printed operating instructions and maintenance requirements for each piece of equipment.
   2. Included data for controls and wring diagrams.

1.9 QUALITY ASSURANCE

A. The equipment shall comply with the National Electric Code and ANSI-Z-245-1.

B. Manufacturer shall have at least (5) five years experience in the manufacture of the specified equipment and shall maintain a servicing and replacement parts system for at least (3) three years after installation of equipment.

C. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
   1. Maintenance Proximity: Not more than (2) two hours' normal travel time from Installer's place of business to Project site.

D. Waste-Compactor Standards:
   1. As specified.

E. Waste Bin and Hopper Standard: Comply with ANSI Z245.30.

F. The work in this section shall be subject to all applicable provisions of governing building codes and ordinances.

G. Concrete shall be a minimum of 6 –inches thick and contractor shall coordinate with contractor.
   1. Steel reinforced and 3000 psi concrete strength, minimum.

1.10 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Protection: Equipment shall be protected at all times from physical damage, dirt, water etc.

B. Handle and deliver equipment to the site according to manufacturer's recommendations.

C. Factory protect and handle painted metal products to prevent damage or defacing.

D. Under no condition shall compactor be used for construction trash, or any other use other than what it was intended for.

1.11 WARRANTY

A. Conform to Section 01 7813 Bonds and Warranties.

B. Contractor and manufacturer shall warranty all equipment provided under this Section against malfunction or the failure of any structural part for (1) one year, component parts for (1) one year and warranty labor limited to (6) months.

1.12 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide (12) twelve months' full maintenance by skilled employees of waste compactor Installer.
   1. Schedule regular surveillance and preventive maintenance visits at (7) seven-day intervals for (3) three months and at (1) one-month intervals for (9) nine months.
   2. Repair or replace worn or defective components; and lubricate, clean, and adjust equipment as required for proper equipment operation.
      a. Use replacement parts and maintenance supplies that were used in the manufacture and installation of the original equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Waste Compactors and Containers: Manufacturer's standard compactor packaged units with components, containers, options, and accessories needed to comply with requirements and provide complete functional systems.

B. Basis-of-Design:
   1. Model VIP FL/3 Ramjet series stationary and self contained leak proof type trash compactor as manufactured by Marathon, a Dover Company, www.marathonequipment.com to accommodate wet and dry refuse, or a comparable products by one of the following:
      a. Substitutions. Refer to Section 01 2500.

C. Provide Waste Compactors and containers produced by one manufacturer.

D. Verify compactor clearances and service access clearance with local hauler.
   1. Provide documentation of acceptance as a construction submittal.

2.2 WASTE (TRASH) COMPACTORS

A. General:
   1. Compactors shall include the following features:
      a. Type: Vertical
      b. Standards / Approvals:
         1) WASTEC rated
         2) 100 percent UL Listed
      c. Outdoor rated: Yes
      d. Container support system: Yes
      e. Charge Box Capacity:
         1) Mfgr's rating: 0.72 cu. yards.
         2) WASTEC Rating: 0.54 cu. yards
      f. Container
         1) Capacity: **3** cubic yards / 2,000 lbs.

2) Weight: 675 lbs.
3) Casters: Yes

g. Operation:
1) Loading: Front
a) Dog House and door
2) Clear top opening: 23.5 –inches by 46 –inches wide
3) Feed/Loading height: 46.375 -inches

h. Compaction:
1) Ram Pressure: 26,400 lbs. normal force
2) Ram Pressure: 30,200 lbs. maximum force
3) Cycle Time: 30 seconds

i. Electrical Equipment:
1) Power requirement: 460 Volt, 3phase, 30 amps
2) Controls: Two button – Start & Stop
3) Control Voltage required: 120 volt
4) Panel Box assembly: UL listed, Key Operated
5) All circuits fused: Yes
6) Electric Motor: 3 HP
7) UL approved: Yes

j. Hydraulic Equipment: (Side mounted)
1) Pump: 3 gpm
2) Normal Pressure: 15.3 psi
3) Maximum Pressure: 17.5 psi
4) Cylinders: Two 4 –inch with 2 –inch rods

k. Safety:
1) Mechanical Door 3 separate Interlocks: Mfgr's Triple Lock feature

l. Weight: 3,375 Lbs. complete assembly

m. Features:
1) Integrated Driver Light
2) Air sanitizer: Yes, standard feature
3) Feed chute adaptable. Yes

2. Compactor size:
a. Overall Width: 96 –inches
b. Overall Depth: 60 –inches
c. Overall Height: 86.375 –inches

B. Operation:
1. The operation shall be automatically controlled when the compaction chamber fills to the level where the photo sensor activates the compaction ram.
2. The compactor ram shall continue to cycle until all refuse is cleared.
3. When the container is full, compactor will automatically shut down and activate the full indicator light.

C. Safety Features:

1. Container Support System raises the container up off the ground to remove stress on the floor and container casters.
2. Compactor door shall be fitted with captive switch not easily defeated to shut the machine down when the access door is opened.
3. Keylock controls prevent both unsafe and unauthorized operation.
4. Magnetic Read Safety Switches.

D. Hydraulic System:
1. Include a pump as specified to develop ram pressure as specified.

E. Control Panel:
1. The control panel shall be mounted to the compactor and shall include;
   a. Key activated on-off switch.
   b. Multi-Cycle selector and selector for;
      1) Forward
      2) Reverse
      3) Auto
   c. Emergency stop switch
   d. 100 percent Full Indicator

F. (PLC) Programmable Controller: The compactor shall be controlled and monitored by a microprocessor, which shall visually allow the user to read the various operations of the compactor.
1. Eliminates the need for mechanical limit switches and controls all functions on the compactor.

G. Remote Control Pack: With 15 -foot capacity

H. Electrical System:
1. All components are to be 100 percent UL labeled.
2. Hardwired.

I. Ozone Sanitizer: Manufacturers integrated sanitizer.

J. Accessories:
1. Fluid Filled 3000psi Pressure Gauge
2. Oil temperature

2.3 CONTAINERS

A. General:
1. Containers shall be manufactured by same company as compactor.
2. Containers shall include (4) four heavy-duty casters.
3. Color shall match Compactor unless directed otherwise by Architect.
4. Container shall be Front loading as required by Waste retrieval company
   a. Front loading: Model VIP FL/3 container

B. Compactor shall be provided with;
   1. (1) One (3) three cubic yard container.
   2. Size: 81 –inches overall width by 57 1/2 -inch overall depth by 45 1/8 –inch tall.

C. Contactor shall provide;
   1. (1) One additional (3) three cubic yard containers which are the same units as those provided with compactors.
   2. Size: 81 –inches overall width by 57 1/2 -inch overall depth by 45 1/8 –inch tall.

2.4 FINISHES

A. Color to be selected by Architect from manufacturer's full range of available colors.

2.5 FABRICATION

A. Fabricate waste compactors with smooth, eased, exposed edges to prevent injury to persons in vicinity of the equipment.

B. Fabricate containers, hoppers, compaction chambers, unit bodies, and similar components of steel with welded joints.
   1. Reinforce with steel members sized and spaced to withstand impacts and pressures of normal operations and to prevent deformation.

C. Fabricate equipment with replaceable parts at points of normal wear.

D. Fabricate liquidtight compactor baffles to stop liquid from leaking out.

E. Fabricate diverter to fit chute and properly align with compactor hoppers.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances, clearances, service rough-ins, and other conditions affecting performance of waste-compactor work.

B. Examine walls, floors, and chutes for suitable conditions where each waste compactor will be installed.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install each waste compactor according to manufacturer's written instructions, ANSI Z245.2, and ANSI Z245.21.

B. Compactors shall be installed in accordance with approved drawings.

C. Field assembly work: perform minor field assembly work to install certain fragile or projecting parts that were not installed at the factory.

D. Set each component of work securely and accurately, level and properly aligned with other components and other work. Anchor as required for secure operation.

E. Install automatic sprinkler in hopper of each chute-fed compactor according to NFPA 82.

F. Set waste compactors level, plumb, properly aligned, and securely in place. Anchor as required for secure operation.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:
   1. Perform installation and startup checks according to ANSI Z245.21, Annex D, "Tests for Evaluation of Equipment and Performance," and manufacturer's written instructions.
   2. Test and adjust controls, alarms, and safeties. Replace damaged and malfunctioning controls and equipment.
   3. Verify unrestricted access to each firefighting access door or fire port required by ANSI Z245.21 and NFPA 82 for compactor container(s).
   4. Verify correct locations, color-coding, and legibility of caution, warning, and danger markings.
   5. Certify compliance with test parameters.

C. A waste compactor will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain waste compactors according to manufacturer's requirements and ANSI Z245.2.

- END OF SECTION -

DIVISION 12 – FURNISHINGS

TABLE OF CONTENTS

- SECTION 12 3000 -

ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. (**COURTYARD, PUBLIC SPACES** and **RESIDENCE INN**) Custom Cabinet Units
      a. Plastic Laminate Custom Box Cabinet Units
      b. Wood, Transparent Finish, Custom Box Cabinet Units
   2. Cabinet Hardware
   3. **RESIDENCE INN**:
      a. Premanufactured Casework
   4. **RESIDENCE INN**:
      a. Decorative Glass for Cabinets

1.3 RELATED REQUIREMENTS

A. Pertinent Sections specifying Volatile Organic Compound (VOC) Content Restrictions.

B. Section 01 6116 “Volatile Organic Compound (VOC) Restrictions”

C. Section 06 2000.01 “Finish Carpentry (Courtyard)”

D. Section 06 2000.02 “Finish Carpentry (Residence Inn)”

E. Section 06 6113 “Cultured Marble Fabrications”.

F. Section 08 8000 “Interior Glazing”.

G. Section 12 3213 “Manufactured Wood-Veneer-Faced Casework”.

H. Section 12 3216 “Manufactured Plastic Laminate Clad Casework”.

I. Section 12 3530 “Kitchen Casework”(Residence Inn)

J. Section 12 3616 “Metal Countertops”

K. Section 12 3619 “Wood Countertops”

L. Section 12 3623 “Plastic Countertops”.

M. Section 12 3640 “Stone Countertops and Facings”.

N. Section 12 3661 “Quartz Surfacing Countertops and Facings”.

O. Division 22 for Plumbing Fixtures.

1.4 REFERENCES

A. “Phoenix Building Construction Code”, International Building Code 2006, with City of Phoenix administrative provisions and amendments.

B. Architectural Woodwork Standards (AWS), 1st ed. 2009, published jointly by:
1. Architectural Woodwork Institute, www.awi.net.org.
2. Woodwork Institute, www.woodworkinstitute.com.
3. Architectural Woodwork Manufacturers Association of Canada, www.awmac.com.

C. 36 CFR 1191 - Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities; Final Rule; Federal Register, July 26, 1991; updated 2010.

D. ASTM International (ASTM) Publications:
1. C1048 “Standard Specification for Heat-Treated Flat Glass—Kind HS, Kind FT Coated and Uncoated Glass”
2. D523 “Standard Test Method for Specular Gloss”
3. E84 "Standard Test Method for Surface Burning Characteristics of Building Materials"

E. American National Standards Institute (ANSI) Publications:
1. A135.4 Basic Hardboard
2. ANSI/KCMA A161.1 “Performance and Construction Standard for Kitchen and Vanity Cabinets
3. A161.2 “Standards for Fabricated High Pressure Decorative Laminate Countertops”
4. A208.1 "Standards for the Performance of Particleboard"

F. Federal Specifications (FS) Publications:
1. FS MM-L-736 - Lumber, Hardwood
2. FS MMM-A-130 - Adhesive, Contact

G. Forest Stewardship Council (FSC) Publications:
1. FSC 1.2, "Principles and Criteria."

H. National Electrical Manufacturer’s Association (NEMA) Standards Publications:
1. NEMA LD3 “High Pressure Decorative Laminates”
2. U.S. Department of Commerce (DOC), National Institute of Standards and Technology (NIST) Publications

3. PS 1 - Construction and Industrial Plywood
4. PS 20 - American Softwood Lumber Standard
5. PS 51 - Hardwood and Decorative Plywood
6. PS 58 - Basic Hardboard

1.8 SUBMITTALS

A. General: Submit in accordance with Section 01 3300.

B. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

C. Product Data: For each type of product indicated, demonstrate compliance with specified attributes.

D. VOC Submittals:
1. Product Data – VOC Limits: For adhesives sealants, fillers and primers, documentation including printed statement of VOC contents, comply with limits specified in Section 01 6116.

E. Submit “Letter of Conformance” in accordance with Section 01 3300 indicating specified items selected for use in project with the following supporting data.
1. Submit Shop Drawings and product data. Include materials, component profiles, fastening methods, assembly methods, joint details, accessory listings, and schedule of finishes.
   a. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
   b. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers, and other items installed in architectural woodwork.

F. Qualification Data: For Fabricator

1.9 QUALITY ASSURANCE

A. Perform work to (custom) quality in accordance with "Quality Standards" of the Architectural Woodwork Institute (AWI).

B. Plastic Laminate Materials shall comply with NEMA LD-3 as follows:
1. GP 50: Horizontal grade
2. CL 20: Cabinet liner
3. BK 20: Backing sheet
4. PF-40: Post Forming Grade
5. FR 50: Horizontal application, fire retardant material
6. FR 32: Vertical application, fire retardant material

1.10 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of Section 01 6000.

B. Do not deliver casework until painting and similar operations that could damage synthetic marble have been completed in installation areas. If casework components must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

C. Handle materials to prevent damage to finished surfaces. Provide protective coverings to prevent physical damage or staining following installation for duration of project.

1.11 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Limits for adhesives sealants, fillers and primers. Comply with limits specified in Section 01 6116.

2.2 PLASTIC LAMINATE

A. Plastic Laminate: Shall be standard grade, 1/16-inch thick, general purpose material complying with current NEMA Standard and LD-3. Comply with ANSI A161.2. Pattern and color shown on Interior Finish Index.

1. Avendra, LLC Preferred Manufacturers:
   a. None
2. Approved Manufacturers:
   a. Formica Corporation (800-367-6422)
   b. WilsonArt International, Inc. (800-433-3222)
   c. Lamin-Art (800-323-7624)
   d. Nevamar Company, LLC (800-638-4380)
   e. Pionite Decorative Surfaces, a Panolam Industries International Incorporated Company (800-746-6483)
   f. "Abet Laminati"; ABET Inc. (800-228-2238)

2.3 PLASTIC LAMINATE CUSTOM BOX CABINET UNITS – COURTYARD & PUBLIC SPACES

A. Modular Box-Type Cabinets: Where shown on Drawings, system shall be modular box-cabinet type construction.

B. Manufacturers:
1. Avendra, LLC Preferred Manufacturers:
   a. None
2. Approved Manufacturers:
   a. Millrock, Inc. (800-645-7625)
   b. J. Suss Industries Inc. (866-769-5666)

C. Laminate Clad Cabinets:
1. Materials:
   a. Particleboard: Minimum 45 pound per one cubic foot; ANSI A208.1.
   b. Hardboard: Tempered, ANSI 135.4.
   c. Facing: 100 gram melamine resistant to water and typical cleaners.
2. Quality Standard: Comply with AWI Section 400 and Division 400B, “Laminate Clad Cabinets”.
3. AWI Type of Cabinet Construction: As Indicated
4. Laminate Cladding:
   a. High-Pressure Decorative Laminate: NEMA LD 3, grades as required by woodwork quality standard, as manufactured by one of the listed manufacturers under Paragraph 2.01.
5. Particle Board: ANSI A208.1, Mat-Formed Particle Board, Grade 1-M-2, with minimum density of 45 pcf. Internal bond of 60 psi, and minimum screw holding capacity of 225 lb. on faces and 200 lb. on edges.
6. Concealed Surfaces: Sound and dry solid wood, plywood, or particleboard without defects affecting strength, utility, or stability.
7. Sides, Dividers, Tops, Bottoms, Shelves, and Stretchers: Plastic laminate GP 50 (0.50 inch nominal thickness) on 3/4 -inch thick particleboard. Provide stretchers for top of base cabinet.
8. Back Panels: 1/8 -inch thick hardboard with thermoset decorative panels on interior surfaces fastened to rear edge of end panels and to top and bottom rails.
9. Exposed Edge Treatment: Edge doors and drawer fronts with plastic laminate of same material as exposed faces.
10. Semi-Exposed Edge Treatment: Edge top of drawer body with high-impact plastic tee edging. Edge remaining casework surfaces with plastic laminate GP 50 (0.50 inch nominal thickness) matching adjoining plastic laminate in color, pattern, and finish.
11. Doors, Drawer Fronts, Fixed Panels, Toeboards, and Ends: Plastic laminate GP 50 (0.50 inch nominal thickness) on 5/8 -inch thick particleboard.
12. Drawers: Fabricate with front, bottom, and back rabbeted in sides and secured with glue and mechanical fasteners as follows:
   a. Subfronts, Sides, and Backs: 3/8 -inch thick particleboard.
   b. Bottoms: Not less than 1/2 -inch thick vinyl-faced plywood.
13. Joinery: Rabbet backs flush into end panels and secure with concealed mechanical fasteners. Connect tops and bottoms of wall cabinets and bottoms and stretchers of

base cabinets to ends and dividers with mechanical fasteners. Rabbet tops, bottoms, and backs into end panels.

14. Toe Board: 5/8 -inch thick particleboard attached to subbase with concealed fasteners.
15. **RESIDENCE INN**:
    a. Interior face of exposed units shall be melamine, wood grain, medium stock color.

2.4 WOOD, TRANSPARENT FINISH CUSTOM BOX CABINET UNITS

A. Manufacturers:
1. Avendra, LLC Preferred Manufacturers:
    a. None
2. Approved Manufacturers:
    a. Millrock, Inc. (800-645-7625)
    b. J. Suss Industries Inc. (866-769-5666)

B. Quality Standard: Comply with AWI Section 400 requirements for wood cabinets.
1. Particleboard: Minimum 45 pound per cubic foot; ANSI A208.1.

C. Hardwood Plywood: ANSI/HPMA HP hardwood and decorative plywood, Good Grade (1) or better, of thickness, species, cut, and core construction indicated.

D. Hardwood Lumber: Clear, dry, sound, and free of defects selected from First Grade lumber (NHLA), of species indicated.

E. Hardboard: ANSI A135.4, Class 1, tempered.

F. Solid Lumber: Dry, sound, selected to eliminate appearance defects, of any species of hardwood or softwood with color and grain characteristics similar exposed portions.
1. Stained Interior Wood Veneers and Panels (Typical):
    a. **COURTYARD & PUBLIC SPACES**:
        1) Rift Cut White Oak
            a) Stained to match; Wilsonart Laminate, Loft Oak #7968K-12.
            b) Sizes and shapes shown on Drawings, of straight grain type sufficient to receive stained finish, smooth surfaced.
        2) Coordinate stain matching with drawings and specifications including, but not limited to;
            a) Section 06 2000.01 “Finish Carpentry (Courtyard)”
            b) Section 06 4023 “Interior Architectural Woodwork”
    b. **RESIDENCE INN**:
        1) Rift Cut White Oak
            a) Stained to match; Wilsonart Laminate, Warehouse Oak #7969K-12.
            b) Sizes and shapes shown on Drawings, of straight grain type sufficient to receive stained finish, smooth surfaced.
        2) Coordinate stain matching with drawings and specifications including, but not limited to;
            a) Section 06 2000.02 “Finish Carpentry (Residence Inn)”
            b) Section 06 4023 “Interior Architectural Woodwork”

2. Stained Interior Standing and Running Trim (Typical):
   a. **COURTYARD & PUBLIC SPACES**:
      1) Rift Cut Alder, Beech
         a) Stained to match; Wilsonart Laminate, Loft Oak #7968K-12.
         b) Sizes and shapes shown on Drawings, of straight grain type sufficient to receive stained finish, smooth surfaced.
      2) Coordinate stain matching with drawings and specifications including, but not limited to;
         a) Section 06 2000.01 “Finish Carpentry (Courtyard)”
         b) Section 06 4023 “Interior Architectural Woodwork”
   b. **RESIDENCE INN**:
      1) Rift Cut Alder, Beech
         a) Stained to match; Wilsonart Laminate, Warehouse Oak #7969K-12.
         b) Sizes and shapes shown on Drawings, of straight grain type sufficient to receive stained finish, smooth surfaced.
      2) Coordinate stain matching with drawings and specifications including, but not limited to;
         a) Section 06 2000.02 “Finish Carpentry (Residence Inn)”
         b) Section 06 4023 “Interior Architectural Woodwork”

H. Plywood Face Veneer: Same species as exposed lumber, unless otherwise indicated, selected for grain and color compatible with exposed solid lumber, no defects. Edgeband exposed edges with solid wood of same species as face veneer.
   1. Stained Interior Wood Veneers and Panels (Typical):
      a. **COURTYARD & PUBLIC SPACES**:
         1) Rift Cut White Oak
            a) Stained to match; Wilsonart Laminate, Loft Oak #7968K-12.
            b) Sizes and shapes shown on Drawings, of straight grain type sufficient to receive stained finish, smooth surfaced.
         2) Coordinate stain matching with drawings and specifications including, but not limited to;
            a) Section 06 2000.01 “Finish Carpentry (Courtyard)”
            b) Section 06 4023 “Interior Architectural Woodwork”
      b. **RESIDENCE INN**:
         1) Rift Cut White Oak
            a) Stained to match; Wilsonart Laminate, Warehouse Oak #7969K-12.
            b) Sizes and shapes shown on Drawings, of straight grain type sufficient to receive stained finish, smooth surfaced.
         2) Coordinate stain matching with drawings and specifications including, but not limited to;
            a) Section 06 2000.02 “Finish Carpentry (Residence Inn)”
            b) Section 06 4023 “Interior Architectural Woodwork”

I. Style of face construction for base, wall, and full-height units, if any, with drawer fronts, doors, and fixed panels as follows:
   1. Flush overlay concealing face frames of cabinet body.

2. Flush Door Construction: Lumber core plywood, 5-ply with hardwood face veneer and crossbanding.
3. Flush Drawer Front Construction: Same as door or, where standard with manufacturer, solid or glued-up lumber, not less than 1/2 -inch.

J. Construction for face frame style casework as follows:
1. Rails and Stiles for Face Frame: Not less than 1-inch by 1-5/8 -inch solid lumber with glued mortise and tendon joints.
2. Exposed Ends: Not less than 1/2 -inch thick, medium-density particle board core with exterior veneer to match door and drawer fronts and not less than 4-mil vinyl laminate on interior surfaces. Connect to stile with pressure-glued tongue and plow joint and supplement by concealed mechanical fasteners.
3. Unexposed Ends: Not less than 1/2 -inch thick, medium-density particle board with not less than 4-mil prefinished vinyl laminate on interior surfaces. Attach to front frame in same manner as exposed ends.
4. Back, Top, and Bottom Rails: Not less than 3/4 -inch by 3 -inch solid lumber, machined to interlock with end panels, and rabbeted to receive top and bottom panels; with back rails secured under pressure with glue and mechanical fastening devices.
5. Shelving: Not less than 5/8 -inch thick particle board core plywood or 1/2 -inch thick medium-density particle board prefinished with not less than 4-mil vinyl laminate on top, bottom, and exposed (front) edge.

K. Construction for wall units with doors and fixed panels as follows:
1. Tops and Bottoms: Not less than 1/2 -inch thick particle board or 3/8 -inch thick hardwood plywood, fully supported by and secured in rabbets in end panels, front frame, and back rail.
2. Backs: Not less than 1/8 -inch hardboard or 3/16 -inch plywood fastened to machined rear edge of ends and to top and bottom hanger rails.
3. **RESIDENCE INN**:
   a. Interior face of exposed units shall be melamine, wood grain, medium stock color.

L. Construction for base units with doors and fixed panels as follows:
1. Front Frame Drawer Rails: Not less than 1 -inch by 1-1/4 inch lumber mortised and fastened into face frame.
2. Bottoms: Not less than 1/2 -inch thick particle board with 4-mil vinyl laminate finish or 3/8 -inch thick, 5-ply veneer core plywood, fully supported by and secured in rabbets in end panels, front frame, and back bottom rail.
3. Back Panels: Not less than 1/8 -inch thick hardboard fastened to machine rear edge of end panels and to top and bottom rails. Interior surface prefinished with 4-mil vinyl laminate.
4. Toe Boards: Not less than 5/8 -inch particle board core attached between end panels and extended from bottom panel to floor.
5. Corner Blocks: Glued and fastened in each of four top corners to maintain cabinet squareness and rigidity.
6. **RESIDENCE INN**:
   a. Interior face of exposed units shall be melamine, wood grain, medium stock color.

M. Construction for drawer units as follows:

1. Drawer Body: Not less than 3/8 -inch thick vinyl faced particle board subfront, back, and sides. Provide box-type construction with subfront and back rabbeted into sides and secured with glue and mechanical fasteners. Exposed fronts fastened to subfront with mounting screws from interior of body. Drawer bottom of not less than 1/4 -inch thick hardboard, set into rabbets in back, sides, and front.

N. Cabinet Hardware:
1. Avendra, LLC Preferred Manufacturers:
   a. None
2. Approved Manufacturers
   a. Corbin Russwin Architectural Hardware, an ASSA ABLOY Group (800-543-3658)
   b. J. G. Edelen Company, Inc. (410-918-1200)
   c. Epco, The Engineered Products Co. (810-767-2050)
   d. Stylmark, Inc. (Garcy Corp.) (800-328-2495)
   e. Hettich America, LP (800-777-1772)
   f. H.B. Ives, an Ingersoll-Rand Company (800-820-5542)
   g. Knape & Vogt Manufacturing Co. (800-253-1561) (KV)
   h. Stanley Hardware, Div. of the Stanley Works (800-493-5263)
   i. Grass America, Inc. (800-334-3512)
   j. Hafele America Co. (800-423-3531)
   k. Accuride International (562-903-0200)
   l. Rockler Companies, Inc. (800-279-4441)

O. Products: Provide cabinet hardware and accessory materials associated with architectural cabinets. Coordinate finishes of exposed cabinet hardware with adjacent finish hardware as specified in Section 08 7100 .
1. All exposed hardware to beunless noted otherwise.
   a. **COURTYARD & PUBLIC SPACES**: US26D
   b. **RESIDENCE INN**: US15
2. Hardware Schedules:
   a. **COURTYARD & PUBLIC SPACES**:

ITEM	MODEL NO.	MANUFACTURER
WELCOME PEDISTALS		
Cabinet Pulls	DP41-A-3	EPCO
Cabinet Locks	**280 SERIES (DRAWERS)** **290 SERIES (DOORS)** **C700LP-15 PLUGS** keyed alike	CompX-Timberline
Concealed Hinges	3073 Overlay 3074 Half Overlay 3074 Inset	Grass America
Drawer Slides – Box and File Drawers	3832	Accuride
Drawer Slides – Pencil and Cash Drawers	2632	Accuride
FOCAL WALL		
Cabinet Pulls	DP41-A-3	EPCO
Concealed Hinges		Grass
Shelf Supports (non-exposed 5mm)	345	KV
Cabinet Locks	290 Series (Doors)	CompX - Timberline

	C700LP-15 Plugs Keyed Alike	
GOBOARD & COFFEE AREA		
Cabinet Pulls	DP41-A-3	EPCO
Concealed Hinges	3073 Overlay 3074 Half Overlay 3074 Inset	Grass America
Shelf Supports (non-exposed 5mm)	345	KV
Cabinet Locks	290 Series (Doors) C700LP-15 Plugs Keyed Alike	CompX - Timberline
BUSINESS CENTER		
Cabinet Pulls	DP41-A-3	EPCO
Concealed Hinges	3073 Overlay 3074 Half Overlay 3074 Inset	Grass America
Shelf Supports (non-exposed 5mm)	345	KV
Cabinet Locks	290 Series (Doors) C700LP-15 Plugs Keyed Alike	CompX - Timberline
Wire Management	631.39.301	Hafele
QUICK PRINT / LOCAL LIBRARY		
Cabinet Pulls	DP41-A-3	EPCO
Concealed Hinges	3073 Overlay 3074 Half Overlay 3074 Inset	Grass America
Shelf Supports (non-exposed 5mm)	345	KV
Cabinet Locks	290 Series (Doors) C700LP-15 Plugs Keyed Alike	CompX - Timberline
OFFICE AREA		
Finger Pulls		Stanley
Cabinet Pulls	4485 x US26D	Stanley
Drawer Slides	3832	Accuride
Standards and Clips	255/256 x US26D	KV
GUEST ROOM SUITES AND CONFERENCE ROOMS		
Cabinet Pulls	4485 x US26D	Stanley
Concealed Hinges	3073 Overlay 3074 Half Overlay 3074 Inset	Grass America
Catches	2 x A4	Ives
Magnetic Stops	46 x US26	Stanley
Standards & Clips	255/256 x Anachrome	KV
S-BAR		
Cabinet Pulls	DP41-A-3	EPCO
Cabinet Locks	280 Series (Drawers) 290 Series (Doors) C700LP-15 Plugs keyed alike	CompX-Timberline
Concealed Hinges	3073 Overlay 3074 Half Overlay 3074 Inset	Grass America
Shelf Supports (non-exposed 5mm)	345	KV
Shelf Supports Pins and Bussings (Exposed 5mm)	326 Gromments w/ 330 Round Shelf Pins	KV
Pocket Door Hardware With Locking	Special pattern and product	Hafele (TBD)

(Tbd)	for Marriott Courtyard projects (TBD)	
THE MARKET		
Cabinet Pulls	DP41-A-3	EPCO
Cabinet Locks	280 Series (Drawers) 290 Series (Doors) C700LP-15 Plugs keyed alike	CompX-Timberline
Concealed Hinges	3073 Overlay 3074 Half Overlay 3074 Inset	Grass America
Shelf Supports (non-exposed 5mm)	345	KV
Shelf Supports Pins and Bussings (Exposed 5mm)	326 Gromments w/ 330 Round Shelf Pins	KV
Barrister Drawer Slide	18235	Rockler
Note: At drawer slides for large drawers, verify potential loading and adjust slide type to accommodate loads. For drawers over 16" wide and less than 24" wide use Accuride 7432. For applications wider than 24" use Accuride 3640.		

b. **RESIDENCE INN**:

ITEM	MODEL NO.	MANUFACTURER
GUESTROOM		
innFUSION: Guestroom Vanity Pulls	117.05.610 (7")	Hafele
innFUSION: Guestroom Vanity Cabinet Mounted Towel Bar	117.05.650 (20.87")	Hafele
innFUSION: Kitchen Cabinet Door and Drawer Pulls	102.83.600	Hafele
EMPLOYEE LOUNGE		
Cabinet Pulls: Upper Cabinets	104.33.200	Hafele
Cabinet Pulls: Drawers	132.00.229	Hafele
FRONT DESK		
Brackets, Interior	187, 171, 173, and 179	K&V
Catch, Elbow	2 (Bronze)	Ives
Catch, Roller	336 (Bronze)	Ives
Drawer Locks		
Drawer Slides	3832	Accuride
Folding Table Brackets	250080 (Zinc)	Stanley
Hinges, Pivot	341	Stanley
Hinges, Continuous (Piano)	311-1/4 x 2-1/2" x 72"	Stanley
Magnetic Catches	323, 326, and 327	Ives
Pulls, Door and Drawer (Refer to Interior Finish Index for locations)	120.61.950 x Tarnished Silver	Hafele
Shelf Supports, Interior	256	K&V
Sliding Door Finger Pulls		
Sliding Door Lock		
Standards, Interior	255, 87, 71, & 80 (Anachrome)	K&V
THE MARKET		
Base Cabinet Legs	637.45.326	Hafele

Toe Kick Panel Clip	637.45.915	Hafele
Concealed Shelf Standard	T-Standard7/16" HB800-7	Victory Store Fixtures
Adjustable Shelf Bracket	179 Anochrome	KV
Shelf Fastener	154 Anochrome	KV
Glass Doors	3/16" Thick Tempered Safety Glass	
Glass Door Hinges (matt chrome)	316.33.300 Type 18	Hafele
Glass Door Hinge Round Trim Cap	316.10.420	Hafele
Cabinet Pulls	115.61.601	Stanley
Cabinet Pulls (Option)	4485 1/2	Stanley
Cabinet Locks	02066	Corbin
Concealed Hinges	1805 VZDT32	Grass America
Alum. Slatwall	# ALU7584-M	Outwater
Slatwall Hooks	Coordinate with Slatwall manufacturer.	
Condiment Container	2Y Bain Marie (Stain Steel)	Polarware
Metal Shelf (powder coated aluminum)	Flat Metal Shelf	Franklin Fixtures
Concealed Hinges	1805 VZDT32	Grass America
Note: At drawer slides for large drawers, verify potential loading and adjust slide type to accommodate loads. For drawers over 16" wide and less than 24" wide use Accuride 7432. For applications wider than 24" use Accuride 3640.		

3. ADA Accessible Guest Room:
   a. Door hardware at kitchen sink: "Pocket Door" retractable doors, hardware system, Julius Blum, or approved substitution.
4. Exposed Wall Shelving: "No. 80 x No. 182"; Knape & Vogt Manufacturing Co.; inset type, adjustable on 1" centers.

2.5 PREMANUFACTURED CASEWORK -KITCHENS– RESIDENCE INN

A. Avendra, LLC Preferred Manufacturers:
   1. None.

B. Approved Manufacturers:
   1. Grandview Products Co., Inc. (800-247-9105)
      a. Style: RESIDENCE INN, Gen 9 InnFUSION Décor Package: "Shaker-PFG" Face-Frame Construction or Custom as indicated or selected by Architect.
   2. J. Suss Industries Inc. (866-769-5666)
      a. RESIDENCE INN, Gen 9 InnFUSION II Décor Package: "InnFUSION" Frameless Construction or Custom as indicated or selected by Architect.
   3. Refer to Interior Finish Index for Finish.

C. Face-Frame Cabinet Construction: Materials:
   1. Solid hardwood: Stained Interior Wood Veneers and Panels (Typical):
      a. RESIDENCE INN:
         1) Rift Cut White Oak

a) Stained to match; Wilsonart Laminate, Warehouse Oak #7969K-12.
b) Sizes and shapes shown on Drawings, of straight grain type sufficient to receive stained finish, smooth surfaced.

2. Stained Interior Standing and Running Trim (Typical):
   a. RESIDENCE INN:
      1) Rift Cut Alder, Beech
         a) Stained to match; Wilsonart Laminate, Warehouse Oak #7969K-12.
         b) Sizes and shapes shown on Drawings, of straight grain type sufficient to receive stained finish, smooth surfaced.
   b. Particleboard: Minimum 45 pound per cubic foot; ANSI A208.1.
   c. Hardboard: Tempered, ANSI 135.4.
   d. Facing: 100 gram melamine resistant to water and typical cleaners.
3. Construction:
   a. Exposed Ends: 1/2 -inch 100-gram melamine finish; rabbet ends to receive tops and bottom. Rabbet base cabinet end to receive floor and shelf.
   b. Residence Inn, “InnFusion” Décor only:
      1) Doors and Drawer Fronts: Fabricate door as five-piece type with plywood panel in rabbet. Tenon and cope all joints. Drawer Fronts: Fabricate from solid KD hardwood stock; 3/4 -inch thick.
   c. Doors Hinges: Concealed hinges, Self Closing.
   d. Drawer Slides: Side Mount, 75 lb. load capacity, epoxy coated, self closing.
   e. Doors and Drawer Face Grain: All to be Horizontal (not face frame).
   f. Drawer construction for standard wood drawer construction: Provide drawer construction meeting AWI and WIC standards as applicable to the facility location. Provide minimum 1/8 -inch drawer bottoms fabricated from tempered hardboard, fully rabbeted into drawer sides. Drawer sides and ends must be glued and power nailed at all joints. Screw drawer into drawer face.
      1) Drawers: 7/16 -inch fiberboard base coated, printed, top coated (4 sides.)
   g. Wall cabinet and base cabinet shelving: 5/8 -inch 100 gram white melamine with front edge smooth, fully adjustable. Fabricate base shelf to half-depth.
   h. Wall cabinet top and bottom: Not less than 1/2 -inch gram vinyl covered particle board.
   i. Base Cabinet Floors: Not less than 1/2 -inch gram vinyl covered particle board. Let into sides and face frame; glue and power nail all joints; set rear of floor on supporting member and glue and fasten.
   j. Cabinet backs: 1/8 -inch standard hardboard, painted maple or white.
   k. Toeboard: Minimum 1/2 -inch by 3-1/2 -inch ", extend from floor to the cabinet bottom and cover with black vertical grade plastic laminate finish.
   l. End Panels: Exposed end panels are to be stained to match cabinets. At end panels that are not visible, fabricate from melamine with matching wood grain.
   m. Fillers:
      1) Provide all fillers and toe kicks, where required, to match exterior finish color.
      2) Provide DW10 Filler with cleat at dishwashers.
   n. Accessible Guestrooms:

1) Provide pocket doors at accessible guestroom sink bases in locations as shown on the Drawings. Cabinet to be minimum 36-inches wide.

4. Accessories and Fasteners:
   a. Provide nails, screws, and adhesives recommended by AWI "Custom" grade fabrication standards.
5. Hardware:
   a. Refer to Interior Finish Index.

D. Frameless Cabinet Construction: Materials
1. Solid hardwood: Stained Interior Wood Veneers and Panels (Typical):
   a. **COURTYARD & PUBLIC SPACES**:
      1) Rift Cut White Oak
         a) Stained to match; Wilsonart Laminate, Loft Oak #7968K-12.
         b) Sizes and shapes shown on Drawings, of straight grain type sufficient to receive stained finish, smooth surfaced.
   b. **RESIDENCE INN**:
      1) Rift Cut White Oak
         a) Stained to match; Wilsonart Laminate, Warehouse Oak #7969K-12.
         b) Sizes and shapes shown on Drawings, of straight grain type sufficient to receive stained finish, smooth surfaced.
2. Stained Interior Standing and Running Trim (Typical):
   a. **COURTYARD & PUBLIC SPACES**:
      1) Rift Cut Alder, Beech
         a) Stained to match; Wilsonart Laminate, Loft Oak #7968K-12.
         b) Sizes and shapes shown on Drawings, of straight grain type sufficient to receive stained finish, smooth surfaced.
   b. **RESIDENCE INN**:
      1) Rift Cut Alder, Beech
         a) Stained to match; Wilsonart Laminate, Warehouse Oak #7969K-12.
         b) Sizes and shapes shown on Drawings, of straight grain type sufficient to receive stained finish, smooth surfaced.
   c. Particleboard: Minimum 45 pound per cubic foot; ANSI A208.1.
   d. Hardboard: 1/4 -inch Tempered Masonite, ANSI 135.4. Match interior color.
   e. Facing: 100 gram melamine resistant to water and typical cleaners.
3. Construction:
   a. Exposed Ends: 5/8 -inch 100-gram melamine finish to match doors.
   b. Residence Inn, “InnFusion” Décor only:
      1) Doors and Drawer Fronts: Fabricate door and drawer from 3/4 -inch thick solid hardwood stock as five-piece Shaker style with 1/4 -inch veneered center panel in rabbet. Tenon and cope all joints.
   c. Doors Hinges: Concealed hinges, Self Closing.
   d. Drawer Slides: Side Mount, 75 lb. load capacity, epoxy coated, self closing.
   e. Doors and Drawer Face Grain: All to be Horizontal.
   f. Drawer construction for standard wood drawer construction: Provide drawer construction meeting AWI and WIC standards as applicable to the facility location.

Provide minimum 1/8-inch drawer bottoms fabricated from tempered hardboard, fully rabbeted into drawer sides. Drawer sides and ends must be glued and power nailed at all joints. Screw drawer into drawer face.

1) Drawers: MetaBox drawer sides with 85 lb. capacity, epoxy coated.

h. **RESIDENCE INN:** "InnFusion" Décor, or Custom as indicated or selected by Architect.

1) Wall cabinet and base cabinet shelving: 5/8 -inch 100 gram white melamine with front edge smooth, fully adjustable. Fabricate base shelf to 15-inch depth.

i. Wall cabinet top and bottom: 5/8 -inch 100 gram melamine to match interior color.

j. Base Cabinet Floors: Not less than 5/8 -inch 100 melamine. Let into sides and face frame; glue and power nail all joints; set rear of floor on supporting member and glue and fasten.

k. Cabinet backs: 1/4 -inch standard hardboard, painted to match interior color.

l. Toeboard: Minimum 5/8 -inch by 4-1/2 -inch, extend from floor to the cabinet bottom and cover with black melamine.

m. End Panels: Exposed end panels are to be stained to match cabinets. At end panels that are not visible, fabricate from melamine with matching wood grain.

n. Fillers:

1) Provide all fillers and toe kicks, where required, to match exterior finish color.

2) Provide dishwasher filler to match exterior finish color.

o. Accessible Guestrooms:

1) Provide pocket doors at accessible guestroom sink bases in locations as shown on the Drawings. Cabinet to be minimum 36-inches wide.

4. Accessories and Fasteners:

a. Provide nails, screws, and adhesives recommended by AWI "Custom" grade fabrication standards.

5. Hardware:

a. Refer to Interior Finish Index.

2.6 DECORATIVE FLOAT GLASS FOR CABINET DOORS – RESIDENCE INN

A. Sandblasted Glass: Heat Treated Float Glass, ASTM C1048, Type I, Class 1, Quality Q3, Condition A, Kind FT (Fully Tempered), 3/16-inch thick, unless otherwise indicated.

1. Provide evenly abraded sandblasted or Acid-Etched Finish. Translucent Pattern as approved by Owner's Representative.

B. The glass should be installed into the cabinet door frame using a clear flexible vinyl retainer molding "Model No. C-10215", as manufactured by Top Supplies, Inc. (336-841-5100), or approved substitution.

2.7 INSTALLATION MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

1. Adhesives: Installation adhesives as recommended by manufacturer for use intended.

2.8 FABRICATION

A. General:

1. Shop assemble casework for delivery to site in units easily handled and to permit passage through building openings.
2. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trip for scribing and site cutting.
3. Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes, and other fixtures and fittings.

B. Woodwork:

1. Interior trim shall be "custom grade" manufactured from solid stock meeting the following requirements:
   a. Minor warp which can be held flat and straight with normal nailing.
   b. Natural and manufacturing defects in excess of those permitted in the grade specified are permitted if such defects are to be covered by adjoining members or otherwise concealed.
   c. Trim members for application on flat surfaces shall have the reverse side "backed out", except members with exposed ends.
   d. "Custom grade" pieces shall be smoothly machined with top flat surfaces machine sanded. Depressed flat surfaces and molded contours shall be smoothly machined.
2. Carefully fit equipment to be installed into millwork. Provide filler pieces when required.
3. Protection: Exposed ends of millwork to be sealed with two coats of spar varnish.
   a. See Section 09 9123 “Interior Painting”
   b. See Section 09 9123.13 “Paint Schedule”
   c. See Section 09 9300 “Staining & Transparent Finishing” including custom stain colors.

2.9 SHOP FINISHING

A. Quality Standard: Comply with AWI Section 1500, unless otherwise indicated.

B. General: Finish casework at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

C. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling.

D. Transparent Finish: Comply with requirements indicated below for grade, finish system, staining, and sheen, with sheen measured on 60-degree gloss meter per ASTM D523:

1. Grade: Custom.

2. AWI Finish System: TR-2 (custom), catalyzed lacquer.
   Stain Color: Refer to Interior Finish Index.
   a. 1 Coat precatalyzed sanding sealer
   b. Sand (240 Grit)
   c. 1 Coat colored sealer
   d. 1 Coat precatalyzed sealer
   e. Sand (320 Grit)
   f. 1 Coat precatalyzed lacquer – 30 percent Sheen (semi-gloss) to match approved sample provided by Marriott.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify adequacy of backing and support framing.

3.2 INSTALLATION

A. All cabinets and shelving shall be installed as shown on Drawings and as specified by manufacturer.

B. Set and secure casework in place rigid, plumb, and level.

C. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
   1. Secure cabinet and counter bases to floor using appropriate angles and anchorages.
   2. Install cabinets with no more than 1/8 -inch in 96 -inch sag, bow, or other variation from a straight line.
   3. Maintain veneer sequence matching of cabinets with transparent finish.
   4. Carefully scribe casework which is against other building materials, leaving gaps of 1/32 -inch maximum. Do not use additional overly trim for this purpose.

D. Fasteners:
   1. Use purpose designed fixture attachments at concealed locations for wall-mounted components.
   2. Use threaded steel concealed joint fasteners to align and secure adjoining cabinet units and counter tops.
   3. Countersink anchorage devices at exposed locations used to wall-mount components, and conceal with solid plugs of species to match surrounding wood. Finish flush with surrounding surfaces.
   4. Install countertops with no more than 1/8 -inch in 96 -inch sag, bow, or other variation from a straight line.

3.3 PLASTIC LAMINATE

A. Installation:

1. The plastic laminate shall be bonded to a suitable substrate. Rigid setting type adhesive is recommended. The temperature of the materials, surfacing, substrate, and adhesive, and the area in which the actual fabrication is to be done shall not be less than 65 degrees F. with a relative humidity of not less than 35 percent and not more than 85 percent. All inside corners of cutouts in plastic laminate shall be radiused as large as possible with 1/8 –inch R minimum. File edges of the radius smooth and free of cracks and crazes.

3.4 ADJUSTING AND CLEANING

A. Adjust doors, drawers, hardware, fixtures and other moving or operating parts to function smoothly and correctly.

B. Clean casework, shelves, hardware, fittings and fixtures.

- END OF SECTION -

- SECTION 12 3213 -

MANUFACTURED WOOD-VENEER-FACED CASEWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. **COURTYARD, PUBLIC SPACES** and **RESIDENCE INN**
      a. Custom Cabinet Units
         1) Wood, Transparent Finish, Custom Cabinet Units
      b. Cabinet Hardware.
   2. **RESIDENCE INN**: (Guestrooms)
      a. Decorative Glass for Guestroom Cabinets

1.3 RELATED REQUIREMENTS

A. Pertinent Sections specifying Volatile Organic Compound (VOC) Content Restrictions.

B. Section 01 6116 “Volatile Organic Compound (VOC) Restrictions”

C. Section 06 1053 “Miscellaneous Rough Carpentry”.

D. Section 06 2000.01 “Finish Carpentry (Courtyard)”

E. Section 06 2000.02 “Finish Carpentry (Residence Inn)”

F. Section 06 6113 “Cultured Marble Fabrications”.

G. Section 08 8000 “InteriorGlazing”.

H. Section 09 9300 “Staining and Transparent Finishing”

I. Section 12 3216 “Manufactured Plastic Laminate Clad Casework”

J. Section 12 3530 “Kitchen Casework”(Residence Inn).

K. Section 12 3616 “Metal Countertops”

L. Section 12 3619 “Wood Countertops”

M. Section 12 3623 “Plastic Countertops”.

N. Section 12 3640 “Stone Countertops and Facings”.

O. Section 12 3661 “Quartz Surfacing Countertops and Facings”.

P. Division 22 for Plumbing Fixtures.

1.4 REFERENCES

A. “Phoenix Building Construction Code”, International Building Code 2006, with City of Phoenix administrative provisions and amendments.

B. Architectural Woodwork Standards (AWS), 1st ed. 2009, published jointly by:
1. Architectural Woodwork Institute, www.awi.net.org.
2. Woodwork Institute, www.woodworkinstitute.com.
3. Architectural Woodwork Manufacturers Association of Canada, www.awmac.com.

C. 36 CFR 1191 - Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities; Final Rule; Federal Register, July 26, 1991; updated 2010.

D. ASTM International (ASTM) Publications:
1. C1048 “Standard Specification for Heat-Treated Flat Glass—Kind HS, Kind FT Coated and Uncoated Glass”
2. D523 “Standard Test Method for Specular Gloss”
3. E84 "Standard Test Method for Surface Burning Characteristics of Building Materials"

E. American National Standards Institute (ANSI) Publications:
1. A135.4 Basic Hardboard
2. ANSI/KCMA A161.1 “Performance and Construction Standard for Kitchen and Vanity Cabinets
3. A161.2 “Standards for Fabricated High Pressure Decorative Laminate Countertops”
4. A208.1 "Standards for the Performance of Particleboard"

F. Federal Specifications (FS) Publications:
1. FS MM-L-736 - Lumber, Hardwood
2. FS MMM-A-130 - Adhesive, Contact

G. Forest Stewardship Council (FSC) Publications:
1. FSC 1.2, "Principles and Criteria."

H. Hardwood Plywood & Veneer Association (HPVA) Publications:
1. ANSI/HPVA HP-1: "American National Standard for Hardwood and Decorative Plywood"

I. National Electrical Manufacturer's Association (NEMA) Standards Publications:
   1. NEMA LD3 "High Pressure Decorative Laminates"

J. U.S. Department of Commerce (DOC), National Institute of Standards and Technology (NIST) Publications
   1. PS 1 - Construction and Industrial Plywood
   2. PS 20 - American Softwood Lumber Standard
   3. PS 51 - Hardwood and Decorative Plywood
   4. PS 58 - Basic Hardboard

1.5 SUBMITTALS

A. General: Submit in accordance with Section 01 3300.

B. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

C. Product Data: For each type of product indicated, demonstrate compliance with specified attributes.

D. VOC Submittals:
   1. Product Data – VOC Limits: For adhesives sealants, fillers and primers, documentation including printed statement of VOC contents, comply with limits specified in Section 01 6116.

E. Submit "Letter of Conformance" in accordance with Section 01 3300 indicating specified items selected for use in project with the following supporting data.
   1. Submit Shop Drawings and product data. Include materials, component profiles, fastening methods, assembly methods, joint details, accessory listings, and schedule of finishes.
      a. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
      b. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers, and other items installed in architectural woodwork.

F. Qualification Data: For Fabricator

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of Section 01 6000.

B. Do not deliver casework until painting and similar operations that could damage synthetic marble have been completed in installation areas. If casework components must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

C. Handle materials to prevent damage to finished surfaces. Provide protective coverings to prevent physical damage or staining following installation for duration of project.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install casework until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where casework is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before being enclosed and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Limits for adhesives sealants, fillers and primers. Comply with limits specified in Section 01 6116.

2.2 APPROVED MANUFACTURERS

A. Avendra, LLC Preferred Manufacturers:

1. None

B. Approved Manufacturers:

1. MillRock RiverRun Casework (540-438-5973)
2. R.B. Woodcraft, Inc. (315-474-2429)
3. J. Suss Industries Inc. (866-769-5666)

2.3 WOOD, TRANSPARENT FINISH CUSTOM BOX CABINET UNITS - GENERAL

A. Quality Standard:

1. Perform work to meet the requirements of Custom Grade in accordance with the "Architectural Woodwork Standards (AWS)", unless noted otherwise manufactured from solid stock meeting the following requirements:
   a. Minor warp which can be held flat and straight with normal nailing.
   b. Natural and manufacturing defects in excess of those permitted in the grade specified are permitted if such defects are to be covered by adjoining members or otherwise concealed.
   c. Trim members for application on flat surfaces shall have the reverse side "backed out", except members with exposed ends.
   d. "Custom grade" pieces shall be smoothly machined with top flat surfaces machine sanded. Depressed flat surfaces and molded contours shall be smoothly machined.

B. Design:

1. Style of face construction for base, wall, and full-height units, if any, with drawer fronts, doors, and fixed panels as follows:
   a. Face Frame or Frameless.
      1) All cabinets shall be the same construction type for the entire Project.
   b. Cabinet and Door Interface: Flush (Full) Overlay.
   c. Flush Panel Doors.
   d. Flush Panel Drawer Fronts.
   e. Color: Refer to Interior Finish Index and as specified
2. Grain Direction:
   a. Vertical on doors, horizontal on drawer fronts.
   b. Lengthwise on face frame members.
   c. Vertical on end panels.
   d. Side to side on bottoms and tops of units.
   e. Vertical on knee-space panels.
   f. Horizontal on aprons.

2.4 MATERIALS

A. Lumber shall be in accordance with the AWS Grade specified for the product being fabricated. Moisture content shall be 6 percent to 12 percent for boards up to 2-inches nominal thickness, and shall not exceed 19 percent for thicker pieces.

B. Solid Lumber: Dry, sound, selected to eliminate appearance defects. Do not use two adjacent exposed surfaces that are noticeably dissimilar in color, grain, figure, or natural character markings. Provide the following species:
   1. Custom Grade.
   2. Stained Interior Wood Veneers and Panels (Typical):
      a. **COURTYARD & PUBLIC SPACES**:
         1) Rift Cut White Oak
            a) Stained to match; Wilsonart Laminate, Loft Oak #7968K-12.
            b) Sizes and shapes shown on Drawings, of straight grain type sufficient to receive stained finish, smooth surfaced.
         2) Coordinate stain matching with drawings and specifications including, but not limited to;
            a) Section 06 2000.01 “Finish Carpentry (Courtyard)”
            b) Section 06 4023 “Interior Architectural Woodwork”
      b. **RESIDENCE INN**:
         1) Rift Cut White Oak
            a) Stained to match; Wilsonart Laminate, Warehouse Oak #7969K-12.
            b) Sizes and shapes shown on Drawings, of straight grain type sufficient to receive stained finish, smooth surfaced.
         2) Coordinate stain matching with drawings and specifications including, but not limited to;
            a) Section 06 2000.02 “Finish Carpentry (Residence Inn)”
            b) Section 06 4023 “Interior Architectural Woodwork”

3. Stained Interior Standing and Running Trim (Typical):
   a. **COURTYARD & PUBLIC SPACES**:
      1) Rift Cut Alder, Beech
         a) Stained to match; Wilsonart Laminate, Loft Oak #7968K-12.
         b) Sizes and shapes shown on Drawings, of straight grain type sufficient to receive stained finish, smooth surfaced.
      2) Coordinate stain matching with drawings and specifications including, but not limited to;
         a) Section 06 2000.01 “Finish Carpentry (Courtyard)”
         b) Section 06 4023 “Interior Architectural Woodwork”
   b. **RESIDENCE INN**:
      1) Rift Cut Alder, Beech
         a) Stained to match; Wilsonart Laminate, Warehouse Oak #7969K-12.
         b) Sizes and shapes shown on Drawings, of straight grain type sufficient to receive stained finish, smooth surfaced.
      2) Coordinate stain matching with drawings and specifications including, but not limited to;
         a) Section 06 2000.02 “Finish Carpentry (Residence Inn)”
         b) Section 06 4023 “Interior Architectural Woodwork”

C. Plywood Face Veneer: HPVA HP-1. Same species as exposed lumber, unless otherwise indicated, selected for grain and color compatible with exposed solid lumber, with Grade A faces and Grade C backs of same species as faces, no defects. Edgeband exposed edges with solid wood of same species as face veneer.
   1. Custom Grade.
   2. Stained Interior Wood Veneers and Panels (Typical):
      a. **COURTYARD & PUBLIC SPACES**:
         1) Rift Cut White Oak
            a) Stained to match; Wilsonart Laminate, Loft Oak #7968K-12.
            b) Sizes and shapes shown on Drawings, of straight grain type sufficient to receive stained finish, smooth surfaced.
         2) Coordinate stain matching with drawings and specifications including, but not limited to;
            a) Section 06 2000.01 “Finish Carpentry (Courtyard)”
            b) Section 06 4023 “Interior Architectural Woodwork”
      b. **RESIDENCE INN**:
         1) Rift Cut White Oak
            a) Stained to match; Wilsonart Laminate, Warehouse Oak #7969K-12.
            b) Sizes and shapes shown on Drawings, of straight grain type sufficient to receive stained finish, smooth surfaced.
         2) Coordinate stain matching with drawings and specifications including, but not limited to;
            a) Section 06 2000.02 “Finish Carpentry (Residence Inn)”
            b) Section 06 4023 “Interior Architectural Woodwork”

D. Particle Board: ANSI A208.1, Mat-Formed Particle Board, Grade 1-M-2, with minimum density of 45 pcf. Internal bond of 60 psi, and minimum screw holding capacity of 225 lb. on faces and 200 lb. on edges.

E. Hardboard: ANSI A135.4, Class 1, tempered.

F. MDF: ANSI A208.2, Grade 130.

G. Thermoset Decorative Overlay (Melamine): Not less than 100 gram thermally fused, melamine-impregnated decorative paper, complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10. Finish shall be resistant to water and mild cleaners.

H. Edgebanding for use Thermoset Decorative Overlay (Melamine) finished Panels: PVC or polyester edgebanding matching thermoset decorative overlay.

I. Decorative Glass for Cabinet Doors:
1. Application: RESIDENCE INN, Guestrooms:
2. Material:
a. Sandblasted Glass: Heat Treated Float Glass, ASTM C1048, Type I, Class 1, Quality Q3, Condition A, Kind FT (Fully Tempered), 3/16-inch thick, unless otherwise indicated.
1) Provide evenly abraded sandblasted or Acid-Etched Finish. Translucent Pattern as approved by Owner's Representative.
b. Refer to Drawings for locations and size.

2.5 FABRICATION - GENERAL

A. General:
1. Shop-assemble casework for delivery to site in units easily handled and to permit passage through building openings.
2. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trip for scribing and site cutting.
3. Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes, and other fixtures and fittings.

2.6 FABRICATION - FACE-FRAME CABINETS

A. General:
1. Face Frame Rails and Stiles: Not less than 3/4-inch by 1-1/2 -inch solid lumber with glued mortise and tendon joints.
2. Exposed and Semi-exposed Ends; Top and Bottom Rails; and Sub-toe Boards:
a. Not less than 1/2-inch hardwood plywood with exterior veneer to match door and drawer fronts. Machine ends for wood-dowel or mechanical dowel fasteners to receive top, bottom, and back. Rabbet base ends to receive bottom and back. Base ends to extend to floor. Finish exposed ends to match doors and doors and drawer fronts. Finish interior with clear finish.
b. Connect to stiles with pressure-glued tongue and plow joint and supplement by concealed mechanical fasteners. Finish exposed ends to match doors and

drawers. If wood veneered materials used, clear coat interior to achieve water resistant cleanable surface.

3. Unexposed Ends: Not less than 1/2-inch thick, hardwood plywood. Attach to front frame in same manner as exposed ends.
4. Back Panels:
   a. Not less than 1/4-inch hardwood plywood; clear coat interior to achieve water resistant cleanable surface.
5. Doors 48 -inches or Less in Height: 3/4 -inch thick, with solid hardwood stiles and rails, Particle Board or MDF cores, and hardwood face veneers and crossbands. Provide stop silencers at the top and bottom of all hinged doors.
   a. **RESIDENCE INN**:
      1) Secure glass into rabbet in door frame in locations shown on Drawings using a clear flexible vinyl retainer molding "Model No. C-10215", as manufactured by Top Supplies, a division of Richelieu Hardware (800-619-5446), or approved substitution. Glass clips are also permitted.
6. Shelving: Not less than 5/8 -inch particle board with Thermoset Decorative Overlay (Melamine) to match cabinet interior, PVC edge banding; adjustable at least every 1-1/2 -inch; clear plastic seismic shelf clip pressed into 5mm holes bored in cabinet side. Fabricate base shelf to half depth.
7. Filler Strips:
   a. Provide as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinets.
   b. Oversize for field cutting to suit field conditions and assure continuous enclosure of open spaces.
   c. Provide raw (unfinished) cleats at blind corners and appliance openings as required to support countertops, minimum 3/4 -inch by 1-1/2 -inch by 8 -foot length, to be field cut and fit by the installer

B. Base Cabinet Units:
1. Base Cabinet Top Frames: 3/4-inch solid wood with mortise and tenon or doweled connections, glued and pinned or screwed.
2. Base Cabinet Stretchers: 3/4-inch by 4-1/2-inch plywood, Particle Board, or MDF strips or solid-wood boards at front and back of cabinet, glued and pinned or screwed.
3. Base Cabinet Stretchers may be provided as an option to base cabinet top frames.
4. Front Frame Drawer Rails: Not less than 3/4-inch solid wood mortised and fastened into face frame.
5. Bottoms: Not less than 1/2-inch hardwood plywood with exterior veneer to match door and drawer fronts, fully supported by and secured in rabbets in end panels, front frame, and back bottom rail.
6. Corner Blocks: Glued and fastened in each of four top corners to maintain cabinet squareness and rigidity.
7. Drawers:
   a. Provide box-type construction with sub-front and back joined with glued dovetail or rabbeted into sides and secured with glue and mechanical fasteners. Clear coat all exposed surfaces. Match color of sides and bottoms with drawer fronts.
   b. Drawer Fronts: 3/4-inch Particle Board-core hardwood veneered plywood or solid hardwood.

c. Drawer Sides Sub-fronts, and Backs: Not less than 1/2-inch solid hardwood or veneered plywood.

d. Exposed fronts fastened to Sub-fronts with mounting screws from interior of body.

e. Drawer bottom of not less than 1/4-inch veneer hardboard, set into rabbets in back, sides, and sub-fronts.

C. Wall Cabinet Units:

1. Tops and Bottoms: Not less than 1/2-inch hardwood veneered plywood with exterior veneer to match door fronts, fully supported by and secured in rabbets in end panels, front frame, and back rail.

2.7 FABRICATION – FRAMELESS CABINETS

A. General:

1. Exposed and Semi-exposed Ends; Top and Bottom Rails; and Sub-toe Boards:

a. Not less than 3/4-inch Particle Board with Thermoset Decorative Overlay (Melamine) to match door and drawer fronts. Ma chine ends for wood-dowel or mechanical dowel fasteners to receive top, bottom, and back. Base ends to extend to floor. Finish exposed ends to match doors and doors and drawer fronts.

2. Unexposed Ends: Not less than 3/4-inch hardboard or particle board; finished with Thermoset Decorative Overlay (Melamine). Attach to front frame in same manner as exposed ends.

3. Back Panels:

a. Not less than 1/4-inch tempered hardboard or MDF; finished with Thermoset Decorative Overlay (Melamine).

4. Doors 48 -inches or Less in Height:

a. Refer to Drawings for application of the following:

1) Flush (Slab) Style Doors: 3/4 -inch thick, Particle Board or MDF cores, and hardwood face veneers and edge tape.

2) Single Fixed Panel Stile and Rail Style Doors: 3/4 -inch thick, with solid hardwood stiles and rails, Particle Board or MDF cores, and hardwood face veneers and crossbands.

b. Provide stop silencers at the top and bottom of all hinged doors.

c. **RESIDENCE INN**:

1) Secure glass into rabbet in door frame in locations shown on Drawings using a clear flexible vinyl retainer molding “Model No. C-10215”, as manufactured by Top Supplies, a division of Richelieu Hardware (800-619-5446), or approved substitution. Glass clips are also permitted.

5. Shelving: Not less than 5/8 -inch board with Thermoset Decorative Overlay (Melamine) to match cabinet interior, PVC edge banding; adjustable at least every 1-1/2 -inch; clear plastic seismic shelf clip pressed into 5mm holes bored in cabinet side. Fabricate base shelf to half depth.

6. Filler Strips:

a. Provide as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinets.

b. Oversize for field cutting to suit field conditions and assure continuous enclosure of open spaces.

c. Provide raw (unfinished) cleats at blind corners and appliance openings as required to support countertops, minimum 3/4-inch by 1-1/2 -inch by 8 -foot length, to be field cut and fit by the installer

B. Base Cabinet Units:

1. Base Cabinet Top Frames: 3/4-inch solid wood with mortise and tenon or doweled connections, glued and pinned or screwed.
2. Base Cabinet Stretchers: 3/4-inch by 4-1/2-inch plywood, Particle Board, or MDF strips or solid-wood boards at front and back of cabinet, glued and pinned or screwed.
   a. Base Cabinet Stretchers may be provided as an option to base cabinet top frames.
3. Bottoms: Not less than 1/2-inch hardwood plywood with exterior veneer to match door and drawer fronts, fully supported by and secured in rabbets in end panels, front frame, and back bottom rail.
4. Corner Blocks: Glued and fastened in each of four top corners to maintain cabinet squareness and rigidity, or provide plastic or composite glue blocks. Full cabinet rails are an acceptable alternate to corner blocks.
5. Drawers:
   a. Provide box-type construction with sub-front and back joined with glued dovetail or rabbeted into sides and secured with glue and mechanical fasteners. Clear coat all exposed surfaces. Match color of sides and bottoms with drawer fronts.
   b. Drawer Fronts: 3/4-inch Particle Board-core hardwood veneered plywood or solid hardwood.
   c. Drawer Sides Sub-fronts, and Backs: Not less than 1/2-inch veneer hardwood, or soild hardwood with dovetail construction.
   d. Exposed fronts fastened to Sub-fronts with mounting screws from interior of body.
   e. Drawer bottom of not less than 1/4-inch veneer hardboard, set into rabbets in back, sides, and sub-fronts.

C. Wall Cabinet Units:

1. Tops and Bottoms: Not less than 1/2-inch hardwood veneered plywood with exterior veneer to match door fronts, fully supported by and secured in rabbets in end panels, front frame, and back rail.

2.8 CABINET HARDWARE

A. See Cabinet Hardware Schedule for list of which Manufacturer's are approved for use on a specific item.

B. Avendra, LLC Preferred Manufacturers:

1. None

C. Approved Manufacturers

1. Accuride International (562-903-0200)
2. Blum, Inc. (800-438-6788)
3. CompX Timberline (847-752-2600)
4. Corbin Russwin Architectural Hardware, an ASSA ABLOY Group (800-543-3658)
5. Epco, The Engineered Products Co. (810-767-2050)
6. Franklin Fixtures (508-291-1475)

7. Grass America, Inc. (800-334-3512)
8. Hafele America Co. (800-423-3531)
9. H.B. Ives, an Ingersoll-Rand Company (800-820-5542)
10. Hercules Casters and Wheels (800-942-8717)
11. Hettich America, LP (800-777-1772)
12. J. G. Edelen Company, Inc. (410-918-1200)
13. Knape & Vogt Manufacturing Co. (800-253-1561) (KV)
14. Doug Mockett & Company, Inc. (800-523-1269)
15. Outwater Plastics Industries, Inc. (800-631-8375)
16. Polar Ware Company (800-237-3655)
17. Rockler Companies, Inc. (800-279-4441)
18. Selby Furniture Hardware Co., Inc. (718-993-3700)
19. Shepherd Caster Corporation (800-253-0868)
20. Stanley Hardware, Div. of the Stanley Works (800-493-5263)
21. Stylmark, Inc. (Garcy Corp.) (800-328-2495)
22. Victory Display & Store Fixture Mfg. (800-262-1126)

D. General: Provide cabinet hardware and accessory materials associated with architectural cabinets. Coordinate finishes of exposed cabinet hardware with adjacent finish hardware as specified in Section 08 7100 .

All exposed hardware to be US26D (626 Bronze) unless noted otherwise.

2.9 CABINET HARDWARE SCHEDULE: (COURTYARD) (PUBLIC SPACES)

ITEM	MODEL NO.	MANUFACTURER
THE MARKET		
Cabinet Pulls	DP41-A-3	EPCO
Cabinet Locks	280 Series (Drawers) 290 Series (Doors) C700LP-15 Plugs (This item keyed separately- See Note 2)	CompX-Timberline
Concealed Hinges	3073 Overlay 3074 Half Overlay 3074 Inset	Grass America
Shelf Supports (non-exposed 5mm)	345	KV
Shelf Supports Pins and Bussings (Exposed 5mm)	326 Gromments w/ 330 Round Shelf Pins	KV
Barrister Drawer Slide	18235	Rockler
OTHER HARDWARE		
(Refer to Section 12 32 16)		

Note 1:	At drawer slides for large drawers, verify potential loading and adjust slide type to accommodate loads. For drawers over 16" wide and less than 24" wide use Accuride 7432. For applications wider than 24" use Accuride 3640.
Note 2:	All locks in the same component to be on the same key, unless noted otherwise. Other millwork items on the hotel property with locks shall be keyed separately. Ensure master key is different at each hotel in the system.

C. **RESIDENCE INN: Cabinet Hardware Schedule: (RESIDENCE INN Gen 9)**

ITEM	MODEL NO.	MANUFACTURER
Employee Lounge	•	•
Cabinet Pulls: Upper Cabinets	104.33.200	Hafele
Cabinet Pulls: Drawers	132.00.229	Hafele
FRONT DESK	•	•
Brackets, Interior	187, 171, 173, and 179	K&V
Catch, Elbow	2 (Bronze)	Ives
Catch, Roller	336 (Bronze)	Ives
Drawer Locks	•	•
Drawer Slides	3832	Accuride
•	•	•
Folding Table Brackets	250080 (Zinc)	Stanley
Hinges, Pivot	341	Stanley
Hinges, Continuous (Piano)	311-1/4 x 2-1/2" x 72"	Stanley
Magnetic Catches	323, 326, and 327	Ives
Pulls, Door and Drawer (Refer to Interior Finish Index for locations)	120.61.950 x Tarnished Silver	Hafele
Shelf Supports, Interior	256	K&V
Sliding Door Finger Pulls	•	
Sliding Door Lock	•	•
Standards, Interior	255, 87, 71, & 80 (Anachrome)	K&V
THE MARKET	•	•
Base Cabinet Legs	637.45.326	Hafele
Toe Kick Panel Clip	637.45.915	Hafele
Concealed Shelf Standard	T-Standard7/16" HB800-7	Victory Store Fixtures
Adjustable Shelf Bracket	179 Anochrome	KV
Shelf Fastener	154 Anochrome	KV
Glass Doors	3/16" Thick Tempered Safety Glass	•
Glass Door Hinges (matt chrome)	316.33.300 Type 18	Hafele
Glass Door Hinge Round Trim Cap	316.10.420	Hafele
Cabinet Pulls	115.61.601	Stanley

Cabinet Pulls (Option)	4485 1/2	Stanley
Cabinet Locks	02066	Corbin
Concealed Hinges	1805 VZDT32	Grass America
Alum. Slatwall	# ALU7584-M	Outwater
Slatwall Hooks	Coordinate with Slatwall manufacturer.	•
Condiment Container	2Y Bain Marie (Stain Steel)	Polarware
Metal Shelf (powder coated aluminum)	Flat Metal Shelf	Franklin Fixtures
Concealed Hinges	1805 VZDT32	Grass America
GUESTROOMS	•	•
(Refer to Section 12 35 30.13)	•	•
	•	•

1. All exposed hardware in Public Spaces to be US15 unless noted otherwise.
2. All exposed hardware in Guestrooms to be US26 unless noted otherwise.

D. Exposed Wall Shelving: "No. 80 x No. 182"; Knape & Vogt Manufacturing Co.; inset type, adjustable on 1" centers.

E. Cash Drawer With Lock
1. Avendra, LLC Preferred Manufacturers:
   a. None
2. Approved Manufacturers
   a. "Model T-631-F"; RISCO Products Incorporated; (888-392-6150)
3. Dimensions:
   a. 15-5/8 -inch Wide by 10-7/16 -inch Long by 2-1/4 -inch High
   b. Provide 1/8 -inch clearance around all four sides, or as recommended by manufacturer.

2.10 INSTALLATION MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

Adhesives: Installation adhesives as recommended by manufacturer for use intended.

2.11 SHOP FINISHING

A. Quality Standard: Comply with AWS Appendix B, unless otherwise indicated.

B. General: Finish casework at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

C. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling.

D. Transparent Finish: Comply with requirements indicated below for grade, finish system, staining, and sheen, with sheen measured on 60-degree gloss meter per ASTM D523:

1. Grade: Custom.
2. Finish System: TR-2 (custom), catalyzed lacquer.
   a. Stain Color: Refer to Interior Finish Index.
   b. 1 Coat precatalyzed sanding sealer
   c. Sand (240 Grit)
   d. 1 Coat colored sealer
   e. 1 Coat precatalyzed sealer
   f. Sand (320 Grit)
   g. 1 Coat precatalyzed lacquer – 30 percent Sheen (semi-gloss) to match approved sample provided by Marriott.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify adequacy of backing and support framing.

3.2 INSTALLATION

A. All cabinets and shelving shall be installed as shown on Drawings and as specified by manufacturer.

B. Set and secure casework in place rigid, plumb, and level.

C. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Secure cabinet and counter bases to floor using appropriate angles and anchorages.
2. Install cabinets with no more than 1/8 -inch in 96-inch sag, bow, or other variation from a straight line.
3. Maintain veneer sequence matching of cabinets with transparent finish.
4. Carefully scribe casework which is against other building materials, leaving gaps of 1/32 -inch maximum. Do not use additional overly trim for this purpose.
5. Carefully fit equipment to be installed into millwork. Provide filler pieces when required.

D. Fasteners:
   1. Use purpose designed fixture attachments at concealed locations for wall-mounted components.
   2. Use threaded steel concealed joint fasteners to align and secure adjoining cabinet units and counter tops.
   3. Countersink anchorage devices at exposed locations used to wall-mount components, and conceal with solid plugs of species to match surrounding wood. Finish flush with surrounding surfaces.
   4. Install countertops with no more than 1/8 -inch in 96-inch sag, bow, or other variation from a straight line.

E. INSTALLATION - GLAZING
   1. Refer to Section 08 8000 “Interior Glazing for installation methods.

3.3 ADJUSTING AND CLEANING

A. Adjust doors, drawers, hardware, fixtures and other moving or operating parts to function smoothly and correctly.

B. Clean casework, shelves, hardware, fittings and fixtures.

- END OF SECTION -

- SECTION 12 3216-
MANUFACTURED PLASTIC LAMINATE CLAD CASEWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Custom Cabinet Units
      a. Plastic Laminate Clad Custom Cabinet Units
   2. Cabinet Hardware

1.3 RELATED REQUIREMENTS

A. Pertinent Sections specifying Volatile Organic Compound (VOC) Content Restrictions.

B. Section 01 6116 “Volatile Organic Compound (VOC) Restrictions”

C. Section 06 1053 “Miscellaneous Rough Carpentry”.

D. Section 06 2000.01 “Finish Carpentry (Courtyard)”

E. Section 06 2000.02 “Finish Carpentry (Residence Inn)”

F. Section 12 3213 “Manufactured Wood-Veneer-Faced Casework”.

G. Section 12 3530 “Kitchen Casework (Residence Inn)”.

H. Section 12 3616 “Metal Countertops”

I. Section 12 3619 “Wood Countertops”

J. Section 12 3623 “Plastic Countertops”.

K. Section 12 3640 “Stone Countertops and Facings”.

L. Section 12 3661 “Quartz Surfacing Countertops and Frames”.

M. Division 22 for Plumbing Fixtures.

1.4 REFERENCES

A. "Phoenix Building Construction Code", International Building Code 2006, with City of Phoenix administrative provisions and amendments.

B. Architectural Woodwork Standards (AWS), 1st ed. 2009, published jointly by:
1. Architectural Woodwork Institute, www.awi.net.org.
2. Woodwork Institute, www.woodworkinstitute.com.
3. Architectural Woodwork Manufacturers Association of Canada, www.awmac.com.

C. 36 CFR 1191 - Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities; Final Rule; Federal Register, July 26, 1991; updated 2010.

D. ASTM International (ASTM) Publications:
1. C1048 "Standard Specification for Heat-Treated Flat Glass—Kind HS, Kind FT Coated and Uncoated Glass"
2. D523 "Standard Test Method for Specular Gloss"
3. E84 "Standard Test Method for Surface Burning Characteristics of Building Materials"

E. American National Standards Institute (ANSI) Publications:
1. A135.4 Basic Hardboard
2. ANSI/KCMA A161.1 "Performance and Construction Standard for Kitchen and Vanity Cabinets
3. A161.2 "Standards for Fabricated High Pressure Decorative Laminate Countertops"
4. A208.1 "Standards for the Performance of Particleboard"

F. Federal Specifications (FS) Publications:
1. FS MM-L-736 - Lumber, Hardwood
2. FS MMM-A-130 - Adhesive, Contact

G. Forest Stewardship Council (FSC) Publications:
1. FSC 1.2, "Principles and Criteria."

H. National Electrical Manufacturer's Association (NEMA) Standards Publications:
1. NEMA LD3 "High Pressure Decorative Laminates"
   a. Grade HGS (GP 50): Horizontal grade
   b. Grade VGS (GP-28): Vertical Grade
   c. Grade CLS (CL 20): Cabinet liner
   d. Grade BKL (BK 20): Backing sheet
   e. Grade HGF (FR 50): Horizontal application, fire retardant material
   f. Grade VGF (FR 32): Vertical application, fire retardant material

I. U.S. Department of Commerce (DOC), National Institute of Standards and Technology (NIST) Publications
1. PS 1 - Construction and Industrial Plywood

2. PS 20 - American Softwood Lumber Standard
3. PS 51 - Hardwood and Decorative Plywood
4. PS 58 - Basic Hardboard

1.5 SUBMITTALS

A. General: Submit in accordance with Section 01 3300.

B. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

C. Product Data: For each type of product indicated, demonstrate compliance with specified attributes.

D. VOC Submittals:

1. Product Data – VOC Limits: For adhesives sealants, fillers and primers, documentation including printed statement of VOC contents, comply with limits specified in Section 01 6116.

E. Submit “Letter of Conformance” in accordance with Section 01 33 00 indicating specified items selected for use in project with the following supporting data.

1. Submit Shop Drawings and product data. Include materials, component profiles, fastening methods, assembly methods, joint details, accessory listings, and schedule of finishes.
   a. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
   b. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers, and other items installed in architectural woodwork.

F. Qualification Data: For Fabricator

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of Section 01 6000.

B. Do not deliver casework until painting and similar operations that could damage synthetic marble have been completed in installation areas. If casework components must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

C. Handle materials to prevent damage to finished surfaces. Provide protective coverings to prevent physical damage or staining following installation for duration of project.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install casework until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where casework is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before being enclosed and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Limits for adhesives sealants, fillers and primers. Comply with limits specified in Section 01 6116.

2.2 APPROVED MANUFACTURERS

A. Avendra, LLC Preferred Manufacturers:

1. None

B. Approved Manufacturers:

1. MillRock RiverRun Casework (540-438-5973)
2. R.B. Woodcraft, Inc. (315-474-2429)
3. J. Suss Industries Inc. (866-769-5666)

2.3 PLASTIC LAMINATE CUSTOM BOX CABINET UNITS

A. Quality Standard:

1. Perform work to meet the requirements of Custom Grade in accordance with the "Architectural Woodwork Standards (AWS)", unless noted otherwise manufactured from solid stock meeting the following requirements:.
   a. Minor warp which can be held flat and straight with normal nailing.
   b. Natural and manufacturing defects in excess of those permitted in the grade specified are permitted if such defects are to be covered by adjoining members or otherwise concealed.
   c. Trim members for application on flat surfaces shall have the reverse side "backed out", except members with exposed ends.

B. Design:

1. Style of face construction for base, wall, and full-height units, if any, with drawer fronts, doors, and fixed panels as follows:
   a. Face Frame or Frameless.
      1) All cabinets shall be the same construction type for the entire Project.
   b. **COURTYARD & PUBLIC SPACES**:
      1) Cabinet and Door Interface:
         a) Face Frame Reveal Overlay
         b) Frameless: Flush (Full) Overlay

c. **RESIDENCE INN**:
1) Cabinet and Door Interface: Flush (Full) Overlay.
d. Flush Panel Doors.
e. Flush Panel Drawer Fronts.
2. Grain Direction:
a. Vertical on doors, horizontal on drawer fronts.

2.4 MATERIALS

A. Lumber shall be in accordance with the AWS Grade specified for the product being fabricated. Moisture content shall be 6 percent to 12 percent for boards up to 2-inches nominal thickness, and shall not exceed 19 percent for thicker pieces.

B. Plastic Laminate: Shall be high-pressure decorative laminate material complying with current NEMA Standard LD-3. Comply with ANSI A161.2. Pattern and color shown on Interior Finish Index.
1. Laminate Manufacturers:
a. Avendra, LLC Preferred Manufacturers:
1) None
b. Approved Manufacturers:
1) Formica Corporation (800-367-6422)
2) WilsonArt International, Inc. (800-433-3222)
3) Lamin-Art (800-323-7624)
4) Nevamar Company, LLC (800-638-4380)
5) Pionite Decorative Surfaces, a Panolam Industries International Incorporated Company (800-746-6483)
6) "Abet Laminati"; ABET Inc. (800-228-2238)

C. Particle Board: ANSI A208.1, Mat-Formed Particle Board, Grade 1-M-2, with minimum density of 45 pcf. Internal bond of 60 psi, and minimum screw holding capacity of 225 lb. on faces and 200 lb. on edges.

D. Hardboard: ANSI A135.4, Class 1, tempered.

E. MDF: ANSI A208.2, Grade 130.

F. Thermoset Decorative Overlay (Melamine): Not less than 100 gram thermally fused, melamine-impregnated decorative paper, complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10. Finish shall be resistant to water and mild cleaners.

G. Edgebanding for use Thermoset Decorative Overlay (Melamine) finished Panels: PVC or polyester edgebanding matching thermoset decorative overlay.

2.5 FABRICATION - GENERAL

A. General:
1. Shop assembles casework for delivery to site in units easily handled and to permit passage through building openings.

2. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trip for scribing and site cutting.
3. Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes, and other fixtures and fittings.

2.6 FABRICATION - FACE-FRAME CABINETS

A. General:

1. Face Frame Rails and Stiles: Not less than 3/4-inch by 1-1/2 -inch Particle Board faced with Grade VGS plastic laminate with glued mortise and tendon joints.
2. Exposed Ends: Grade VGS plastic laminate or minimum 0.030-inch thick PVC edgebanding. Color to match exposed faces.
3. Semi-exposed Ends; Grade VGS plastic laminate or minimum 0.030-inch thick PVC edgebanding. Color to match exposed faces.
4. Top and Bottom Rails; and Sub-toe Boards:
   a. Not less than 3/4-inch particle board faced with Grade VGS plastic laminate to match door and drawer fronts. Machine ends for wood-dowel or mechanical dowel fasteners to receive top, bottom, and back. Base ends to extend to floor. Finish exposed ends to match doors and doors and drawer fronts.
5. Unexposed Ends: Not less than 3/4-inch particle board or MDF; finished with Thermoset Decorative Overlay (Melamine). Attach to front frame in same manner as exposed ends.
6. Back Panels:
   a. Not less than 1/4-inch tempered hardboard; finished with Thermoset Decorative Overlay (Melamine).
7. Doors 48 -inches or Less in Height: 3/4 -inch thick, Particle Board cores. Front faces to be Grade VGS plastic laminate overlay, and back faces to be Thermoset Decorative Overlay (melamine). Provide stop silencers at the top and bottom of all hinged doors.
8. Shelving: Not less than 5/8 -inch particle board with Thermoset Decorative Overlay (Melamine) to match cabinet interior, PVC edge banding; adjustable at least every 1-1/2 -inch; clear plastic seismic shelf clip pressed into 5mm holes bored in cabinet side. Fabricate base shelf to half depth.
9. Filler Strips:
   a. Provide as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinets.
   b. Oversize for field cutting to suit field conditions and assure continuous enclosure of open spaces.
   c. Provide raw (unfinished) cleats at blind corners and appliance openings as required to support countertops, minimum 3/4-inch by 1-1/2 -inch by 8 -foot length, to be field cut and fit by the installer
10. Interior Cabinet Finish: **(COURTYARD) (PUBLIC SPACES)**
    a. Public Space Casework: Interior face of cabinet units that have surfaces that are exposed shall be Black Thermoset Decorative Overlay (melamine).
    b. Public Space Casework Wet Areas: Interior unexposed face of units that are likely to become wet (such as cabinets housing refrigerated cold pans) should be constructed of polyester overlaid plywood cabinet liner materials:
       1) Approved Manufacturer: "Cabinet Liner Industrial Panel"; Olympic Panel Products, LLC (800-782-7265), or approved substitution.

c. Back-of-House Casework: Interior face of cabinet units that have surfaces that are exposed shall be Black Thermoset Decorative Overlay (melamine).

d. Guestroom Casework: Interior face of exposed units shall be Black Thermoset Decorative Overlay (melamine).

11. Interior Cabinet Finish: **(RESIDENCE INN)**

a. Public Space Casework: Interior face of cabinet units that have surfaces that are exposed shall be Medium Wood Grain Thermoset Decorative Overlay (melamine).

b. Public Space Casework Wet Areas: Interior unexposed face of units that are likely to become wet (such as cabinets housing refrigerated cold pans) should be constructed of polyester overlaid plywood cabinet liner materials:

1) Approved Manufacturer: "Cabinet Liner Industrial Panel"; Olympic Panel Products, LLC (800-782-7265), or approved substitution.

c. Back-of-House Casework: Interior face of exposed units shall be Medium Wood Grain Thermoset Decorative Overlay (melamine).

B. Base Cabinet Units:

1. Base Cabinet Top Frames: 3/4-inch solid wood with mortise and tenon or doweled connections, glued and pinned or screwed.

a. Base Cabinet Stretchers: 3/4 -inch by-4-1/2-inch plywood, Particle Board, or MDF strips or solid-wood boards at front and back of cabinet, glued and pinned or screwed.

2. Base Cabinet Stretchers may be provided as an option to base cabinet top frames.

3. Front Frame Drawer Rails: Not less than 3/4-inch lumber mortised and fastened into face frame.

4. Bottoms: Not less than 1/2-inch hardwood plywood faced with Thermoset Decorative Overlay (Melamine) to match door and drawer fronts, fully supported by and secured in rabbets in end panels, front frame, and back bottom rail.

5. Corner Blocks: Glued and fastened in each of four top corners to maintain cabinet squareness and rigidity.

6. Drawers:

a. Provide box-type construction with sub-front and back joined with glued dovetail or rabbeted into sides and secured with glue and mechanical fasteners. Clear coat all exposed surfaces. Match color of sides and bottoms with drawer fronts.

b. Drawer Fronts: 3/4 -inch thick, Particle Board cores. Front faces to be Grade VGS plastic laminate overlay, and back faces to be Thermoset Decorative Overlay (melamine).

c. Drawer Sides Sub-fronts, and Backs: Not less than 1/2-inch hardwood dovetail construction, or 3/4-inch thick Particle Board faced with Thermoset Decorative Panel overlay (melamine). Provide PVC edge banding to match finish of fronts.

d. Exposed fronts fastened to Sub-fronts with mounting screws from interior of body.

e. Drawer bottom of not less than 1/4-inch thick MDF, tempered hardboard, or plywood faced with Thermoset Decorative Overlay (melamine), set into rabbets in back, sides, and sub-fronts.

C. Wall Cabinet Units:

1. Tops and Bottoms: Not less than 1/2-inch hardwood plywood faced with Thermoset Decorative Overlay (Melamine) to match door and drawer fronts, fully supported by and secured in rabbets in end panels, front frame, and back rail.

2.7 FABRICATION – FRAMELESS CABINETS

A. General:

1. Exposed Ends: Grade VGS plastic laminate or minimum 0.030-inch thick PVC edgebanding. Color to match exposed faces.
2. Semi-exposed Ends; Grade VGS plastic laminate or minimum 0.030-inch thick PVC edgebanding. Color to match exposed faces.
3. Top and Bottom Rails; and Sub-toe Boards:
   a. Not less than 3/4-inch particle board faced with Grade VGS plastic laminate to match door and drawer fronts. Machine ends for wood-dowel or mechanical dowel fasteners to receive top, bottom, and back. Base ends to extend to floor. Finish exposed ends to match doors and doors and drawer fronts.
4. Unexposed Ends: Not less than 3/4-inch tempered hardboard; finished with Thermoset Decorative Overlay (Melamine). Attach to front frame in same manner as exposed ends.
5. Back Panels:
   a. Not less than 1/4-inch tempered hardboard or MDF; finished with Thermoset Decorative Overlay (Melamine).
6. Doors 48 -inches or Less in Height: 3/4 -inch thick, Particle Board cores. Front faces to be Grade VGS plastic laminate overlay, and back faces to be Thermoset Decorative Overlay (melamine). Provide stop silencers at the top and bottom of all hinged doors.
7. Shelving: Not less than 5/8 –inch particle board with Thermoset Decorative Overlay (melamine) to match cabinet interior, PVC edge banding; adjustable at least every 1-1/2 -inch; clear plastic seismic shelf clip pressed into 5mm holes bored in cabinet side. Fabricate base shelf to half depth.
8. Filler Strips:
   a. Provide as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinets.
   b. Oversize for field cutting to suit field conditions and assure continuous enclosure of open spaces.
   c. Provide raw (unfinished) cleats at blind corners and appliance openings as required to support countertops, minimum 3/4 -inch by 1-1/2 -inch by 8 -foot length, to be field cut and fit by the installer
9. Interior Cabinet Finish: **(COURTYARD & PUBLIC SPACES)**
   a. Public Space Casework: Interior face of exposed units shall be Black Thermoset Decorative Overlay (melamine).
   b. Public Space Casework Wet Areas: Interior unexposed face of units that are likely to become wet (such as cabinets housing refrigerated cold pans) should be constructed of polyester overlaid plywood cabinet liner materials:
      1) Approved Manufacturer: “Cabinet Liner Industrial Panel”; Olympic Panel Products, LLC (800-782-7265), or approved substitution.
   c. Back-of-House Casework: Interior face of exposed units shall be Black Thermoset Decorative Overlay (melamine).
   d. Guestroom Casework: Interior face of exposed units shall be Black Thermoset Decorative Overlay (melamine).
10. Interior Cabinet Finish: **(RESIDENCE INN)**
    a. Public Space Casework: Interior face of exposed units shall be Medium Wood Grain Thermoset Decorative Overlay (melamine).

b. Public Space Casework Wet Areas: Interior unexposed face of units that are likely to become wet (such as cabinets housing refrigerated cold pans) should be constructed of polyester overlaid plywood cabinet liner materials:

1) Approved Manufacturer: "Cabinet Liner Industrial Panel"; Olympic Panel Products, LLC (800-782-7265), or approved substitution.

c. Back-of-House Casework: Interior face of exposed units shall be Medium Wood Grain Thermoset Decorative Overlay (melamine).

B. Base Cabinet Units:

1. Base Cabinet Top Frames: 3/4-inch solid wood with mortise and tenon or doweled connections, glued and pinned or screwed.

2. Base Cabinet Stretchers: 3/4-inch by 4-1/2-inch plywood, Particle Board, or MDF strips or solid-wood boards at front and back of cabinet, glued and pinned or screwed.

a. Base Cabinet Stretchers may be provided as an option to base cabinet top frames.

3. Bottoms: Not less than 1/2-inch hardwood plywood faced with Thermoset Decorative Overlay (Melamine) to match door and drawer fronts, fully supported by and secured in rabbets in end panels, front frame, and back bottom rail.

4. Corner Blocks: Glued and fastened in each of four top corners to maintain cabinet squareness and rigidity.

5. Drawers:

a. Provide box-type construction with sub-front and back joined with glued dovetail or rabbeted into sides and secured with glue and mechanical fasteners. Clear coat all exposed surfaces. Match color of sides and bottoms with drawer fronts.

b. Drawer Fronts: 3/4 -inch thick, Particle Board cores. Front faces to be Grade VGS plastic laminate overlay, and back faces to be Thermoset Decorative Overlay (melamine).

c. Drawer Sides Sub-fronts, and Backs: Not less than 1/2 -inch hardwood dovetail construction or 3/4 -inch thick Particle Board faced with Thermoset Decorative Overlay (melamine). Provide PVC edge banding to match finish of fronts.

d. Exposed fronts fastened to Sub-fronts with mounting screws from interior of body.

e. Drawer bottom of not less than 1/4 -inch thick plywood faced with Thermoset Decorative Panel overlay (melamine), set into rabbets in back, sides, and sub-fronts.

C. Wall Cabinet Units:

1. Tops and Bottoms: Not less than 1/2-inch hardwood plywood faced with Thermoset Decorative Overlay (Melamine) to match door and drawer fronts, fully supported by and secured in rabbets in end panels, front frame, and back rail.

2.8 CABINET HARDWARE

A. See Cabinet Hardware Schedule for list of which Manufacturer's are approved for use on a specific item.

B. Avendra, LLC Preferred Manufacturers:

1. None

C. Approved Manufacturers

1. Accuride International (562-903-0200)

2. Blum, Inc. (800-438-6788)
3. CompX Timberline (847-752-2600)
4. Corbin Russwin Architectural Hardware, an ASSA ABLOY Group (800-543-3658)
5. Epco, The Engineered Products Co. (810-767-2050)
6. Franklin Fixtures (508-291-1475)
7. Grass America, Inc. (800-334-3512)
8. Hafele America Co. (800-423-3531)
9. H.B. Ives, an Ingersoll-Rand Company (800-820-5542)
10. Hercules Casters and Wheels (800-942-8717)
11. Hettich America, LP (800-777-1772)
12. J. G. Edelen Company, Inc. (410-918-1200)
13. Knape & Vogt Manufacturing Co. (800-253-1561) (KV)
14. Doug Mockett & Company, Inc. (800-523-1269)
15. Outwater Plastics Industries, Inc. (800-631-8375)
16. Polar Ware Company (800-237-3655)
17. Rockler Companies, Inc. (800-279-4441)
18. Selby Furniture Hardware Co., Inc. (718-993-3700)
19. Shepherd Caster Corporation (800-253-0868)
20. Stanley Hardware, Div. of the Stanley Works (800-493-5263)
21. Stylmark, Inc. (Garcy Corp.) (800-328-2495)
22. Victory Display & Store Fixture Mfg. (800-262-1126)

D. General: Provide cabinet hardware and accessory materials associated with architectural cabinets. Coordinate finishes of exposed cabinet hardware with adjacent finish hardware as specified in Section 08 7100 .

E. Cabinet Hardware Schedule: (COURTYARD) (PUBLIC SPACES)

1. Cabinet Hardware Schedule:

ITEM	MODEL NO.	MANUFACTURER
WELCOME PEDESTALS		
Cabinet Pulls	DP41-A-3	EPCO
Cabinet Locks	**280 SERIES (DRAWERS)** **290 SERIES (DOORS)** **C700LP-15 PLUGS** (This item keyed separately-See Note 2)	CompX-Timberline
Concealed Hinges	3073 Overlay 3074 Half Overlay 3074 Inset	Grass America
Drawer Slides – Box and File Drawers	3832	Accuride
Drawer Slides – Pencil and Cash Drawers	2632	Accuride
FOCAL WALL		
Cabinet Pulls	DP41-A-3	EPCO
Concealed Hinges		Grass
Shelf Supports (non-exposed 5mm)	345	KV
Cabinet Locks	290 Series (Doors) C700LP-15 Plugs (This item keyed separately-	CompX - Timberline

	See Note 2)	
GOBOARD & COFFEE AREA		
Cabinet Pulls	DP41-A-3	EPCO
Concealed Hinges	3073 Overlay 3074 Half Overlay 3074 Inset	Grass America
Shelf Supports (non-exposed 5mm)	345	KV
Cabinet Locks	290 Series (Doors) C700LP-15 Plugs (This item keyed separately- See Note 2)	CompX - Timberline
BUSINESS CENTER		
Cabinet Pulls	DP41-A-3	EPCO
Concealed Hinges	3073 Overlay 3074 Half Overlay 3074 Inset	Grass America
Shelf Supports (non-exposed 5mm)	345	KV
Cabinet Locks	290 Series (Doors) C700LP-15 Plugs (This item keyed separately- See Note 2)	CompX - Timberline
Wire Management	631.39.301	Hafele
QUICK PRINT / LOCAL LIBRARY		
Cabinet Pulls	DP41-A-3	EPCO
Concealed Hinges	3073 Overlay 3074 Half Overlay 3074 Inset	Grass America
Shelf Supports (non-exposed 5mm)	345	KV
Cabinet Locks	290 Series (Doors) C700LP-15 Plugs (This item keyed separately- See Note 2)	CompX - Timberline
OFFICE AREA		
Finger Pulls		Stanley
Cabinet Pulls	4485 x US26D	Stanley
Drawer Slides	3832	Accuride
Standards and Clips	255/256 x US26D	KV
GUEST ROOM SUITES AND CONFERENCE ROOMS		
Cabinet Pulls	4485 x US26D	Stanley
Concealed Hinges	3073 Overlay 3074 Half Overlay 3074 Inset	Grass America
Catches	2 x A4	Ives
Magnetic Stops	46 x US26	Stanley
Standards & Clips	255/256 x Anachrome	KV
S-BAR		
Cabinet Pulls	DP41-A-3	EPCO
Cabinet Locks	280 Series (Drawers) 290 Series (Doors) C700LP-15 Plugs (This item keyed separately- See Note 2)	CompX-Timberline
Concealed Hinges	3073 Overlay 3074 Half Overlay 3074 Inset	Grass America
Shelf Supports (non-exposed 5mm)	345	KV

Shelf Supports Pins and Bussings (Exposed 5mm)	326 Gromments w/ 330 Round Shelf Pins	KV
Pocket Door Hardware With Locking (Tbd)	Special pattern and product for Marriott Courtyard projects (TBD)	Hafele (TBD)
THE MARKET		
(Refer to Section 12 32 13)		

Note 1:	At drawer slides for large drawers, verify potential loading and adjust slide type to accommodate loads. For drawers over 16" wide and less than 24" wide use Accuride 7432. For applications wider than 24" use Accuride 3640.
Note 2:	All locks in the same component to be on the same key, unless noted otherwise. Other millwork items on the hotel property with locks shall be keyed separately. Ensure master key is different at each hotel in the system.

2. All exposed hardware to be US26D (626 Bronze) unless noted otherwise.

F. Cabinet Hardware Schedule: (RESIDENCE INN)

1. Refer to Section 12 3213 "Manufactured Wood Veneer Faced Casework."

G. Exposed Wall Shelving: "No. 80 x No. 182"; Knape & Vogt Manufacturing Co.; inset type, adjustable on 1" centers.

H. Cash Drawer With Lock

1. Avendra, LLC Preferred Manufacturers:
   a. None
2. Approved Manufacturers
   a. "Model T-631-F"; RISCO Products Incorporated; (888-392-6150)
3. Dimensions:
   a. 15-5/8 -inch Wide by 10-7/16 -inch Long by 2-1/4 -inch High
   b. Provide 1/8 -inch clearance around all four sides, or as recommended by manufacturer.

2.9 INSTALLATION MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

1. Adhesives: Installation adhesives as recommended by manufacturer for use intended.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify adequacy of backing and support framing.

3.2 INSTALLATION

A. All cabinets and shelving shall be installed as shown on Drawings and as specified by manufacturer.

B. Set and secure casework in place rigid, plumb, and level.

C. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Secure cabinet and counter bases to floor using appropriate angles and anchorages.
2. Install cabinets with no more than 1/8 -inch in 96-inch sag, bow, or other variation from a straight line.
3. Maintain veneer sequence matching of cabinets with transparent finish.
4. Carefully scribe casework which is against other building materials, leaving gaps of 1/32 -inch maximum. Do not use additional overly trim for this purpose.
5. Carefully fit equipment to be installed into millwork. Provide filler pieces when required.

D. Fasteners:

1. Use purpose designed fixture attachments at concealed locations for wall-mounted components.
2. Use threaded steel concealed joint fasteners to align and secure adjoining cabinet units and counter tops.
3. Countersink anchorage devices at exposed locations used to wall-mount components, and conceal with solid plugs of species to match surrounding wood. Finish flush with surrounding surfaces.
4. Install countertops with no more than 1/8 -inch in 96-inch sag, bow, or other variation from a straight line.

3.3 ADJUSTING AND CLEANING

A. Adjust doors, drawers, hardware, fixtures and other moving or operating parts to function smoothly and correctly.

B. Clean casework, shelves, hardware, fittings and fixtures.

- END OF SECTION -

- SECTION 12 3530 -

KITCHEN CASEWORK (RESIDENCE INN)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: **(RESIDENCE INN)**
   1. Cabinet Units
      a. Wood Premanufactured Cabinets
         1) Location: Guestroom Kitchen
         2) Location: Guestroom Dressing Area
         3) Location: Employee Lounge
   2. Decorative Glass for Guestroom Cabinets
   3. Cabinet Hardware

1.3 RELATED REQUIREMENTS

A. Pertinent Sections specifying Volatile Organic Compound (VOC) Content Restrictions.

B. Section 01 6116 “Volatile Organic Compound (VOC) Restrictions”

C. Section 06 1053 “Miscellaneous Rough Carpentry”.

D. Section 06 2000.01 “Finish Carpentry (Courtyard)”

E. Section 06 2000.02 “Finish Carpentry (Residence Inn)”

F. Section 08 8000 “InteriorGlazing”.

G. Section 12 3213 “Manufactured Wood-Veneer-Faced Casework”.

H. Section 12 3216 “Manufactured Plastic Laminate Clad Casework”

I. Section 12 3616 “Metal Countertops”

J. Section 12 3619 “Wood Countertops”

K. Section 12 3623 “Plastic Countertops”.

L. Section 12 3640 “Stone Countertops”.

M. Section 12 3661 “Quartz Surfacing Countertops and Facings”.

N. Division 22 Sections: Plumbing Fixtures and Equipment.

1.4 REFERENCES

A. “Phoenix Building Construction Code”, International Building Code 2006, with City of Phoenix administrative provisions and amendments.

B. Architectural Woodwork Standards (AWS), 1st ed. 2009, published jointly by:
1. Architectural Woodwork Institute, www.awi.net.org.
2. Woodwork Institute, www.woodworkinstitute.com.
3. Architectural Woodwork Manufacturers Association of Canada, www.awmac.com.

C. 36 CFR 1191 - Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities; Final Rule; Federal Register, July 26, 1991; updated 2010.

D. ASTM International (ASTM) Publications:
1. C1048 “Standard Specification for Heat-Treated Flat Glass—Kind HS, Kind FT Coated and Uncoated Glass”
2. D523 “Standard Test Method for Specular Gloss”
3. E84 "Standard Test Method for Surface Burning Characteristics of Building Materials"

E. American National Standards Institute (ANSI) Publications:
1. A135.4 Basic Hardboard
2. A161.2 “Standards for Fabricated High Pressure Decorative Laminate Countertops”
3. A208.1 "Standards for the Performance of Particleboard"

F. Hardwood Plywood & Veneer Association (HPVA) Publications:
1. ANSI/HPVA HP-1: "American National Standard for Hardwood and Decorative Plywood"

G. Kitchen Cabinet Manufacturers Association (KCMA)
1. ANSI/KCMA A161.1 “Performance & Construction Standard for Kitchen and Vanity Cabinets”

H. National Electrical Manufacturer’s Association (NEMA) Standards Publications:
1. NEMA LD3 “High Pressure Decorative Laminates”

I. U.S. Department of Commerce (DOC), National Institute of Standards and Technology (NIST) Publications
1. PS 1 - Construction and Industrial Plywood
2. PS 20 - American Softwood Lumber Standard
3. PS 51 - Hardwood and Decorative Plywood
4. PS 58 - Basic Hardboard

1.5 SUBMITTALS

A. General: Submit in accordance with Section 01 3300.

B. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

C. Product Data: For each type of product indicated, demonstrate compliance with specified attributes.

D. VOC Submittals:

1. Product Data – VOC Limits: For adhesives sealants, fillers and primers, documentation including printed statement of VOC contents, comply with limits specified in Section 01 6116.

E. Submit “Letter of Conformance” in accordance with Section 01 33 00 (01330) indicating specified items selected for use in project with the following supporting data.

1. Submit Shop Drawings and product data. Include materials, component profiles, fastening methods, assembly methods, joint details, accessory listings, and schedule of finishes.
   a. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
   b. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers, and other items installed in architectural woodwork.

F. Qualification Data: For Fabricator

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of Section 01 6000.

B. General Contractor shall allow a minimum delivery lead time of 16 to 18 weeks after final approval of Shop Drawings and Samples for import production.

C. Do not deliver casework until painting and similar operations that could damage synthetic marble have been completed in installation areas. If casework components must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

D. Handle materials to prevent damage to finished surfaces. Provide protective coverings to prevent physical damage or staining following installation for duration of project.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install casework until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where casework is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on

Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before being enclosed and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Limits for adhesives sealants, fillers and primers. Comply with limits specified in Section 01 6116.

2.2 APPROVED MANUFACTURERS

A. Avendra, LLC Preferred Manufacturers:
   1. None

B. Approved Manufacturers:
   1. MillRock RiverRun Casework (540-438-5973)
      a. Residence Inn Gen 9 Possibilities Décor Package: “Possibilities Shaker Style” Frameless Construction.
   2. J Suss Industries (866-769-5666)
      a. Residence Inn Gen 9 Possibilities Décor Package: “EuroPossibilities Style” Framelesss Construction.

2.3 CABINET UNITS - GENERAL

A. Quality Standard:
   1. Provide cabinets that comply with KCMA A161.1, unless noted otherwise manufactured meeting the following requirements:
      a. Minor warp which can be held flat and straight with normal nailing.
      b. Natural and manufacturing defects in excess of those permitted in the grade specified are permitted if such defects are to be covered by adjoining members or otherwise concealed.
      c. Trim members for application on flat surfaces shall have the reverse side "backed out", except members with exposed ends.

B. Design:
   1. Style of face construction for base, wall, and full-height units, if any, with drawer fronts, doors, and fixed panels as follows:
      a. Face Frame or Frameless.
         1) All cabinets shall be the same construction type for the entire Project.
      b. Cabinet and Door Interface: Flush (Full) Overlay.
      c. Single Fixed Panel Doors.
      d. Flush Panel Drawer Fronts.
      e. Interior Finish: Classic Maple Thermoset Decorative Overlay (Melamine)

1) Refer also to specifications and Drawings.

2. Grain Direction:
   a. Vertical on doors, horizontal on drawer fronts.
   b. Lengthwise on face frame members.
   c. Vertical on end panels.
   d. Side to side on bottoms and tops of units.
   e. Vertical on knee-space panels.
   f. Horizontal on aprons.

2.4 MATERIALS

A. Solid Lumber: Dry, sound, selected to eliminate appearance defects, of the following species: Moisture content shall be 6 percent to 12 percent . Do not use two adjacent exposed surfaces that are noticeably dissimilar in color, grain, figure, or natural character markings.

1. Custom Grade
2. Stained Interior Wood Veneers and Panels (Typical):
   a. **RESIDENCE INN**:
      1) Rift Cut White Oak
         a) Stained to match; Wilsonart Laminate, Warehouse Oak #7969K-12.
         b) Sizes and shapes shown on Drawings, of straight grain type sufficient to receive stained finish, smooth surfaced.
      2) Coordinate stain matching with drawings and specifications including, but not limited to;
         a) Section 06 2000.02 “Finish Carpentry (Residence Inn)”
         b) Section 06 4023 “Interior Architectural Woodwork”
3. Stained Interior Standing and Running Trim (Typical):
   a. **RESIDENCE INN**:
      1) Rift Cut Alder, Beech
         a) Stained to match; Wilsonart Laminate, Warehouse Oak #7969K-12.
         b) Sizes and shapes shown on Drawings, of straight grain type sufficient to receive stained finish, smooth surfaced.
      2) Coordinate stain matching with drawings and specifications including, but not limited to;
         a) Section 06 2000.02 “Finish Carpentry (Residence Inn)”
         b) Section 06 4023 “Interior Architectural Woodwork”

B. Plywood Face Veneer: HPVA HP-1. Same species as exposed lumber, unless otherwise indicated, selected for grain and color compatible with exposed solid lumber, with Grade A faces and Grade C backs of same species as faces, no defects. Edgeband exposed edges with solid wood of same species as face veneer.

1. Custom Grade
2. Stained Interior Wood Veneers and Panels (Typical):
   a. **RESIDENCE INN**:
      1) Rift Cut White Oak
         a) Stained to match; Wilsonart Laminate, Warehouse Oak #7969K-12.

b) Sizes and shapes shown on Drawings, of straight grain type sufficient to receive stained finish, smooth surfaced.

2) Coordinate stain matching with drawings and specifications including, but not limited to;

a) Section 06 2000.02 “Finish Carpentry (Residence Inn)”

b) Section 06 4023 “Interior Architectural Woodwork”

C. Particle Board: ANSI A208.1, Mat-Formed Particle Board, Grade 1-M-2, with minimum density of 45 pcf. Internal bond of 60 psi, and minimum screw holding capacity of 225 lb. on faces and 200 lb. on edges.

D. Hardboard: ANSI A135.4, Class 1, tempered.

E. MDF: ANSI A208.2, Grade 130.

F. Thermoset Decorative Overlay (Melamine): Not less than 100 gram thermally fused, melamine-impregnated decorative paper, complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10. Finish shall be resistant to water and mild cleaners.

G. Edgebanding for use Thermoset Decorative Overlay (Melamine) finished Panels: PVC or polyester edgebanding matching thermoset decorative overlay.

H. Decorative Glass for Cabinet Doors:

I. Sandblasted Glass: Heat Treated Float Glass, ASTM C1048, Type I, Class 1, Quality Q3, Condition A, Kind FT (Fully Tempered), 3/16-inch thick, unless otherwise indicated.

1. Provide evenly abraded sandblasted or Acid-Etched, Non-Marking (no fingerprint) Finish.
   a. Translucent Pattern as approved by Owner's Representative.
2. Refer to Drawings for locations and size.

2.5 FABRICATION - GENERAL

A. General:

1. Shop assemble, package, and label casework for delivery to site in units easily handled and to permit passage through building openings.
2. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trip for scribing and site cutting.
3. Allow adequate clearance to supports at cutouts.
   a. Do not cut through support members.

2.6 FABRICATION - FACE-FRAME CABINETS

A. General:

1. Face Frame Rails and Stiles: Not less than 3/4-inch by 1-1/2 -inch solid lumber with glued mortise and tendon joints.
2. Exposed and Semi-exposed Ends; Top and Bottom Rails; and Sub-toe Boards:
   a. Not less than 1/2-inch hardwood plywood with exterior veneer, with stained and clear finish to match doors and drawer faces and with clear finish on interior or not less than 3/4-inch Particle Board with medium wood grain Thermoset Decorative

Overlay (Melamine), to match door and drawer fronts. Machine ends for wood-dowel fasteners to receive top, bottom, and back. Rabbet base ends to receive bottom and back. Base ends to extend to floor. Finish exposed ends to match doors and doors and drawer fronts.

b. Connect to stiles with pressure-glued tongue and plow joint and supplement by concealed mechanical fasteners. Finish exposed ends to match doors and drawers. If wood veneered materials used, clear coat interior to achieve water resistant cleanable surface.

3. Unexposed Ends: Not less than 1/2-inch hardwood plywood, or not less than 3/4-inch hardboard; finished with Thermoset Decorative Overlay (Melamine). Attach to front frame in same manner as exposed ends.

4. Back Panels:

a. Not less than 1/4-inch hardwood plywood, or not less than 1/4 -inch MDF faced with Thermoset Decorative Overlay (Melamine). If wood veneered materials, clear coat interior to achieve water resistant cleanable surface.

5. Doors 48 -inches or Less in Height: 3/4 -inch thick, with solid hardwood stiles and rails, Particle Board or MDF cores, and hardwood face veneers and crossbands. Provide stop silencers at the top and bottom of all hinged doors.

a. Secure glass into rabbet in door frame in locations shown on Drawings using a clear flexible vinyl retainer molding “Model No. C-10215”, as manufactured by Top Supplies, a division of Richelieu Hardware (800-619-5446), or approved substitution.

6. Shelving: not less than 5/8 -inch Particle Board with Thermoset Decorative Overlay (melamine) to match cabinet interior, PVC edge banding; adjustable at least every 1-1/2 -inch; clear plastic seismic shelf clip pressed into 5mm holes bored in cabinet side. Fabricate base shelf to half or three-quarter depth.

7. Filler Strips:

a. Provide as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinets.

b. Oversize for field cutting to suit field conditions and assure continuous enclosure of open spaces.

c. Provide raw (unfinished) cleats at blind corners and appliance openings as required to support countertops, minimum 3/4-inch by 1-1/2 -inch by 8 -foot length, to be field cut and fit by the installer

8. Interior Cabinet Finish:

a. Interior face of cabinet units that have surfaces that are exposed shall be wood grain, medium stock color Thermoset Decorative Overlay (melamine), or clear finish where hardwood plywood is provided.

B. Base Cabinet Units:

1. Base Cabinet Top Frames: 3/4-inch thickness of same material as side panels with mortise and tenon or doweled connections, glued and pinned or screwed.

2. Base Cabinet Stretchers: 3/4-inch by-4-1/2-inch plywood, Particle Board, or MDF strips or solid-wood boards at front and back of cabinet, glued and pinned or screwed.

a. Base Cabinet Stretchers may be provided as an option to base cabinet top frames.

3. Front Frame Drawer Rails: Not less than 3/4-inch solid wood mortised and fastened into face frame.

4. Bottoms: Not less than 1/2-inch hardwood plywood with exterior veneer, or not less than 5/8 -inch particle board with Thermoset Decorative Overlay (Melamine), to match door and drawer fronts, fully supported by and secured in rabbets in end panels, front frame, and back bottom rail.
5. Corner Blocks: Glued and fastened in each of four top corners to maintain cabinet squareness and rigidity, or provide plastic or composite glue blocks. Full cabinet rails are an acceptable alternate to corner blocks.
6. Drawers:
   a. Provide box-type construction with sub-front and back joined with glued dovetail or rabbeted into sides and secured with glue and mechanical fasteners. Clear coat all exposed surfaces.
      1) Optional Drawer sides by “Metabox Drawer System” are acceptable. Sides to be epoxy coated to match interior Thermoset Decorative Overlay (Melamine) color.
   b. Drawer Fronts: 3/4-inch Particle Board-core hardwood veneered plywood or solid hardwood.
   c. Drawer Sides Sub-fronts and Backs: Not less than 1/2-inch solid hardwood, or veneered plywood, or not less than 1/2 thick particle board with Thermoset Decorative Overlay (Melamine).
   d. Exposed fronts fastened to Sub-fronts with mounting screws from interior of body.
   e. Drawer bottom of not less than 1/4-inch veneer hardboard, or not less than 1/4-inch MDF faced with Thermoset Decorative Overlay (Melamine), set into rabbets in back, sides, and sub-fronts.

C. Wall Cabinet Units:
1. Tops and Bottoms: Not less than 1/2-inch hardwood veneered plywood with exterior veneer, or not less than 5/8 -inch particle board with Thermoset Decorative Overlay (Melamine), to match door fronts, fully supported by and secured in rabbets in end panels, front frame, and back rail.

2.7 FABRICATION – FRAMELESS CABINETS

A. General:
1. Exposed and Semi-exposed Ends; Top and Bottom Rails; and Sub-toe Boards:
   a. Not less than 5/8 -inch Particle Board with Thermoset Decorative Overlay (Melamine) to match door and drawer fronts. Machine ends for wood-dowel fasteners to receive top, bottom, and back. Base ends to extend to floor. Finish exposed ends to match doors and drawer fronts.
2. Unexposed Ends: Not less than 3/4-inch hardboard; finished with Thermoset Decorative Overlay (Melamine). Attach to front frame in same manner as exposed ends.
3. Back Panels:
   a. Not less than 1/4-inch tempered hardboard; finished with Thermoset Decorative Overlay (Melamine), or not less than 1/8-inch MDF faced with Thermoset Decorative Overlay (Melamine).
4. Doors 48 -inches or Less in Height: 3/4 -inch thick, with solid hardwood stiles and rails, center panel of Particle Board or MDF cores, and hardwood face veneers and crossbands. Provide stop silencers at the top and bottom of all hinged doors.
   a. Secure glass into rabbet in door frame in locations shown on Drawings using a clear flexible vinyl retainer molding “Model No. C-10215”, as manufactured by Top

Supplies, a division of Richelieu Hardware (800-619-5446), or approved substitution. Glass clips are also permitted.

5. Shelving: not less than 5/8 -inch Particle Board with Thermoset Decorative Overlay (Melamine) to match cabinet interior, PVC edge banding; adjustable at least every 1-1/2 -inch; clear plastic seismic shelf clip pressed into 5mm holes bored in cabinet side. Fabricate base shelf to half or three-quarter depth.
6. Filler Strips:
   a. Provide as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinets.
   b. Oversize for field cutting to suit field conditions and assure continuous enclosure of open spaces.
   c. Provide raw (unfinished) cleats at blind corners and appliance openings as required to support countertops, minimum 3/4-inch by 1-1/2 -inch by 8 -foot length, to be field cut and fit by the installer
7. Interior Cabinet Finish:
   a. Interior face of exposed units shall be wood grain, medium stock color Thermoset Decorative Overlay (melamine).

B. Base Cabinet Units:
1. Base Cabinet: 3/4-inch solid wood, or material to match cabinet sides, with mortise and tenon or doweled connections, glued and doweled.
2. Base Cabinet Stretchers: 3/4-inch by-4-1/2-inch plywood, Particle Board, or MDF strips or solid-wood boards at front and back of cabinet, glued and pinned or screwed.
   a. At sink base cabinet provide stretcher at vertical location in front of cabinet where horizontal location interferes with cut out for sink, or 2-1/2 inch wide horizontal stretcher at front.
3. Bottoms: Not less than 1/2-inch hardwood plywood with exterior veneer, or not less than 5/8-inch particle board with Thermoset Decorative Overlay (Melamine), to match door and drawer fronts, fully supported by and secured in rabbets or dowelled in end panels, and front frame.
4. Corner Blocks: Glued and fastened in each of four top corners to maintain cabinet squareness and rigidity, or provide plastic or composite glue blocks. Full cabinet rails are an acceptable alternate to corner blocks.
5. Drawers:
   a. Provide box-type construction with sub-front and back joined with glued dovetail or rabbeted into sides and secured with glue and mechanical fasteners. Clear coat all exposed surfaces.
      1) Optional Drawer sides by “Metabox Drawer System” are acceptable. Sides to be epoxy coated to match interior Thermoset Decorative Overlay (Melamine) color.
   b. Drawer Fronts: 3/4-inch Particle Board-core solid hardwood, or veneered plywood.
   c. Drawer Sides Sub-fronts, and Backs: Not less than 1/2-inch hardwood veneered plywood, or not less than 5/8 -inch particle board with Thermoset Decorative Overlay (Melamine).
   d. Exposed fronts fastened to Sub-fronts with mounting screws from interior of body.
   e. Drawer bottom of not less than 1/4-inch veneer hardboard, or not less than 1/4-inch MDF faced with Thermoset Decorative Overlay (Melamine), set into rabbets in back, sides, and sub-fronts.

C. Wall Cabinet Units:

1. Tops and Bottoms: Not less than 1/2-inch hardwood veneered plywood with exterior veneer, or not less than 1/2 thick particle board with Thermoset Decorative Overlay (Melamine), to match door fronts, fully supported by and secured in rabbets, or dowelled in end panels, front frame, and back rail.

2.8 CABINET HARDWARE

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets. Coordinate finishes of exposed cabinet hardware with adjacent finish hardware as specified in Section 08 7100 .

B. All exposed hardware to be US26D (BMHA 626 Bronze) unless noted otherwise.

C. Cabinet Hardware Schedule:

ITEM	MODEL NO.	MANUFACTURER
GUESTROOM		
Possibilities: Kitchen Cabinet Door Pulls	4000-128	J.G. Edelen
Possibilities: Kitchen Cabinet Drawer Pulls	4000-288	J.G. Edelen
Possibilities: Dressing Area Drawer Base	4000-672	J.G. Edelen
EMPLOYEE LOUNGE		
Cabinet Pulls: Upper Cabinets	104.33.200	Hafele
Cabinet Pulls: Drawers	132.00.229	Hafele

1. Doors Hinges: Concealed hinges, Self Closing.
2. Drawer Slides: Side Mount, 75 lb. load capacity, epoxy coated, self closing.

D. ADA Accessible Guest Room:

1. Door hardware at kitchen sink: Provide Flipper type "Pocket Door" retractable doors, hardware system, by Julius Blum, or approved substitution.
   a. Cabinet to be sized for a minimum knee clearance clear opening of 30-inches wide and 27-inches high, after flipper doors are retracted into sides of cabinet, complying with 2010 ADA, as approved by Owner's Representative or Architect.
   b. Eliminate toe kick base of sink cabinet with flipper doors.
2. Finish all interior surfaces to match doors and drawers.

2.9 INSTALLATION MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

1. Adhesives: Installation adhesives as recommended by manufacturer for use intended.

2.10 SHOP FINISHING

A. General: Finish casework at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify adequacy of backing and support framing.

3.2 INSTALLATION

A. All cabinets and shelving shall be installed as shown on Drawings and as specified by manufacturer.

B. Set and secure casework in place rigid, plumb, and level.

C. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Secure cabinet and counter bases to floor using appropriate angles and anchorages.
2. Install cabinets with no more than 1/8 -inch in 96 -inch sag, bow, or other variation from a straight line.
3. Maintain veneer sequence matching of cabinets with transparent finish.
4. Carefully scribe casework which is against other building materials, leaving gaps of 1/32 -inch maximum. Do not use additional overly trim for this purpose.
5. Carefully fit equipment to be installed into millwork. Provide filler pieces when required.
6. Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes, and other fixtures and fittings.

D. Fasteners:

1. Use purpose designed fixture attachments at concealed locations for wall-mounted components.
2. Use threaded steel concealed joint fasteners to align and secure adjoining cabinet units and counter tops.
3. Countersink anchorage devices at exposed locations used to wall-mount components, and conceal with solid plugs of species to match surrounding wood. Finish flush with surrounding surfaces.
4. Install countertops with no more than 1/8 -inch in 96 -inch sag, bow, or other variation from a straight line.

3.3 INSTALLATION - GLAZING

A. Refer to Section 08 8000 “InteriorGlazing”, for installation methods.

B. Glass at cabinet doors shall be factory installed, prior to shipment.

3.4 ADJUSTING AND CLEANING

A. Adjust doors, drawers, hardware, fixtures and other moving or operating parts to function smoothly and correctly.

B. Clean casework, shelves, hardware, fittings and fixtures.

- END OF SECTION -

- SECTION 12 3616 -

METAL COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section Includes the following shop fabricated items:
   1. Custom metal countertops, aprons and backsplashes.
      a. Metal laminated to wood core.

1.3 RELATED REQUIREMENTS

A. Pertinent Sections specifying Volatile Organic Compound (VOC) Content Restrictions.

B. Section 01 6116 “Volatile Organic Compound (VOC) Restrictions”

C. Section 06 1053 "Miscellaneous Rough Carpentry" for furring, blocking, shims, hanging strips and other carpentry, not exposed to view, required for installing countertops specified in this Section.

D. Section 06 2000.01 “Finish Carpentry (Courtyard)”

E. Section 06 2000.02 “Finish Carpentry (Residence Inn)”

F. Section 06 4023 "Interior Architectural Woodwork" for custom-made cabinets.

G. Section 07 9200 “Joint Sealants”.

H. Section 09 2216 "Non-Structural Metal Framing" for reinforcements in metal-framed partitions for anchoring countertops.

I. Section 12 3213 "Manufactured Wood-Veneer-Faced Casework" for cabinets of standard design that receive countertops.

J. Section 12 3216 "Manufactured Plastic Laminate Clad Casework" for cabinets of standard design that receive countertops.

K. Division 22 for plumbing fixtures and plumbing connections penetrating countertops.

L. Division 26 for services and connections penetrating countertops.

M. Pertinent sections specifying items built into or penetrating work of this section.

1.4 REFERENCES

A. "Phoenix Building Construction Code", International Building Code 2006, with City of Phoenix administrative provisions and amendments.

B. Architectural Woodwork Standards (AWS), 1st ed. 2009, published jointly by:
1. Architectural Woodwork Institute, www.awi.net.org.
2. Woodwork Institute, www.woodworkinstitute.com.
3. Architectural Woodwork Manufacturers Association of Canada, www.awmac.com.

C. 36 CFR 1191 - Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities; Final Rule; Federal Register, July 26, 1991; updated 2010.

D. ASTM International (ASTM) Publications: (Former American Society for Testing and Materials)
1. A240/A 240M "Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications"
2. A666 "Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar"
3. B69/B69M "Standard Specification for Rolled Zinc".
4. E84 "Standard Test Method for Surface Burning Characteristics of Building Materials"

1.5 SUBMITTALS

A. General: Submit in accordance with Section 01 3300.

B. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

C. Product Data: For each type of product indicated, demonstrate compliance with specified attributes, including panel products, laminating adhesive, fire-retardant-treated materials and finishing materials and processes.
1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.

D. VOC Submittals:
1. Product Data – VOC Limits: For adhesives sealants, fillers and primers, documentation including printed statement of VOC contents, comply with limits specified in Section 01 6116.

E. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
1. Show details full size.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.

3. Show locations and sizes of cutouts and holes for plumbing fixtures and other items installed in metal countertops.
4. Apply AWI Quality Certification Program label to Shop Drawings.

F. Product Certificates: For each type of product, signed by product manufacturer.

G. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

H. Qualification Data: For fabricator.

1.6 QUALITY ASSURANCE

A. All work and materials in full accordance with the latest rules of U.S. Public Health Service, and local or state ordinances.

B. Wood Substrate Fabrication and Installation: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a licensee of AWI Quality Certification Program.
1. Installer Qualifications: Licensee of AWI Quality Certification Program.

C. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
1. Provide AWI Quality Certification Program compliance labels and certificates indicating that woodwork, including installation, complies with requirements of grades specified.

D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of Section 01 6000.

B. Do not deliver countertops until painting and similar operations that could damage countertops have been completed in installation areas. If countertops must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

C. Handle materials to prevent damage to finished surfaces. Provide protective coverings to prevent physical damage or staining following installation for duration of project.

D. Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install countertops until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where countertops are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support countertops by field measurements before being enclosed, and indicate measurements on Shop Drawings.

C. Established Dimensions: Where countertops are indicated to fit to other construction, establish dimensions for areas where countertops are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.9 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that countertops can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Limits for adhesives, sealants, fillers and primers. Comply with limits specified in Section 01 6116.

2.2 METAL COUNTERTOPS

A. Stainless Steel Countertops: Formed with integral edges and backsplashes of stainless steel sheet in minimum thickness indicated with fully welded, ground smooth and blended joints, laminated after fabrication to core material. Provide smooth, clean exposed tops and edges in uniform plane, free of defects. Provide front and end overhang of 1 -inch (25 mm) over the base cabinets.

1. Stainless Steel Finish: No. 4, with grain pattern running in long direction of item.
2. Joints: Fabricate countertops without field-made joints.
3. Welding: Weld seams and joints continuously. Control welding processes and temperatures to avoid metal discoloration. Grind joints smooth and blend metal surface finish to match adjoining surfaces.
4. Countertop Cores: Industrial grade medium density fiberboard of thickness required, but not less than indicated, fabricated to completely support underside of stainless steel surfaces.
5. Extend the top down to provide a 1-inch (25-mm-) thick edge with a 1/2-inch (12.7-mm) return flange.
6. Form the backsplash coved to and integral with top surface, with a 1/2-inch (12.7-mm) thick top edge and 1/2-inch (12.7-mm) return flange.

7. Provide raised (marine) edge around perimeter of tops containing sinks; pitch tops containing sinks two ways to provide drainage without channeling or grooving.
8. Where stainless-steel sinks occur in stainless-steel tops, factory weld into one integral unit.

B. Stainless-Steel Sinks: Fabricate from stainless-steel sheet, not less than 0.050-inch (1.27-mm) nominal thickness. Fabricate with corners rounded and coved to at least 5/8-inch (16-mm) radius. Slope the sink bottoms to outlet without channeling or grooving. Provide continuous butt-welded joints.
1. Provide sizes indicated or manufacturer's closest standard size of equal or greater volume, as approved by Architect.
2. Provide double-wall construction for sink partitions with top edge rounded to at least 1/2-inch (13-mm) diameter.
3. Factory punch holes for fittings.
4. Provide sinks with stainless-steel strainers and tailpieces.
5. Provide sinks with integral rims except where located in stainless-steel countertops.
6. Apply 1/8-inch (3-mm-) thick coating of heat-resistant, sound-deadening mastic to undersink surfaces.

C. Zinc Countertops: Formed with integral edges and backsplashes of zinc sheet in minimum thickness indicated with fully welded, ground smooth and blended joints, laminated after fabrication to core material. Provide smooth, clean exposed tops and edges in uniform plane, free of defects. Provide front and end overhang of 1 -inch (25 mm) over the base cabinets.
1. Zinc Finish: Selected by Architect from the following:
   a. Satin: directional grain finish
   b. Matte: Random finish
   c. Embossed: Pattern stamped in the surface.
   d. Swirl: A non directional swirled polish
   e. Shot-blast: Soft gray patina
2. Joints: Fabricate countertops without field-made joints.
3. Welding: Weld seams and joints continuously. Control welding processes and temperatures to avoid metal discoloration. Grind joints smooth and blend metal surface finish to match adjoining surfaces.
4. Countertop Cores: Industrial grade medium density fiberboard of thickness required, but not less than indicated, fabricated to completely support underside of stainless steel surfaces.
5. Countertop Edge: Form edges as indicated on the Drawings. If no detail is shown, form edges as follows:
   a. Extend the top down to provide a 1-inch (25-mm-) thick edge with a 1/2-inch (12.7-mm) return flange.
6. Backsplash Edge: Form backsplash as indicated on the Drawings. If no detail is shown, form edges as follows:
   a. Form the backsplash coved to and integral with top surface, with a 1/2-inch (12.7-mm) thick top edge and 1/2-inch (12.7-mm) return flange.
7. Where shown on drawings, provide raised (marine) edge around perimeter of tops containing sinks; pitch tops containing sinks two ways to provide drainage without channeling or grooving.

2.3 METAL MATERIALS

A. Stainless-Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness, minimum 0.0598-inch thick (16 gauge).

B. Zinc Sheet: ASTM B69/B69M, Type 1 or 2, as required for selected finish, Architectural Rolled, flat sheet, stretcher-leveled standard of flatness, minimum weight 48 oz.

C. Filler Materials and Electrodes: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded or brazed and as necessary for strength, corrosion resistance, and compatibility in fabricated items.

1. Use filler metals that will match the color of metal being joined and will not cause discoloration.

2.4 WOOD MATERIALS

A. General: Provide wood materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

B. Core Material: Industrial Grade Medium Density Fiberboard (MDF) manufactured with a formaldehyde-free adhesive system which meets the physical properties of ANSI A208.2-2009, Grade 155 specifications.

1. Product: SierraPine Medite II MDF as manufactured by SierraPine Composite Solutions. Roseville, CA; tel: (800) 676-3339, web: www.sierrapine.com .
2. SCS certified for pre-consumer recycled wood fiber content.
3. Core Thickness: 3/4 -inch (19 mm).

C. Core Material at Sinks and Interior High Moisture Areas: Industrial Grade Medium Density Fiberboard (MDF) manufactured with a formaldehyde-free adhesive system which meets the physical properties of ANSI A208.2-2009, Grade 155 specifications.

1. Product: SierraPine Medex MDF as manufactured by SierraPine Composite Solutions. Roseville, CA; tel: (800) 676-3339, web: www.sierrapine.com .
2. SCS certified for pre-consumer recycled wood fiber content.
3. Core Thickness: 3/4 -inch (19 mm).

D. Core Material at Class 1 (A) Rated Interior Finish Areas: Industrial Grade Medium Density Fiberboard (MDF) manufactured with a formaldehyde-free adhesive system and certified as a Class 1 Flame Retardant panel in accordance with ASTM E 84-02011A.

1. Product: SierraPine Medite FR MDF as manufactured by SierraPine Composite Solutions. Roseville, CA; tel: (800) 676-3339, web: www.sierrapine.com .
2. SCS certified for pre-consumer recycled wood fiber content.
3. Core Thickness: 3/4 -inch (19 mm).

2.5 MISCELLANEOUS MATERIALS

A. Adhesives: Do not use adhesives that contain urea formaldehyde.

1. Wood Glue: Waterproof types as recommended by AWI standards for the particular application. VOC content of not more than 30 g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).

2. Laminating Adhesive: Compatible with substrate; heat resistant and noncombustible after curing, as recommended by adhesive manufacturer for materials being joined.
   a. For adhesives used on-site comply with the following:
      1) Contact Adhesive: VOC content .
         a) Refer to Section 01 6116 “Volatile Organic Compound (VOC) Restrictions”
      2) Metal-to-metal Adhesive: VOC content .
         a) Refer to Section 01 6116 “Volatile Organic Compound (VOC) Restrictions”
      3) Special-Purpose Contact Adhesive (contact adhesive used to bond melamine-covered board, metal, unsupported vinyl, Teflon, ultra-high molecular weight polyethylene, and rubber or wood veneer, 1/16 inch or less in thickness, to any surface):
         a) Refer to Section 01 6116 “Volatile Organic Compound (VOC) Restrictions”

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.6 FABRICATION, GENERAL

A. Shop-fabricate and assemble countertops in one piece. Fabricate based on templates and field measurements to fit tightly to adjoining construction.

B. When necessary to cut and fit on site, provide materials with ample allowance for cutting and scribing. Provide trip by fabricator for on-site scribing, cutting, and finish repairs as required.

C. Increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as needed to provide surface flatness equivalent to stretcher-leveled standard of flatness and sufficient strength for indicated use.

   1. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.

D. Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes, and other fixtures and fittings.

E. Finish all metal edges to a uniform radius. Roll and hem unsupported edges.

F. Provide finished cutouts with fabricated, fully returned and hemmed metal edging for trash cutouts.

G. Where welding or brazing is indicated or required, weld or braze joints and seams continuously. Grind, fill, and dress to produce smooth, flush, exposed surfaces in which joints are not visible after finishing is completed.

H. Conceal fasteners where possible; otherwise, locate where they are as inconspicuous as possible. Size fasteners to support closures and trim, with fasteners spaced to prevent buckling or waviness in finished surfaces.

I. Provide protective coating where required to prevent electrolysis between dissimilar metals.

J. Provide temporary surface film protection following fabrication of all finished metal surfaces.

K. Stainless Steel Finish: Grind and polish surfaces to produce uniform, directional satin finish matching No. 4 finish, with no evidence of welds and free of cross scratches. Run grain with long dimension of each piece. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces clean.

L. Zinc Finish: Grind and polish surfaces to produce finish matching Architect's selection, with no evidence of welds and free of cross scratches. Remove embedded foreign matter and leave surfaces clean.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of metal countertops.

B. Verify adequacy of backing and support framing.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Before installation, condition countertops to average prevailing humidity conditions in installation areas.

B. Before installation, examine shop-fabricated work for completion and complete work as required, including backpriming and removal of packing.

3.3 INSTALLATION

A. All countertops shall be installed as shown on approved Shop Drawings.

B. Set and secure countertops in place rigid, plumb, and level.

C. Field Jointing: Where possible, make field jointing in the same manner as shop jointing; use fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.

D. Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop. Secure tops to cabinets with Z- or L-type fasteners or equivalent; use two or more fasteners at each front, end, and back.

1. Install countertops with no more than 1/8 -inch in 96-inch sag, bow, or other variation from a straight line.

2. Use purpose-designed fixture attachments at concealed locations for wall-mounted components.
3. Use threaded steel concealed joint fasteners to align and secure adjoining counter tops.

E. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection.

F. Seal junctures of countertops, backsplashes and walls with mildew-resistant sealant specified in Division 07 Section "Joint Sealants."

3.4 ADJUSTING AND CLEANING

A. Verify that installed countertops are free from surface blemishes, and scratches, that metal surfaces remain fully bonded to supporting substrates, and that supporting substrates are not damaged from handling, installation, or exposure to excessive amounts of moisture. Perform minor repairs and touch-up damaged finishes that can be adequately performed in the field. Return damaged metal countertops to fabricator for repair or replacement if damaged product cannot be repaired to a like new and undamaged condition in the field.

B. Remove surface protection films and clean surfaces using non-petroleum based cleaning products recommended by fabricators of metal surfaces.
1. Protect surfaces until substantial completion.

- END OF SECTION -

- SECTION 12 3619 -

WOOD COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following shop fabricated items:
   1. Custom wood countertops.

1.3 RELATED REQUIREMENTS

A. Pertinent Sections specifying Volatile Organic Compound (VOC) Content Restrictions.

B. Section 01 6116 “Volatile Organic Compound (VOC) Restrictions”

C. Section 06 1053 "Miscellaneous Rough Carpentry" for furring, blocking, shims, hanging strips and other carpentry, not exposed to view, required for installing countertops specified in this Section.

D. Section 06 2000.01 “Finish Carpentry (Courtyard)”

E. Section 06 2000.02 “Finish Carpentry (Residence Inn)”

F. Section 06 4023 "Interior Architectural Woodwork" for custom-made cabinets.

G. Section 07 9200 “Joint Sealants”.

H. Section 09 2216 "Non-Structural Metal Framing" for reinforcements in metal-framed partitions for anchoring countertops.

I. Section 12 3200 "Manufactured Wood Casework" for cabinets of standard design that receive countertops.

J. Division 22 for plumbing fixtures and plumbing connections penetrating countertops.

K. Division 26 for services and connections penetrating countertops.

L. Pertinent sections specifying items built into or penetrating work of this section.

1.4 REFERENCES

A. "Phoenix Building Construction Code", International Building Code 2006, with City of Phoenix administrative provisions and amendments.

B. Architectural Woodwork Standards (AWS), 1st ed. 2009, published jointly by:
   1. Architectural Woodwork Institute, www.awi.net.org.
   2. Woodwork Institute, www.woodworkinstitute.com.
   3. Architectural Woodwork Manufacturers Association of Canada, www.awmac.com.

C. 36 CFR 1191 - Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities; Final Rule; Federal Register, July 26, 1991; updated 2010.

1.5 SUBMITTALS

A. General: Submit in accordance with Section 01 3300.

B. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

C. Product Data: For each type of product indicated, demonstrate compliance with specified attributes, including panel products, bonding adhesives, fire-retardant-treated materials and finishing materials and processes.
   1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.

D. VOC Submittals:
   1. Product Data – VOC Limits: For adhesives sealants, fillers and primers, documentation including printed statement of VOC contents, comply with limits specified in Section 01 6116.

E. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
   1. Show details full size.
   2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
   3. Show locations and sizes of cutouts and holes for plumbing fixtures and other items installed in architectural woodwork.
   4. Apply AWI- Quality Certification Program label to first page of Shop Drawings.

F. Samples for Initial Selection:
   1. Shop-applied transparent finishes.

G. Samples for Verification:
   1. Lumber with or for transparent finish, not less than 5 -inches (125 mm) wide by 5 -inches (125 mm) long, for each species and cut, finished on 1 side and 1 edge.

H. Woodwork Quality Standard Compliance Certificates: AWI-certified compliance certificates.

I. Qualification Data: For fabricator.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a licensee of AWI Quality Certification Program.

B. Installer Qualifications: Licensee of AWI Quality Certification Program.

C. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

1. Provide AWI Quality Certification Program compliance labels and certificates indicating that woodwork, including installation, complies with requirements of grades specified.
2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with such selections and requirements in addition to the quality standard.

D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of Section 01 6000.

B. Do not deliver countertops until painting and similar operations that could damage countertops have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install countertops until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where countertops are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.

C. Established Dimensions: Where countertops are indicated to fit to other construction, establish dimensions for areas where countertops are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.9 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that countertops can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Limits for adhesives, sealants, fillers and primers. Comply with limits specified in Section 01 6116.

2.2 WOOD COUNTERTOPS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades indicated for construction, finishes, installation, and other requirements.
   1. Provide labels and certificates from AWI certification program indicating that woodwork and installation complies with requirements of grades specified.
   2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.

B. Grade:
   1. Public Areas: Premium.
   2. Back Of House: Custom.

2.3 WOOD MATERIALS

A. Solid butcher block for transparent finish. Narrow strips of lumber glued together. Arrange strips for random mix of color and grain.
   1. Wood Species: As shown on Drawings or as selected by Architect.
   2. Strip Thickness: 1-1/2 -inches (38 mm).
   3. Finish: Penetrating Oil.

B. Solid, wide width for transparent finish. Solid wood, edge glued, with crown direction reversed in adjacent boards, to produce widths indicated. Select boards for similarity of color and grain and arrange boards for optimum match between adjacent boards.
   1. Wood Species and Cut: As shown on Drawings or as selected by Architect. .
   2. Edge Profile: Solid stock, same Species and Grade, profile as indicated.
   3. Finish: Conversion Varnish.

C. Medium Density Fiberboard: Industrial Grade MDF manufactured with a formaldehyde-free adhesive system which meets the physical properties of ANSI A208.2-2009, Grade 155 specifications.
   1. Product: SierraPine Medite II MDF as manufactured by SierraPine Composite Solutions. Roseville, CA; tel: (800) 676-3339, web: www.sierrapine.com .

2. SCS certified for pre-consumer recycled wood fiber content.
3. Panel Thickness: 3/4 -inch (19 mm).

D. Medium Density Fiberboard at Sinks and Interior High Moisture Areas: Industrial Grade MDF manufactured with a formaldehyde-free adhesive system which meets the physical properties of ANSI A208.2-2009, Grade 155 specifications.
1. Product: SierraPine Medex MDF as manufactured by SierraPine Composite Solutions. Roseville, CA; tel: (800) 676-3339, web: www.sierrapine.com .
2. SCS certified for pre-consumer recycled wood fiber content.
3. Panel Thickness: 3/4 -inch (19 mm).

E. Medium Density Fiberboard at Class 1 (A) Rated Interior Finish Areas: Industrial Grade MDF manufactured with a formaldehyde-free adhesive system and certified as a Class 1 Flame Retardant panel in accordance with ASTM E 84-02011A.
1. Product: SierraPine Medite FR MDF as manufactured by SierraPine Composite Solutions. Roseville, CA; tel: (800) 676-3339, web: www.sierrapine.com .
2. SCS certified for pre-consumer recycled wood fiber content.
3. Panel Thickness: 3/4 -inch (19 mm).

2.4 MISCELLANEOUS MATERIALS

A. Adhesives, General: Do not use adhesives that contain urea formaldehyde.

B. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.5 FABRICATION, GENERAL

A. Interior Woodwork Grade: Unless otherwise indicated, provide Premium-grade interior woodwork complying with referenced quality standard.

B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

C. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

D. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:

1. Solid-Wood (Lumber) Members: 1/16 -inch (1.5 mm) unless otherwise indicated.

E. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for

shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.

F. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

1. Seal edges of openings in countertops with a coat of varnish.

2.6 SHOP FINISHING

A. General: Finish architectural wood countertops at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

B. Shop Priming: Shop apply the prime coat including backpriming, if any, for items specified to be field finished. Refer to Section 09 9300 "Staining and Transparent Finishing" for material and application requirements.

C. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of wood countertops. Apply two coats to end-grain surfaces.

D. Transparent Finish:

1. Grade: Same as item to be finished.
2. Finish: System - 5, conversion varnish.
3. Finish: System - 6, synthetic penetrating oil.
4. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
5. Staining:
   a. Public Areas: Match Architect's sample.
   b. Back Of House: None required.
6. Filled Finish for Open-Grain Woods: After staining, apply wash-coat sealer and allow to dry. Apply paste wood filler and wipe off excess. Tint filler to match stained wood.
7. Sheen:
   a. Varnish Finish: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D 523.
   b. Oil Finish: Flat Sheen 15-30 gloss units measured on 60-degree gloss meter per ASTM D 523..

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of metal countertops.

B. Verify adequacy of backing and support framing.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.

B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including backpriming and removal of packing.

3.3 INSTALLATION

A. All countertops shall be installed as shown on approved Shop Drawings.

B. Grade: Install wood countertops to comply with same grade as item to be installed.

C. Install wood countertops level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 -inch in 96 -inches (3 mm in 2400 mm).

D. Scribe and cut wood countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.

F. Anchor countertops securely by screwing through corner blocks of base cabinets or other supports into underside of countertop. Secure tops to cabinets with Z- or L-type fasteners or equivalent; use two or more fasteners at each front, end, and back.

1. Install countertops with no more than 1/8 -inch in 96 -inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
2. Secure backsplashes as detailed.

G. Seal junctures of countertops, backsplashes and walls with sealant specified in Section 07 9200 "Joint Sealants".

H. Touch up finishing work specified in this Section after installation of wood countertops. Fill nail holes with matching filler where exposed.

I. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are applied in shop.

3.4 ADJUSTING AND CLEANING

A. Repair damaged and defective work, where possible, to eliminate functional and visual defects; where not possible to repair, replace work. Adjust joinery for uniform appearance.

B. Clean exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

3.5 SCHEDULE

A. Board Top: Public Areas, locations indicated.

B. Butcher Block: Back of House, locations indicated.

- END OF SECTION -

- SECTION 12 3623 -

PLASTIC COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following shop fabricated items:
   1. Custom plastic laminate countertops and backsplashes.

1.3 RELATED REQUIREMENTS

A. Pertinent Sections specifying Volatile Organic Compound (VOC) Content Restrictions.

B. Section 01 6116 “Volatile Organic Compound (VOC) Restrictions”

C. Section 06 1053 "Miscellaneous Rough Carpentry" for furring, blocking, shims, hanging strips and other carpentry, not exposed to view, required for installing countertops specified in this Section.

D. Section 06 2000.01 “Finish Carpentry (Courtyard)”

E. Section 06 2000.02 “Finish Carpentry (Residence Inn)”

F. Section 06 4023 "Interior Architectural Woodwork" for custom-made cabinets.

G. Section 07 9200 “Joint Sealants”.

H. Section 09 2216 "Non-Structural Metal Framing" for reinforcements in metal-framed partitions for anchoring countertops.

I. Section 12 3213 "Manufactured Wood-Veneer-Faced Casework" for cabinets of standard design that receive countertops.

J. Section 12 3216 "Manufactured Plastic Laminate Clad Casework" for cabinets of standard design that receive countertops.

K. Section 12 3616 “Metal Countertops”

L. Section 12 3619 “Wood Countertops”

M. Section 12 3623 “Plastic Countertops”

N. Section 12 3640 “Stone Countertops”

O. Section 12 3661 “Quartz Countertops”

P. Division 22 for plumbing fixtures and plumbing connections penetrating countertops.

Q. Division 26 for services and connections penetrating countertops.

R. Pertinent sections specifying items built into or penetrating work of this section.

1.4 REFERENCES

A. “Phoenix Building Construction Code”, International Building Code 2006, with City of Phoenix administrative provisions and amendments.

B. Architectural Woodwork Standards (AWS), 1st ed. 2009, published jointly by:
1. Architectural Woodwork Institute, www.awi.net.org.
2. Woodwork Institute, www.woodworkinstitute.com.
3. Architectural Woodwork Manufacturers Association of Canada, www.awmac.com.

C. American National Standards Institute (ANSI) Publications:
1. A161.2 “Performance Standards for Fabricated High Pressure Decorative Laminate Countertops”
2. A208.1 “Particleboard”

D. ASTM International (ASTM) Publications:
1. E84 "Standard Test Method for Surface Burning Characteristics of Building Materials"

E. Federal Specifications (FS) Publications:
1. MM-L-736 “Lumber, Hardwood”
2. MMM-A-130 “Adhesive, Contact”

F. National Electrical Manufacturer’s Association (NEMA) Standards Publications:
1. LD3 “High Pressure Decorative Laminates”

G. National Institute of Standards and Technology (NIST)
1. PS 1 “Construction and Industrial Plywood”
2. PS 20 “American Softwood Lumber Standard”
3. PS 51 “Hardwood and Decorative Plywood”
4. PS 58 “Basic Hardboard”

H. 36 CFR 1191 - Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities; Final Rule; Federal Register, July 26, 1991; updated 2010.

1.5 SUBMITTALS

A. General: Submit in accordance with Section 01 3300.

B. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

C. Product Data: For each type of product indicated, demonstrate compliance with specified attributes, including panel products, high-pressure decorative laminate adhesive for bonding plastic laminate, fire-retardant-treated materials and finishing materials and processes.

1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.

D. VOC Submittals:

1. Product Data – VOC Limits: For adhesives sealants, fillers and primers, documentation including printed statement of VOC contents, comply with limits specified in Section 01 6116.

E. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show details full size.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
3. Show locations and sizes of cutouts and holes for plumbing fixtures and other items installed in plastic laminate countertops.
4. Apply AWI Quality Certification Program label to Shop Drawings.
5. Include materials, component profiles, fastening methods, assembly methods, joint details, accessory listings, and schedule of finishes.

F. Samples for Initial Selection:

1. Plastic laminates. Full range of manufacturer's available patterns and colors.

G. Samples for Verification:

1. Plastic laminates, 5 –inches by 5 -inches (125 by 125 mm), for each type, color, pattern, and surface finish, with 1 sample applied to core material and specified edge material applied to 1 edge.
2. Thermoset decorative-panels, 5 –inches by 5 -inches (125 by 125 mm), for each type, color, pattern, and surface finish, with edge banding on 1 edge.

H. Product Certificates: For each type of product, signed by product manufacturer.

I. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

J. Qualification Data: For fabricator.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a licensee of AWI Quality Certification Program.

B. Installer Qualifications: Licensee of AWI Quality Certification Program.

C. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for countertops and custom woodwork.

D. Plastic Laminate Materials shall comply with NEMA LD-3 as follows:
1. GP 50: Horizontal grade
2. CL 20: Cabinet liner
3. BK 20: Backing sheet
4. PF-40: Post Forming Grade
5. FR 50: Horizontal application, fire retardant material
6. FR 32: Vertical application, fire retardant material

E. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
1. Provide AWI Quality Certification Program compliance labels and certificates indicating that woodwork, including installation, complies with requirements of grades specified.

F. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of Section 01 6000.

B. Do not deliver countertops until painting and similar operations that could damage countertops have been completed in installation areas. If countertops must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

C. Handle materials to prevent damage to finished surfaces. Provide protective coverings to prevent physical damage or staining following installation for duration of project.

D. Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install countertops until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where countertops are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support countertops by field measurements before being enclosed, and indicate measurements on Shop Drawings.

C. Established Dimensions: Where countertops are indicated to fit to other construction, establish dimensions for areas where countertops are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.9 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that countertops can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Limits for adhesives, sealants, fillers and primers. Comply with limits specified in Section 01 6116.

2.2 PLASTIC LAMINATE COUNTERTOPS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades indicated for construction, installation, and other requirements.

1. Provide labels and certificates from AWI certification program indicating that countertops and installation comply with requirements of grades specified.
2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.

B. Grade:

1. Public Areas: Premium.
2. Back of House: Custom.

2.3 PLASTIC LAMINATE MATERIALS

A. High-Pressure Decorative Laminate: NEMA LD 3, Grade HGS .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Lamin-Art (800-323-7624)
   b. Nevamar Company, LLC (800-638-4380)
   c. Pionite Decorative Surfaces, a Panolam Industries International Incorporated Company (800-746-6483)

d. Formica Corporation (800-367-6422)
e. WilsonArt International, Inc. (800-433-3222)

B. Edge Treatment: As indicated. Provide square returns otherwise.

C. Backsplash Height: As indicated, 6 -inch minimum otherwise.

D. Backer Sheet: Provide plastic-laminate backer sheet, NEMA LD 3, Grade BKL, on underside of countertop substrate.

E. Paper Backing: Provide paper backing on underside of countertop substrate.

F. Color: As selected by the Architect from manufacturer's full range of colors.

2.4 WOOD MATERIALS

A. General: Provide wood materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

B. Core Material: Industrial Grade Medium Density Fiberboard (MDF) manufactured with a formaldehyde-free adhesive system which meets the physical properties of ANSI A208.2-2009, Grade 155 specifications.
1. Product: SierraPine Medite II MDF as manufactured by SierraPine Composite Solutions. Roseville, CA; tel: (800) 676-3339, web: www.sierrapine.com .
2. SCS certified for pre-consumer recycled wood fiber content.
3. Core Thickness: 3/4 -inch (19 mm).

C. Core Material at Sinks and Interior High Moisture Areas: Industrial Grade Medium Density Fiberboard (MDF) manufactured with a formaldehyde-free adhesive system which meets the physical properties of ANSI A208.2-2009, Grade 155 specifications.
1. Product: SierraPine Medex MDF as manufactured by SierraPine Composite Solutions. Roseville, CA; tel: (800) 676-3339, web: www.sierrapine.com .
2. SCS certified for pre-consumer recycled wood fiber content.
3. Core Thickness: 3/4 -inch (19 mm).

D. Core Material at Class 1 (A) Rated Interior Finish Areas: Industrial Grade Medium Density Fiberboard (MDF) manufactured with a formaldehyde-free adhesive system and certified as a Class 1 Flame Retardant panel in accordance with ASTM E 84-02011A.
1. Product: SierraPine Medite FR MDF as manufactured by SierraPine Composite Solutions. Roseville, CA; tel: (800) 676-3339, web: www.sierrapine.com .
2. SCS certified for pre-consumer recycled wood fiber content.
3. Core Thickness: 3/4 -inch (19 mm).
4. Flame Spread: 25 maximum
5. Smoke Developed: 25 maximum
6. Fuel Contributed: 25 maximum

E. Build up countertop thickness to 1-1/2 -inches (38 mm) at front, back, and ends with additional layers of core material laminated to top.

2.5 MISCELLANEOUS MATERIALS

A. Adhesives: Do not use adhesives that contain urea formaldehyde.
   1. Wood Glue: Waterproof types as recommended by AWI standards for the particular application. VOC content .
      a. Refer to Section 01 6116 “Volatile Organic Compound (VOC) Restrictions”
   2. Adhesive for Bonding Plastic Laminate: Contact cement, for general use and for postforming. Use unpigmented product with through-color laminate.
   3. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.
   4. Plastic Laminate: Non-Flammable Type:
      a. Approved Manufacturers:
         1) "DAP Weld-Wood, Non-Flammable Type" - DAP, Inc. (888-327-8477)
         2) Approved substitution, refer to Section 01 2500.
   5. Installation adhesives as recommended by manufacturer for use intended.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.6 COUNTERTOPS

A. Countertops and Edging: Particleboard (except at sinks, use exterior grade plywood only) or Fire-retardant particle board at rated conditions with plastic laminate bonded to tops.
   1. In locations as required by local codes or ordinances, provide fire retardant countertop assemblies, as tested in accordance with ASTM E 84.

B. Plastic Laminate Work:
   1. Where shown as self edged, countertops shall have 4 -inch high square-edged separate matching backsplash and matching aprons with same grade of laminate as top surface unless indicated otherwise.
      a. Apply trim and edging prior to surface sheet.
      b. Apply veneers or plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Make corners and joints hairline. Locate counter butt joints minimum 2 -feet from sink cut-outs.
   2. Counters and work tops with sinks: Substrate for back splashes and at edges shall be trimmed lumber. Use only exterior grade or marine grade Plywood near wet areas. All adhesives used near water shall be formulated to be specially water-resistant.

C. ADA Accessible Guest Room:
   1. Meet all local and national requirements for access. Minimum work surface shall be as follows:
      a. Sink Area: Minimum 28 -inch to 34 -inch maximum above finished floor x 30 -inch in length.
      b. Countertop: Minimum 28 -inch to 34 -inch maximum above finished floor x 30 -inch in length.
   2. For units which have exposed sides and ends due to placement of accessible units, provide durable, nonabsorbent materials for finish.

3. Provide wall brackets and standards of the type capable of loads of 250 pounds per linear foot of horizontal work surface.
4. Provide brackets capable of supporting work surfaces and loads without leading edge deflection greater than 1/2 -inch.

2.7 FABRICATION, GENERAL

A. General:
1. Shop assemble countertops for delivery to site in units easily handled and to permit passage through building openings.
2. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trip for scribing and site cutting.
3. Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes, and other fixtures and fittings.

B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

C. Laminate, Adhesive and Core Compatibility at Class 1 (A) Interior Finish Areas: Confirm compatibility of laminate and adhesive with the respective manufacturer to ensure the Class 1 flame spread classification of the core panel will not be adversely affected.

D. Fabricate countertops to dimensions, profiles, and details indicated. Provide front and end overhang of 1 -inch (25 mm) over base cabinets.

E. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.

F. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
1. Seal edges of openings in countertops with a coat of varnish.

2.8 INSTALLATION MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face

of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of plastic laminate countertops.

B. Verify adequacy of backing and support framing.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Before installation, condition countertops to average prevailing humidity conditions in installation areas.

B. Before installation, examine shop-fabricated work for completion and complete work as required, including backpriming removal of packing.

3.3 INSTALLATION

A. All countertops shall be installed as shown on approved Shop Drawings and as specified by manufacturer.

B. Set and secure countertops in place rigid, plumb, and level.

C. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, fasteners and sealants recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.

1. Secure field joints in plastic-laminate countertops with concealed clamping devices located within 6 -inches (150 mm) of front and back edges and at intervals not exceeding 24 -inches (600 mm). Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.

D. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor countertops securely by screwing through corner blocks of base cabinets or other supports into underside of countertop. Secure tops to cabinets with Z- or L-type fasteners or equivalent; use two or more fasteners at each front, end, and back.

1. Install countertops with no more than 1/8 -inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
2. If applied backsplashes are used, secure to tops with concealed metal brackets at 16 -inches (400 mm) o.c. and to walls with adhesive.
3. Use threaded steel concealed joint fasteners to align and secure adjoining counter tops.

4. Use purpose designed fixture attachments at concealed locations for wall-mounted components.

F. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection.

G. Seal junctures of countertops, backsplashes and walls with mildew-resistant sealant specified in Division 07 Section "Joint Sealants."

3.4 PLASTIC LAMINATE

A. Installation:

1. The plastic laminate shall be bonded to a suitable substrate. Rigid setting type adhesive is recommended. The temperature of the materials, surfacing, substrate, and adhesive, and the area in which the actual fabrication is to be done shall not be less than 65 degrees F. with a relative humidity of not less than 35 percent and not more than 85 percent. All inside corners of cutouts in plastic laminate shall be radiused as large as possible with 1/8 –inch R minimum. File edges of the radius smooth and free of cracks and crazes.

B. Method:

1. Assembly of components should be accomplished using approved procedures, materials, and equipment, and the workmanship should conform to established industry practices, conditions, procedures, and recommendations.

C. Use single sheet at corners. Seams will not be permitted at corners, unless otherwise approved by Architect .

D. Arrange joints in vertical edges away from common view.

3.5 ADJUSTING AND CLEANING

A. Repair damaged and defective work, where possible, to eliminate functional and visual defects; where not possible to repair, replace work. Adjust joinery for uniform appearance.

B. Remove surface protection films and clean surfaces using non-petroleum based cleaning products recommended by fabricators of metal surfaces. Protect surfaces until substantial completion.

C. Clean exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

- END OF SECTION -

- SECTION 12 3640 -

STONE COUNTERTOPS AND FACINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section Includes the following shop fabricated items:
   1. Cut stone countertops, aprons and backsplashes.
   2. Miscellaneous cut stone items
      a. Fireplace Surrounds
      b. Credenza Tops
      c. Tub Seats
      d. Whirlpool Built-In Tops
      e. Casework Faces (Vertical)
      f. Accent / Border Tile
      g. Wall Base
      h. Wall Facing

1.3 RELATED REQUIREMENTS

A. Pertinent Sections specifying Volatile Organic Compound (VOC) Content Restrictions.

B. Section 01 6116 “Volatile Organic Compound (VOC) Restrictions”

C. Section 06 1053 "Miscellaneous Rough Carpentry" for furring, blocking, shims, hanging strips and other carpentry, not exposed to view, required for installing countertops specified in this Section.

D. Section 06 2000.01 “Finish Carpentry (Courtyard)”

E. Section 06 2000.02 “Finish Carpentry (Residence Inn)”

F. Section 06 4023 "Interior Architectural Woodwork" for custom-made cabinets.

G. Section 07 9200 “Joint Sealants”.

H. Section 09 2216 "Non-Structural Metal Framing" for reinforcements in metal-framed partitions for anchoring countertops.

I. Pertinent sections of Division 09 specifying ceramic tile, stone tile and stone floors.

J. Section 12 3213 "Manufactured Wood-Veneer-Faced Casework" for cabinets of standard design that receive countertops.

K. Section 12 3216 "Manufactured Plastic Laminate Clad Casework" for cabinets of standard design that receive countertops.

L. Section 12 3661 “Quartz Surfacing Countertops and Facings”

M. Division 22 for plumbing fixtures and plumbing connections penetrating countertops.

N. Division 26 for services and connections penetrating countertops.

O. Pertinent sections specifying items built into or penetrating work of this section.

1.4 REFERENCES

A. “Phoenix Building Construction Code”, International Building Code 2006, with City of Phoenix administrative provisions and amendments.

B. 36 CFR 1191 - Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities; Final Rule; Federal Register, July 26, 1991; updated 2010.

D. ASTM C503 Standard Specification for Marble Dimension Stone (Exterior)

E. ASTM C568 Standard Specification for Limestone Dimension Stone

F. ASTM C615 Standard Specification for Granite Dimension Stone

G. ASTM C616 Standard Specification for Quartz-Based Dimension Stone

H. ASTM C629 Standard Specification for Slate Dimension Stone

I. ASTM C1526 Standard Specification for Serpentine Dimension Stone

J. ASTM C1527 Standard Specification for Travertine Dimension Stone

1.5 SUBMITTALS

A. General: Submit in accordance with Section 01 3300.

B. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

C. Product Data: For each type of product indicated, demonstrate compliance with specified attributes.

1. Include each type of stone, stonework accessory, and other manufactured products specified.

2. Include data and maintenance information for site-applied adhesives and sealants.
   a. Sealant Compatibility and Adhesion Test Report from sealant manufacturer indicating that sealants will not stain or damage stone.
3. Include maintenance information for stone countertops to include in maintenance manuals.
   a. Product data for stone-care products used or recommended by Installer, and names, addresses, and telephone numbers of local sources for products.

D. VOC Submittals:
1. Product Data – VOC Limits: For adhesives sealants, fillers and primers, documentation including printed statement of VOC contents, comply with limits specified in Section 01 6116.

E. Shop Drawings detailing fabrication and installation of stone. Include cutting and setting Drawings indicating sizes, dimensions, sections, and profiles of stones, arrangement and provisions for jointing, supporting, anchoring, and bonding stonework, and details showing relationship with, attachment to, and reception of related work.
1. Include large-scale details of decorative surfaces and inscriptions.

F. Samples for verification purposes of stone in form of sets for each color, grade, finish, type, and variety of stone required and consisting of stones not less than 12 -inches square. Include two or more stones in each set of samples showing the full range of variations in appearance characteristics to be expected in completed work.
1. Colored pointing mortar and grout samples for each color required showing full range of exposed color and texture to be expected in completed work.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate stone countertops similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of stone countertops.

C. Single-Source Responsibility for Stone: Obtain each color, grade, finish, type, and variety of stone from a single quarry with resources to provide materials of consistent quality in appearance and physical properties, including the capacity to cut and finish material without delaying the progress of the work.

D. Single-Source Responsibility for Materials: Provide all the following from one source, manufacturer or producer for each item.
1. Mortar ingredients of uniform quality for each cementitious and admixture component and for each aggregate.
2. Stone accessory, sealant, and other materials.

E. Mockup: Build mockup to demonstrate aesthetic effects and to set quality standards for fabrication and execution.
1. Build mockup of typical countertop as shown on Drawings.
2. Subject to compliance with requirements, approved mockup may become part of the completed Work if undisturbed at time of Substantial Completion.

F. Stone and Granite materials shall not contain unsafe levels of radioactive materials.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Sealant Adhesion and Compatibility Testing: Submit to joint-sealant manufacturers samples of materials that will contact or affect joint sealants, for compatibility and adhesion testing according to sealant manufacturer's standard testing methods and Section 07 9200 "Joint Sealants".

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of Section 01 6000.

B. Deliver materials to project site in undamaged condition.

C. Store and handle stone and related materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breakage, chipping, or other causes.

1. Do not use pinch or wrecking bars.
2. Lift with wide-belt-type slings where possible. Do not use wire rope or ropes containing tar or other substances that might cause staining. If required to move stone, use wood rollers with cushions at end of wood slides.
3. Store stone on wood skids or pallets covered with nonstaining, waterproof membrane. Place and stack skids and stones to distribute weight evenly and to prevent breakage or cracking of stones. Ventilate under covers to prevent condensation.
4. Store cementitious materials off the ground, under cover, and in dry location.

1.9 PROJECT CONDITIONS

A. Do not set stone when air temperature or material temperature is below 50 degrees F. (10 degrees C.).

B. Maintain minimum ambient temperatures of 50 degrees F. (10 degrees C.) during installation and for seven days after completion, unless higher temperatures are required by fabricator's or supplier's instructions.

C. Field Measurements: Where countertops are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.

D. Established Dimensions: Where countertops are indicated to fit to other construction, establish dimensions for areas where countertops are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.10 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that countertops can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Limits for adhesives, sealants, fillers and primers. Comply with limits specified in Section 01 6116.

2.2 STONE COUNTERTOPS AND BACKSPLASHES

A. Comply with referenced standards and other requirements indicated applicable to each type of material required.
   1. Standard architectural grade, free of cracks, seams, starts, or other traits which may impair structural integrity or function.
   2. Inherent color variations characteristic of the source quarry are acceptable.
   3. Texture and finish as shown in the approved sample.

B. Provide matched blocks from a single quarry for each type, variety, color, and quality of stone required. Extract blocks from a single bed of quarry stratum especially reserved for project, unless stones from randomly selected blocks are acceptable to Architect for aesthetic effect.

C. Quarry stone in manner to ensure that as-quarried block orientations yield finished stone with required characteristics.
   1. Make stone slabs available for examination by Architect.
      a. Architect will select aesthetically acceptable slabs and will indicate aesthetically unacceptable portions of slabs.
      b. Segregate slabs selected for use on Project and mark backs indicating approval.
      c. Mark and photograph aesthetically unacceptable portions of slabs as directed by Architect.

2.3 STONE MATERIALS

A. Stone Types, Locations, Finish and Color: Refer to Interior Drawings.
   1. Slab countertops, 3/4 -inch thickness.
   2. Backsplashes, 3/4 -inch thickness.
   3. Miscellaneous Cut Stone Items: 3/4 -inch thickness, and greater as required to make up profiles indicated.

B. Marble: ASTM C503

C. Limestone: ASTM C568

D. Granite: ASTM C615.

E. Miscellaneous Quartz-Based Stone (Bluestone): ASTM C616.

F. Slate: ASTM C629.

G. Serpentine: ASTM C1526.

H. Travertine: ASTM C1527.

2.4 STONE ANCHORS AND ATTACHMENTS

A. Fabricate anchors from stainless steel, ASTM A 240/A 240M or ASTM A 666, Type 304.
   1. Fasteners for Stainless-Steel Anchors: Annealed stainless-steel bolts, nuts, and washers; ASTM F 593 (ASTM F 738M) for bolts and ASTM F 594 (ASTM F 836M) for nuts, Alloy Group 1 (A1).

B. Fabricate dowels from stainless steel, ASTM A 276, Type 304.

C. Wire Tiebacks: 0.120-inch (3.0-mm-) diameter, stainless-steel wire.

2.5 STONE ACCESSORIES

A. Temporary Setting Shims: Rigid plastic shims, nonstaining to stone, sized to suit joint thickness.

B. Adhesives: Use only adhesives formulated for stone and ceramic tile and that are recommended by their manufacturer for the application indicated.
   1. Approved Manufacturers: Subject to exact compliance with requirements, provide products by one of the following.
      a. Inno Chem LLC, Member of Akemi Group (877-462-5364).
      b. Epoxy Adhesive: "Akepox”
      c. Polyester Adhesive: "Platinum Clear Polyester Adhesive”
      d. Laticrete International Inc. (800-243-4788)
      e. Custom Building Products (800-272-8786)
   2. Water-cleanable Epoxy Adhesive: ANSI A118.3, water-cleanable, tile-setting epoxy adhesive.
   3. Water-Cleanable Epoxy Grout: ANSI A118.3, chemical-resistant, water-cleanable, tile-setting and -grouting epoxy.
   4. Stone Seam Adhesive: 2-part, epoxy or polyester stone adhesive with an initial set time of not more than 2 hours at 70 deg F.
      a. Color: As indicated on Drawings or as directed by Architect.

C. Joint Sealant for Countertops: Manufacturer's standard sealant of characteristics indicated below that complies with applicable requirements in Section 079200 "Joint Sealants" and will not stain the stone it is applied to.
   1. Mildew-Resistant Joint Sealant: Silicone type, neutral cure, non-sag.
   2. Color: As indicated in the Finish Material Key or as directed by Architect.

D. Stone Joint Splines: Stainless-steel or brass washers approximately 1 -inch (25 mm) in diameter and of thickness to fit snugly in saw-cut kerf in edge of stone units. Concealed in final installation.

E. Stone Cleaner: Specifically formulated for stone types, finishes, and applications indicated, as recommended by stone producer and, if a sealer is used, by sealer manufacturer. Do not use cleaning compounds containing acids, caustics, harsh fillers, or abrasives.

F. Stone Sealer: Colorless, stain-resistant sealer that does not affect color or physical properties of stone surfaces, as recommended by stone producer for application indicated, protects the exposed faces of stone and grout from staining.

1. Sealer shall be UV transparent; non-yellowing; VOC compliant; mold and mildew resistant; and USDA approved as safe on food handling surfaces.
2. Material shall exceed ADA standards for slip resistance at traffic areas.
3. Approved Manufacturers: Subject to exact compliance with requirements, provide products by one of the following.
   a. Bostik, Inc.
   b. Custom Building Products.
   c. Hillyard, Inc.
   d. HMK Stone Care System.

2.6 STONE FABRICATION, GENERAL

A. Select stone for intended use to prevent fabricated units from containing cracks, seams, and starts that could impair structural integrity or function.

1. Repairs that are characteristic of the varieties specified are acceptable provided they do not impair structural integrity or function and are not aesthetically unpleasing, as judged by Architect.

B. Fabricate stone trim in sizes and shapes required to comply with requirements indicated.

1. For granite, comply with recommendations in NBGQA's "Specifications for Architectural Granite."
2. For marble, comply with recommendations in MIA's "Dimension Stone - Design Manual VII."
3. For limestone, comply with recommendations in ILI's "Indiana Limestone Handbook."

C. Cut stone to produce pieces of thickness, size, and shape indicated and to comply with fabrication and construction tolerances recommended by applicable stone association.

1. Where items are installed with adhesive or where stone edges are visible in the finished work, make items uniform in thickness and of identical thickness for each type of item; gage back of stone if necessary.
2. Clean sawed backs of stones to remove rust stains and iron particles.
3. Dress joints straight and at right angle to face unless otherwise indicated.
4. Cut and drill sinkages and holes in stone for anchors, supports, and lifting devices as indicated or needed to set stone securely in place; shape beds to fit supports.

D. Fabricate molded work to produce stone shapes with a uniform profile throughout entire unit length and with precisely formed arris slightly eased to prevent snipping, and matched at joints between units.

1. Produce moldings with machines having abrasive shaping wheels made to reverse contour of molding shape; do not sculpt moldings.
2. Miter moldings at corners, unless otherwise indicated, with edges of miters slightly eased at outside corners.

E. Finish exposed faces and edges of stone to comply with requirements indicated for finish of each stone type required and to match approved Samples and mockups.

F. Carefully inspect finished stone units at fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units.
1. Grade and mark stone for overall uniform appearance when assembled in place. Natural variations in appearance are acceptable if installed stone units match range of colors and other appearance characteristics represented in approved Samples and mockups.

2.7 FABRICATION, COUNTERTOPS

A. Grade and mark stone for final locations to produce assembled countertop units with an overall uniform appearance.

B. Fabricate stone countertops in sizes and shapes required to comply with requirements indicated, including details on Drawings and Shop Drawings.
1. Clean sawed backs of stones to remove rust stains and iron particles.
2. Dress joints straight and at right angle to face unless otherwise indicated.
3. Cut and drill sinkages and holes in stone for anchors, supports, and attachments.
4. Provide openings, reveals, and similar features as needed to accommodate adjacent work.
5. Fabricate molded edges with machines having abrasive shaping wheels made to reverse contour of edge profile to produce uniform shape throughout entire length of edge and with precisely formed arris slightly eased to prevent snipping, and matched at joints between units. Form corners of molded edges as indicated with outside corners slightly eased unless otherwise indicated.
6. Finish exposed faces of stone to comply with requirements indicated for finish of each stone type required and to match approved Samples and mockups. Provide matching finish on exposed edges of countertops, splashes, and cutouts.

C. Carefully inspect finished stone units at fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units.

D. Thickness: Provide thickness indicated on Drawings, but not less than the following:
1. Nominal Thickness: 3/4 -inch, gage backs to provide units of identical thickness.

E. Edge Detail: Provide edge detail indicated on Drawings.

F. Joints: Fabricate countertops without joints where possible. If joints are required, fabricate sections indicated for joining in field, with joints as follows:
1. Bonded Seams: 1/32 -inch or less in width.
2. Splined Joints: Accurately cut kerfs in edges at joints for insertion of metal splines to maintain alignment of surfaces at joints. Make width of cuts slightly more than thickness of splines to provide snug fit. Provide at least three splines in each joint.

G. Splashes: Provide 3/4 -inch (20-mm-) thick backsplashes and end splashes unless otherwise indicated, height as indicated and 4 -inches (100 mm) minimum.

H. Cutouts and Holes for Lavatories, Sinks, and Fittings:

1. Undercounter Lavatories: Make cutouts for undercounter lavatories in shop using template or pattern furnished by lavatory manufacturer. Form cutouts to smooth, even curves with edges at right angles to top. Ease juncture of cutout edges with tops, and finish edges to match tops.
2. Counter-Mounted Sinks: Prepare countertops in shop for field cutting openings for counter-mounted sinks. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

2.8 MIXES

A. Spotting Plaster: Stiff mix of molding plaster and water.

B. Mortar, General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortar of uniform quality and with optimum performance characteristics.

1. Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated. Do not use calcium chloride.
2. Combine and thoroughly mix cementitious materials, water, and aggregates in a mechanical batch mixer unless otherwise indicated. Discard mortar when it has reached initial set.

C. Setting Mortar: Comply with ASTM C 270, Proportion Specification.

D. Pointing Mortar: Comply with ASTM C 270, Proportion Specification, for mortar types indicated. Provide pointing mortar mixed to match Architect's sample and complying with the following:

1. Pigmented Pointing Mortar: Select and proportion pigments with other ingredients to produce color required. Do not exceed pigment-to-cement ratio of 1:10, by weight.
2. Packaged Portland Cement-Lime Mix Mortar: Use portland cement-lime mix of selected color.
3. Colored-Aggregate Pointing Mortar: Produce color required by combining colored aggregates with portland cement of selected color.

E. Grout: Comply with mixing requirements of referenced ANSI standards and with manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive stone countertops and trim, and conditions under which stonework will be installed, with installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of stonework.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of stone countertops.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Advise installers of other work about specific requirements relating to placement of inserts, flashing reglets, and similar items to be used by stonework installer for anchoring, supporting, and flashing of dimension stonework. Furnish installers of other work with Drawings or templates showing locations of these items.

B. Protect stone countertops during installation as follows:

1. Prevent staining of stone from mortar, grout, sealants, and other sources. Immediately remove such materials from stone without damage to latter.

3.3 SETTING STONE, GENERAL

A. Before setting stone, clean surfaces that are dirty or stained by removing soil, stains, and foreign materials. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

B. Do necessary field cutting as stone is set. Use power saws with diamond blades to cut stone. Cut lines straight, true, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

C. Contiguous Work: Provide reveals and openings as required to accommodate contiguous work.

D. Set stone to comply with requirements indicated. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure stone in place. Shim and adjust anchors, supports, and accessories to set stone accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances.

E. Erect stone units level, plumb, and true with uniform joint widths. Use temporary shims to maintain joint width.

F. Provide expansion, control, and pressure-relieving joints of widths and at locations indicated.

1. Sealing of expansion and other joints is specified in Section 079200 "Joint Sealants."
2. Keep expansion joints free of plaster, mortar, grout, and other rigid materials.

3.4 INSTALLATION - COUNTERTOPS

A. General: Install countertops over plywood subtops with a full spread of water-cleanable epoxy adhesive.

B. All countertops shall be installed as shown on approved Shop Drawings.

C. Set countertops to comply with requirements indicated. Shim and adjust tops and splashes to locations indicated, with uniform joints of widths indicated and with edges and faces aligned according to established relationships and indicated tolerances. Install anchors and other attachments indicated or necessary to secure stone countertops in place.

D. Bond joints with stone adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears. Use clamps to ensure countertop units are properly aligned and seams are minimum width.

1. Install metal splines in kerfs in stone edges at joints. Fill kerfs with stone adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.
2. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.

E. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts while cutting to prevent damage.

F. Install backsplash and end splash by adhering to wall with water-cleanable epoxy adhesive. Leave 1/16 -inch gap between countertop and splash for filling with sealant. Use temporary shims to ensure uniform spacing.

G. Apply sealant to joints and to gap between countertops and splashes; comply with Section 07 9200 "Joint Sealants".

H. Soapstone: Hone exposed edges to remove saw marks and darken edge color. Treat finished surfaces with mineral oil to uniform dark color acceptable to Architect.

3.5 CONSTRUCTION TOLERANCES

A. Variation from Plumb: For vertical lines and surfaces, do not exceed 1/8 -inch in 96 -inches (3 mm in 2400 mm), 1/4 -inch (6 mm) maximum.

B. Variation from Level: For lintels, sills, chair rails, horizontal bands, horizontal grooves, and other conspicuous lines, do not exceed 1/8 -inch in 10 -feet (3 mm in 3 m), 1/4 -inch in 20 -feet (6 mm in 6 m), 3/8 -inch (10 mm) maximum.

C. Variation from Level : For Countertops, do not exceed 1/8 -inch in 96 -inches (3 mm in 2400 mm), 1/4 -inch (6 mm) maximum.

D. Variation in Joint Width: Do not vary from average joint width more than plus or minus 1/16 -inch (1.5 mm) or one-fourth of nominal joint width, whichever is less.

E. Variation in Line of Edge at Joints (Lipping): Do not exceed 1/64 -inch (0.4-mm) difference between edges of adjacent units, where edge line continues across joint.

F. Variation in Plane at Joints (Lipping): For Countertops, do not exceed 1/64 -inch (0.4-mm) difference between planes of adjacent units.

G. Variation of Linear Building Line: For position shown in plan and related portion of walls and partitions, do not exceed 1/8 -inch in 10 -feet (3 mm in 3 m), 1/4 -inch in 20 -feet (6 mm in 6 m), 3/8 -inch (10 mm) maximum.

H. Variation in Cross-Sectional Dimensions: For thickness of walls from dimensions indicated, do not exceed plus or minus 1/8 -inch (3 mm).

3.6 INSTALLATION – TRIM AND FACING

A. Stone Trim – Adhesive Installation: Set units by adhering to stone paneling with water-cleanable epoxy adhesive. Hold adhesive back from exposed edges of joints to allow for grouting.

B. Stone Trim – Anchored Installation: Set units firmly against setting spots. Locate setting spots at anchors and spaced not more than 18 -inches (450 mm) apart unless otherwise indicated. Provide no fewer than two anchors per piece for stone trim up to 48 -inches (1200 mm) in length, plus one additional anchor for each additional 24 -inches (600 mm) of length.

C. Stone Trim: At locations without stone paneling, adhere units to plywood backing with full spread of water-cleanable epoxy adhesive. Hold adhesive back from exposed edges of joints to allow for grouting.

D. Stone Trim: At locations without stone paneling, adhere units to gypsum board with full spread of water-cleanable epoxy adhesive. Hold adhesive back from exposed edges of joints to allow for grouting.

E. Assemble indicated multiple-piece stone trim by bonding joints with stone adhesive as units are set. Mask areas adjacent to joints to prevent adhesive smears. Clamp units in place to ensure that surfaces are properly aligned and joints are minimum width.

F. Grout or point joints after setting stone as directed by Architect.

G. Fill joints in wet areas with sealant after setting and grouting or pointing stone.

3.7 GROUTING JOINTS

A. Grout stone to comply with ANSI A108.10.
   1. Use sanded grout mixture for joints wider than 1/8 -inch (3 mm).
   2. Use unsanded grout mixture for joints 1/8 -inch (3 mm) and narrower.

B. Remove temporary shims before grouting.

C. Tool joints uniformly and smoothly with plastic tool.

3.8 POINTING JOINTS WITH MORTAR

A. Prepare stone-joint surfaces for pointing with mortar by removing temporary shims, dust, and mortar particles. Where setting spots occur at joints, rake out excess setting mortar or plaster to a depth of not less than 1/2 -inch (13 mm).

B. Point stone joints by placing pointing mortar in layers of not more than 3/8 -inch (10 mm). Compact each layer thoroughly and allow it to become thumbprint hard before applying next layer. Apply mortar first to areas where depths are greater than surrounding areas until a uniform depth is formed.

C. Tool joints when pointing mortar is thumbprint hard. Use a round jointer having a diameter 1/8 -inch (3 mm) larger than width of joint.

3.9 JOINT-SEALANT INSTALLATION

A. Prepare joints and apply sealants of type and at locations indicated to comply with applicable requirements in Section 07 9200 "Joint Sealants." Remove temporary shims before applying sealants.

3.10 ADJUSTING AND CLEANING

A. In-Progress Cleaning: Clean countertops as work progresses. Remove adhesive, grout, mortar, and sealant smears immediately.

B. Remove and replace or repair stonework of the following description:

1. Broken, chipped, stained, or otherwise damaged stones. Broken, chipped, stained, or otherwise damaged stone may be repaired, providing the methods and results are acceptable to Owner’s Representative.
2. Defective stone trim.
3. Defective joints, including misaligned joints.
4. Interior stone trim and joints not matching approved Samples and mockups.
5. Interior stone trim not complying with other requirements indicated.
6. Defective countertops.
7. Stones and joints not matching approved samples.
8. Stonework not complying with other requirements indicated.

C. Replace in manner that results in stonework matching approved samples and field-constructed mock-ups, complying with other requirements, and showing no evidence of replacement.

D. Clean stonework not less than six days after completion of work, using clean water and stiff bristle fiber brushes. Do not use wire brushes, acid-type cleaning agents, cleaning compounds with caustic or harsh fillers, or other materials or methods that could damage stone.

3.11 SEALER APPLICATION

A. All surfaces must be clean and free from all loose grit and debris, satins, dirt, and wax coatings. Surfaces shall remain dry for a minimum of 24 hours before the application of sealer and remain dry for 24 hours after the application of sealer.

B. Floor surface temperature must be above 50° F. and below 90° F.

C. Test on a small area before using to determine if the product is acceptable with type of stone.

D. A uniform coating of sealer shall be applied AFTER installation of stone materials. Install in strict accordance with sealer manufacturer's recommendations.

3.12 PROTECTION

A. Provide final protection and maintain conditions in a manner acceptable to fabricator and installer ensuring dimension stonework being without damage or deterioration at time of Substantial Completion.

- END OF SECTION -

- SECTION 12 3661 -

QUARTZ SURFACING COUNTERTOPS AND FACINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section Includes the following shop fabricated items:
   1. Quartz composite countertops, aprons and backsplashes.

1.3 RELATED REQUIREMENTS

A. Pertinent Sections specifying Volatile Organic Compound (VOC) Content Restrictions.

B. Section 01 6116 “Volatile Organic Compound (VOC) Restrictions”

C. Section 06 1053 "Miscellaneous Rough Carpentry" for furring, blocking, shims, hanging strips and other carpentry, not exposed to view, required for installing countertops specified in this Section.

D. Section 06 2000.01 “Finish Carpentry (Courtyard)”

E. Section 06 2000.02 “Finish Carpentry (Residence Inn)”

F. Section 06 4023 "Interior Architectural Woodwork" for custom-made cabinets.

G. Section 07 9200 “Joint Sealants”.

H. Section 09 2216 "Non-Structural Metal Framing" for reinforcements in metal-framed partitions for anchoring countertops.

I. Pertinent sections of Division 09 specifying ceramic tile, stone tile, stone floors, etc.

J. Section 12 3213 "Manufactured Wood-Veneer-Faced Casework" for cabinets of standard design that receive countertops.

K. Section 12 3216 "Manufactured Plastic Laminate Clad Casework" for cabinets of standard design that receive countertops.

L. Division 22 for plumbing fixtures and plumbing connections penetrating countertops.

M. Division 26 for services and connections penetrating countertops.

N. Pertinent sections specifying items built into or penetrating work of this section.

1.4 REFERENCES

A. "Phoenix Building Construction Code", International Building Code 2006, with City of Phoenix administrative provisions and amendments.

B. 36 CFR 1191 - Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities; Final Rule; Federal Register, July 26, 1991; updated 2010.

C. ASTM International:
1. ASTM C97 – Absorption and Bulk Specific Gravity of Dimension Stone.
2. ASTM C99 – Modulus of Rupture of Dimension Stone.
3. ASTM C170 – Compressive Strength of Dimension Stone.
4. ASTM C217 – Weather Resistance of Slate.
5. ASTM C482 – Bond Strength of Ceramic Tile to Portland Cement.
6. ASTM C484 – Thermal Shock Resistance of Glazed Ceramic Tile.
7. ASTM C501 – Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser.
8. ASTM C531 – Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.
9. ASTM C880 – Flexural Strength of Dimension Stone.
10. ASTM C1028 – Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.
11. ASTM D256 – Izod Pendulum Impact Resistance of Plastics.
12. ASTM D2047 – Static Coefficient of Friction of Polish-Coated Floor Surfaces by the James Machine.
13. ASTM D2299 – Relative Stain Resistance of Plastics.
14. ASTM E84 – Surface Burning Characteristics of Building Materials.

D. International Organization for Standardization:
1. ISO 9002 – Quality systems -- Model for Quality Assurance in Production, Installation and Servicing.
2. ISO 14001 – Environmental Management Systems
3. NSF

1.5 SUBMITTALS

A. General: Submit in accordance with Section 01 3300.

B. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

C. Product Data:

1. Quartz Surfacing: Submit manufacturer's product data, sample warranty form, and fabrication and installation instructions.
2. Accessories: Submit manufacturer's product data and installation instructions.
3. Include maintenance information for quartz countertops and facings to include in maintenance manuals.
   a. Product data for quartz-care products used or recommended by Installer, and names, addresses, and telephone numbers of local sources for products.

D. VOC Submittals:
1. Product Data – VOC Limits: For adhesives sealants, fillers and primers, documentation including printed statement of VOC contents, comply with limits specified in Section 01 6116.

E. Shop Drawings: Show field-verified dimensions, quartz surfacing dimensions, locations and dimensions of cutouts, required locations of support and blocking members, edge profiles, and installation details and methods. Identify colors and finishes.
1. Include cutting and setting Drawings indicating sizes, dimensions, sections, and profiles of material, arrangement and provisions for jointing, supporting, anchoring, and bonding work, and details showing relationship with, attachment to, and reception of related work.
2. Include large-scale details of decorative surfaces and inscriptions.

F. Samples:
1. Samples for Color Approval:
   a. Slab: Submit two samples 10 –inches by 10 -inches (250mm x 250 mm) of each color and finish selected.
2. Quartz Adhesive: Submit two samples of an adhesive joint for each color quartz surfacing selected.
   a. Show color match of adhesive.

G. Fabricator Qualifications: Submit evidence of fabricator's qualifications.

1.6 CLOSEOUT SUBMITTALS:

A. Submit under provisions of Section 01 1700.

B. Warranty: Submit specified warranty.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate quartz countertops and facings similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of quartz countertops.

C. Single-Source Responsibility for Quartz: Obtain each color, finish and type of quartz from a single manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of Section 01 6000.

B. Deliver materials to project site in undamaged condition.

C. Packaging, Shipping, Handling, and Unloading: Observe manufacturer's recommendations and handle in manner to prevent breakage or damage. Brace parts if necessary. Transport in the near-vertical position with finished face toward finished face. Do not allow finished surfaces to rub during shipping or handling.

D. Storage and Protection:
   1. Do not use pinch or wrecking bars.
   2. Store in racks in near-vertical position.
   3. Prevent warpage and breakage.
   4. Store inside away from direct exposure to sun.
   5. Store with finished face toward finished face.

1.9 PROJECT CONDITIONS

A. Do not set quartz when air temperature or material temperature is below 25 degrees F. or above 130 degrees F (-4 and 54 degrees C).

B. Maintain minimum ambient temperatures of 50 degrees F. (10 degrees C.) during installation and for seven days after completion, unless higher temperatures are required by fabricator's or supplier's instructions.

C. Field Measurements: Where countertops or facings are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.

D. Established Dimensions: Where countertops are indicated to fit to other construction, establish dimensions for areas where countertops are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.10 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that countertops and facings can be supported and installed as indicated.

1.11 WARRANTY

A. Provide manufacturer's commercial (10) ten-year limited warranty against product defect agreeing to repair or replace to like new condition.
   1. Contractor shall register installation to begin warranty period.

PART 2 - PRODUCT

2.1 PERFORMANCE REQUIREMENTS

A. VOC Limits for adhesives, sealants, fillers and primers. Comply with limits specified in Section 01 6116.

B. Performance:

1.	Density:	2.2-2.4 gr/cm³	ASTM C97
2.	Water absorption:	≤ 0.03 percent	ASTM C97.
3.	Flexural Strength:	6,200 – 11,000 psi	ASTM C880.
4.	Dimension Stability:	Class A	EN 14617-12
5.	Impact Resistance:	27lbs. (122N)	ASTM D1709
6.	Compressive Strength:	22,000-28,000psi	ASTM C-170
7.	Abrasion:	Volume of Chord: V=89-194mm³	
8.	Freeze-Thaw Resistance:	No detects after 15 freeze-thaw cycles ASATM C1026	
9.	Mohs Hardness:	6.5-7.0	EN101
10.	Microbial Resistance:	Ranking 3: Resistant to Mold Growth	ASTM D6329-98 (2003)
11.	Resistance to Chemical Acids:	Not affected	ASTM C560
12.	Slip Resistance at Honed 400:	R9-R10	DIN 51130

13. Determination of resistance to immersion in boiling water:
    a. Effect of surface (rating): 5 (no visible change)
    b. Standard: AS 2924.2-7 1998 (Equiv. to ISO 4586.2-7: 1997
14. Determination of resistance to dry heat:
    a. Effect of surface (rating): 5 (no visible change)
    b. Standard: AS 2924.2-8 1998 (Equiv. to ISO 4586.2-8: 1997
15. Determination of resistance thermal shock:
    a. Specimens showing defects: NIL
    b. Standard: AS 2924.2-9 1999 (Equiv. to ISO 10545-9: 1994
16. Determination of resistance to staining (Procedure A)
    a. Effect of surface (rating): 5 (no visible change)
    b. Standard: AS 2924.2-15 1998 (Equiv. to ISO 4586.2-15: 1997

2.2 MANUFACTURERS

A. Qualifications: Manufacturer shall be ISO 9002 and ISO 14001 certified.

B. Basis of Design:
1. Provide **Pentalquartz, Quartz Surfacing (VICOSTONE® Quartz Surfaces)** manufactured by **Pental**, www.pentalquartz.com, www.pentalonline.com.
2. Provide **ecoQuartz®, Quartz Surfacing** manufactured by **Belstone**, a ProjectStone Company, www.projectstone.com.

C. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Substitutions, refer to Section 01 2500

2.3 QUARTZ SURFACING AND FACING MATERIAL (ST-2 THROUGH ST-7)

A. Composition:
   1. Natural crystalline silica (quartz), other natural stone combined with resins and pigments and fabricated into slabs.
      a. 90 percent to 93 percent quartz
      b. 7 percent to 10 percent combined bonding agent, special additives and pigments.
      c. Trace materials including; resins and trace materials including, but not limited to; A12O3, Fe2O3, TiO2, CaO, MgO, Na2O and K2O.

B. Schedule:
   1. Slabs:
      a. Thickness: (nominal)
         1) 3/4 -inch (2 cm), unless otherwise indicated in Drawings.
      b. Size: Slabs shall not be less than 55 -inches by 119 -inches (1397mm by 3022mm) to minimize number of joints in installation.
      c. Finish size: As indicated on Drawings.
      d. Color: As indicated on Drawings.
      e. Finish:
         1) As indicated on Drawings.

C. Identification: Material shall be labeled with batch number and imprinted on back with manufacturer's identifying mark.

2.4 ACCESSORIES

A. Mounting Adhesives:
   1. Provide structural-grade silicone or epoxy adhesives of type recommended by manufacturer for application and conditions of use.
   2. Acceptable Silicone Manufactures:
      a. Dow Corning.
      b. GE Sealants and Adhesives.
   3. Acceptable Epoxy Manufacturers:
      a. Akemi North America.
      b. Bonstone Material Corporation.
      c. Tenax USA.
   4. Provide spacers, if required, of type recommended by adhesive manufacturer.

B. Joint Sealants:
   1. Clear silicone sealant of type recommended by manufacturer for application and conditions of use.
   2. Acceptable Manufactures:

a. Dow Corning.
b. GE Sealants and Adhesives.

3. Provide anti-bacterial type in toilet and bath rooms, food preparation areas.

C. Solvent: Product recommended by adhesive manufacturer to clean surface of quartz surfacing to assure adhesion of adhesives and sealants.

D. Cleaning Agents: Non-abrasive, soft-scrub type kitchen cleansers.

2.5 FABRICATION

A. Fabricator: Firm shall have five years experience fabricating architectural quartz and shall have water-cooled cutting tools.

1. Firm shall be authorized in writing by manufacturer.

B. Shop Assembly: Observe proper safety procedures and comply with manufacturer's instructions.

C. Layout: Layout joints as shown on Drawings to minimize joints and to avoid L-shaped pieces of quartz surfacing.

D. Inspect Material:

1. Inspect material for defects prior to fabrication.
2. Color Match: Materials throughout Project shall be from the same batch and shall bear labels with same batch number. Visually inspect materials to be used for adjacent pieces to assure acceptable color match. Inspect in lighting conditions similar to those on Project.
3. Variation in distribution of aggregates in quartz surfacing which are within manufacturer's tolerances is not a defect.

E. Tools:

1. Cut with water-cooled power tools approved by manufacturer.

F. Cutouts:

1. When plunge cutting, drill a 1 –inch relief hole at termination point of the cut prior to beginning the cut.
   a. Always cut toward the relief hole.
2. When making a "U" shaped cut, mark and drill a relief holes where the cut lines will intersect.
3. Always make the shortest cuts first.
4. When making an "L" shaped cut, mark and drill relief holes where the cut lines will intersect.
   a. Always cut the shortest lengths first and cutting towards the relief hole
5. When making a cut the full length of the slab, either with a plunge cut or starting at the edge, mark and drill a relief hole at the termination point of the cut, then cut towards the relief hole.
6. If the remaining material outside a cutout is less than 3 -inches (76 mm) wide, reinforce area by laminating it with a strip of quartz surfacing.

G. Laminations: Laminate layers of quartz surfacing as required to create built-up edges, trim, and other areas requiring additional thickness.

PART 3 - EXECUTION

3.1 ACCEPTABLE INSTALLER

A. Installer: Firm shall have (5) five years experience installing architectural quartz or stone.

3.2 EXAMINATION

A. Site Verification:
   1. Verify dimensions by field measurements prior to fabrication.
   2. Verify that substrates supporting quartz surfaces are strong, sound, plumb, level, and flat to within 1/16 -inch in 10 -feet (1.6 mm in 3000 mm) and that necessary supports and blocking are in place.
   3. Base Cabinets:
      a. Cabinet units shall be securely fixed to adjoining units and back wall.
      b. Cabinet shall be able to withstand a weight in excess of 12lbs. per square foot.

B. Inspect finished surfaces for damage.
   1. Do not install until damage materials have been repaired in an acceptable manner or replaced.

C. Examine surfaces to receive quartz countertops and trim, and conditions under which work will be installed, with installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of quartzwork.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of quartz countertops.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PREPARATION

A. Advise installers of other work about specific requirements for placement of inserts and similar items to be used by Quartz Surfacing Installer for anchoring quartz countertops. Furnish installers of other work with Drawings or templates showing locations of these items.

B. Clean dirty Quartz Surfacing by removing soil, stains, and foreign materials before setting. Allow Quartz Surfacing to dry before installing.

C. Protect finished surfaces against scratches. Apply masking where necessary. Guard against grit, dust, and other trades.

3.4 INSTALLATION

A. Install materials in accordance to manufacturer's recommendations. Lift and place to avoid breakage.

B. Preliminary Installation and Adjustment: Position materials to verify that materials are correctly sized and prepared. Make necessary adjustments.
   1. If jobsite cutting, grinding, or polishing is required, use water-cooled tools. Protect jobsite and surfaces against dust and water. Perform work away from installation site if possible.
   2. Countertops: Gypsum drywall back walls which are not fire or acoustically rated may be routed up to half the thickness of the drywall to allow countertop to fit.
   3. Allow gaps for expansion of not less than 1/16 -inch (1.5 mm) per 5 -feet when installed between walls or other fixed conditions.
   4. Drainage: Adjacent to sin
   5. Countertop material shall be supported around the entire perimeter.
      a. Substrate support rails shall be a minimum of 3.5 –inches wide by 5/8 –inch thick.
      b. Support rails shall not exceed 24 –inches o.c.
      c. Overhangs shall be supported with flat steel plate support rails or other support devices at a minimum size of 5/8 –inch thick by 2.75 –inches wide at 24 –inches o.c. maximum.

C. Permanent Installation:
   1. After verifying fit, remove quartz surfacing from position, clean substrates of dust and contamination, and clean quartz surfacing back side and joints with solvent.
   2. Apply sufficient quantity of mounting adhesive in accordance with adhesive manufacturer's recommendations to provide permanent, secure installation.
   3. Install surfacing plumb, level, and square and flat to within 1/16 -inch in 10 -feet (1.6 mm in 3000 mm).
   4. Install with a 1/8 –inch gap where material abuts walls and backsplashes.

D. Backsplashes:
   1. Install in accordance with manufacturers recommendations.

E. Joints:
   1. Joints Between Adjacent Pieces of Quartz Surfacing:
      a. Joints shall be flush, tight fitting, level, and neat.
      b. Securely join with quartz adhesive. Fill joints level with quartz surfacing.
      c. Clamp or brace quartz surfacing in position until adhesive sets.
   2. Joints Between backsplashes and countertops .

3.5 CONSTRUCTION TOLERANCES

A. Variation from Plumb: For vertical lines and surfaces, do not exceed 1/8 -inch in 96 -inches (3 mm in 2400 mm), 1/4 -inch (6 mm) maximum.

B. Variation from Level: For Countertops, do not exceed 1/16 -inch in 10 -feet (1.6 mm in 3000 mm) maximum.

C. Variation in Joint Width: Do not vary from average joint width more than plus or minus 1/16 -inch (1.5 mm) or one-fourth of nominal joint width, whichever is less.

D. Variation in Line of Edge at Joints (Lipping): Do not exceed 1/64 -inch (0.4-mm) difference between edges of adjacent units, where edge line continues across joint.

E. Variation in Plane at Joints (Lipping): For Countertops, do not exceed 1/64 -inch (0.4-mm) difference between planes of adjacent units.

F. Variation of Linear Building Line: For position shown in plan and related portion of walls and partitions, do not exceed 1/8 -inch in 10 -feet (3 mm in 3 m), 1/4 -inch in 20 -feet (6 mm in 6 m), 3/8 -inch (10 mm) maximum.

G. Variation in Cross-Sectional Dimensions: For thickness of walls from dimensions indicated, do not exceed plus or minus 1/8 -inch (3 mm).

3.6 REPAIR

A. Repair or replace damaged materials in a satisfactory manner.

3.7 JOINT-SEALANT INSTALLATION

A. Prepare joints and apply sealants of type and at locations indicated to comply with applicable requirements in Section 07 9200 "Joint Sealants." Remove temporary shims before applying sealants.

3.8 ADJUSTING AND CLEANING

A. In-Progress Cleaning: Clean countertops, backsplashes, tile, etc. as work progresses.
   1. Remove adhesive and sealant smears immediately.

B. Remove masking and excess adhesives and sealants. Clean exposed surfaces.

C. Remove and replace or repair work of the following description:
   1. Broken, chipped, stained, or otherwise damaged quartz shall be replaced.
   2. Defective trim shall be replaced.
   3. Defective joints, including misaligned joints.
   4. Interior trim and joints not matching approved Samples and mockups.
   5. Interior trim not complying with other requirements indicated.
   6. Defective countertops.
   7. Quartz and joints not matching approved samples.
   8. Work not complying with other requirements indicated.
   9. Work not acceptable with Owner and Architect.

D. Replace in manner that results in quartzwork matching approved samples and field-constructed mock-ups, complying with other requirements, and showing no evidence of replacement.

E. Cleaning not allowed:
   1. Do not use wire brushes, acid-type cleaning agents, cleaning compounds with caustic or harsh fillers, or other materials or methods that could damage quartz.

3.9 PROTECTION

A. Protect surfacing from damage by other Sections.

B. Provide final protection and maintain conditions in a manner acceptable to fabricator and installer ensuring dimension quartzwork being without damage or deterioration at time of Substantial Completion.

- END OF SECTION -

- SECTION 12 3661.16 -

SOLID SURFACING COUNTERTOPS (COURTYARD)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Solid Surfacing
      a. Countertops.
      b. Refer to Drawings.

1.3 RELATED REQUIREMENTS

A. Pertinent Sections specifying Volatile Organic Compound (VOC) Content Restrictions.

B. Section 01 6116 “Volatile Organic Compound (VOC) Restrictions”

C. Section 06 1053 "Miscellaneous Rough Carpentry" for furring, blocking, shims, hanging strips and other carpentry, not exposed to view, required for installing countertops specified in this Section.

D. Section 06 2000.01 “Finish Carpentry (Courtyard)”

E. Section 06 2000.02 “Finish Carpentry (Residence Inn)”

F. Section 06 4023 "Interior Architectural Woodwork" for custom-made cabinets.

G. Section 07 9200 “Joint Sealants”.

H. Section 09 2216 "Non-Structural Metal Framing" for reinforcements in metal-framed partitions for anchoring countertops.

I. Pertinent sections of Division 09 specifying ceramic tile, stone tile, stone floors, etc.

J. Section 12 3213 "Manufactured Wood-Veneer-Faced Casework" for cabinets of standard design that receive countertops.

K. Section 12 3216 "Manufactured Plastic Laminate Clad Casework" for cabinets of standard design that receive countertops.

L. Division 22 for plumbing fixtures and plumbing connections penetrating countertops.

M. Division 26 for services and connections penetrating countertops.

N. Pertinent sections specifying items built into or penetrating work of this section.

1.4 REFERENCES

A. “Phoenix Building Construction Code”, International Building Code 2006, with City of Phoenix administrative provisions and amendments.

B. American National Standards Institute (ANSI) Publications:
1. Z124.3 “Plastic Lavatories”

C. ASTM International (ASTM) Publications:
1. E84 "Standard Test Method for Surface Burning Characteristics of Building Materials"

D. Architectural Woodwork Institute (AWI) Publications:
1. "Architectural Woodwork Quality Standards"
2. AWI Section 400 “Architectural Cabinets”

E. Federal Specifications (FS) Publications:
1. MMM-A-130 “Adhesive, Contact”

F. The International Solid Surface Fabricators Association (ISSFA) Publications:
1. Specification ISSFA 2-0

1.5 SUBMITTALS

A. General: Submit in accordance with Section 01 3300.

B. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

C. Submit “Letter of Conformance” in accordance with Section 01 3300 indicating specified items selected for use in project with the following supporting data.
1. Submit Shop Drawings and product data. Include materials, component profiles, fastening methods, assembly methods, joint details, accessory listings, and schedule of finishes.
   a. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.

D. Product Data: For each type of product indicated, demonstrate compliance with specified attributes.

E. Samples:
1. Samples for Color Approval:
a. Slab: Submit two samples 10 –inches by 10 -inches (250mm x 250 mm) of each color and finish selected.
2. Adhesive: Submit two samples of an adhesive joint for each color quartz surfacing selected.
a. Show color match of adhesive.

1.6 CLOSEOUT SUBMITTALS:

A. Submit under provisions of Section 01 1700.

B. Warranty: Submit specified warranty.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate quartz countertops and facings similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Qualifications: Manufacturer shall be ISO 9002 and ISO 14001 certified.

C. Installer Qualifications: Fabricator of solid surfacing countertops.

D. Single-Source Responsibility for Solid Surfacing.
1. Obtain each color, finish and type of solid surfacing from a single manufacturer.

E. Lavatory/vanity countertopsshall be supplied by one manufacturer. Color shall match for all items. Refer to Interior Finish Index.

F. Allowable Tolerances:
1. Variation in component size: +/- 1/8 inch.
2. Location of openings: +/- 1/8 inch from indicated location.

G. Perform work to (custom) quality in accordance with "Quality Standards" of the Architectural Woodwork Institute (AWI).

H. Fire-Test-Response Characteristics: Where fire-retardant materials or products are indicated, provide materials and products with specified fire-test-response characteristics as determined by testing identical products per test method indicated by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify with appropriate markings of applicable testing and inspecting agency in the form of separable paper label or, where required by authorities having jurisdiction, imprint on surfaces of materials that will be concealed from view after installation.

1.8 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements of Section 01 6000.

B. Do not deliver solid surfacing until painting and similar operations that could damage solid surfacing materials have been completed in installation areas. If solid surfacing must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

C. Handle materials to prevent damage to finished surfaces. Provide protective coverings to prevent physical damage or staining following installation for duration of project.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install solid surfacing until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where solid surfacing is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support solid surfacing work by field measurements before being enclosed and indicate measurements on Shop Drawings.

C. Established Dimensions: Where countertops are indicated to fit to other construction, establish dimensions for areas where countertops are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.10 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that countertops and facings can be supported and installed as indicated.

1.11 WARRANTY

A. Provide manufacturer’s commercial ten (10) year limited warranty against product defect agreeing to repair or replace to like new condition.

1. Contractor shall register installation to begin warranty period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Limits for adhesives, sealants, fillers and primers. Comply with limits specified in Section 01 6116.

B. Fire Hazard Ratings:
   1. Classified in accordance local codes and ordinances, ASTM E84 and the following:
      a. Class A
      b. Flame Spread: Class A: 0 - 25
      c. Smoke Developed: 0-450

2.2 SOLID SURFACE MATERIALS ("ST-8")

A. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with material and performance requirements in ANSI Z124.3, for Type 5 or Type 6, without a precoated finish.
   1. Avendra, LLC Preferred Manufacturers:
      a. Countertops:
         1) None
   2. Approved Manufacturers:
      a. Countertops:
         1) KRION Porcelanosa Solid Surface, www.krion.es
         2) "Corian"; Dupont (800-426-7426)

B. Countertops:
   1. Homogeneous solid surface countertops. Thickness, sizes and profiles as shown on Drawings. Color and Finish as shown on Interior "Finish Specifications" Drawings.
      a. Provide matching backsplash, sidesplash, aprons, shelves, and other accessories as shown on Drawings in same material, color and finish as countertops.
      b. If shown on Drawings, apron shall be prepared to receive facial tissue dispenser as detailed on the Drawings.

2.3 INSTALLATION MATERIALS

A. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage.
   1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance.
   2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

B. Sink/Lavatory Mounting Hardware: Manufacturer's standard bowl clips, panel inserts and fasteners for attachment of undermount sinks/lavatories.

C. Adhesive and Sealant as recommended by solid surfacing manufacturer.

2.4 FABRICATION

A. Fabricator: Firm shall have five years experience fabricating architectural quartz and shall have water-cooled cutting tools.
   1. Firm shall be authorized in writing by manufacturer.

B. Shop Assembly: Observe proper safety procedures and comply with manufacturer's instructions.

C. Layout: Layout joints as shown on Drawings to minimize joints and to avoid L-shaped pieces of quartz surfacing.

D. Inspect Material:
   1. Inspect material for defects prior to fabrication.
   2. Color Match: Materials throughout Project shall be from the same batch and shall bear labels with same batch number. Visually inspect materials to be used for adjacent pieces to assure acceptable color match. Inspect in lighting conditions similar to those on Project.
   3. Variation in distribution of aggregates in quartz surfacing which are within manufacturer's tolerances is not a defect.

E. General:
   1. Fabricate tops in one piece with shop-applied backsplashes and edges, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.
   2. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings.
      a. Rout and finish component edges with clean, sharp returns. Rout cutouts, radii and contours to template. Smooth edges. Repair or reject defective and inaccurate work.
   3. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trip for scribing and site cutting.
   4. Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes, and other fixtures and fittings.

PART 3 - EXECUTION

3.1 ACCEPTABLE INSTALLER

A. Installer: Firm shall have (5) five years experience installing architectural quartz or stone.

3.2 INSPECTION

A. Verify adequacy of backing and support framing.

3.3 PREPARATION

A. Condition solid surfacing to average prevailing humidity conditions in installation areas before installation.

3.4 INSTALLATION

A. All countertops shall be installed as shown on Drawings and as specified by manufacturer.

B. Install components plumb, level and rigid, scribed to adjacent finishes, in accordance with approved shop drawings and product data.

C. Adhere sinks and lavatory bowls to tops using manufacturer's recommended sealant, adhesive and mounting hardware.

D. Countertops:

1. Quality Standard: Comply with AWI Section 400 requirements for countertops.
2. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
3. Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
4. Provide cutouts in panel required for the installation of plumbing outlets.
5. Adhere sinks and lavatory bowls to tops using manufacturer's recommended sealant, adhesive and mounting hardware.
6. Provide backsplashes, sidesplashes, and aprons as indicated on the Drawings. Adhere to tops using manufacturer's recommended adhesive.

3.5 CONSTRUCTION TOLERANCES

A. Variation from Plumb: For vertical lines and surfaces, do not exceed 1/8 -inch in 96 -inches (3 mm in 2400 mm), 1/4 -inch (6 mm) maximum.

B. Variation from Level: For Countertops, do not exceed 1/16 -inch in 10 -feet (1.6 mm in 3000 mm) maximum.

C. Variation in Joint Width: Do not vary from average joint width more than plus or minus 1/16 -inch (1.5 mm) or one-fourth of nominal joint width, whichever is less.

D. Variation in Line of Edge at Joints (Lipping): Do not exceed 1/64 -inch (0.4-mm) difference between edges of adjacent units, where edge line continues across joint.

E. Variation in Plane at Joints (Lipping): For Countertops, do not exceed 1/64 -inch (0.4-mm) difference between planes of adjacent units.

F. Variation of Linear Building Line: For position shown in plan and related portion of walls and partitions, do not exceed 1/8 -inch in 10 -feet (3 mm in 3 m), 1/4 -inch in 20 -feet (6 mm in 6 m), 3/8 -inch (10 mm) maximum.

G. Variation in Cross-Sectional Dimensions: For thickness of walls from dimensions indicated, do not exceed plus or minus 1/8 -inch (3 mm).

3.6 JOINT-SEALANT INSTALLATION

A. Prepare joints and apply sealants of type and at locations indicated to comply with applicable requirements in Section 07 9200 "Joint Sealants." Remove temporary shims before applying sealants.

3.7 ADJUSTING AND CLEANING

A. Keep components clean during installation. Remove adhesives, sealants and other stains.
1. Keep clean until Date of Substantial Completion.
2. Replace stained and damaged components.

B. Protect surfaces from damage until Date of Substantial Completion.

C. Remove and replace or repair work of the following description:
1. Broken, chipped, stained, or otherwise damaged quartz shall be replaced.
2. Defective trim shall be replaced.
3. Defective joints, including misaligned joints.
4. Interior trim and joints not matching approved Samples and mockups.
5. Interior trim not complying with other requirements indicated.
6. Defective countertops.
7. Quartz and joints not matching approved samples.
8. Work not complying with other requirements indicated.
9. Work not acceptable with Owner and Architect.

D. Replace in manner that results in quartzwork matching approved samples and field-constructed mock-ups, complying with other requirements, and showing no evidence of replacement.

E. Cleaning not allowed:
1. Do not use wire brushes, acid-type cleaning agents, cleaning compounds with caustic or harsh fillers, or other materials or methods that could damage quartz.

3.8 PROTECTION

A. Protect surfacing from damage by other Sections.

B. Provide final protection and maintain conditions in a manner acceptable to fabricator and installer ensuring dimension quartzwork being without damage or deterioration at time of Substantial Completion.

- END OF SECTION -

- SECTION 12 4813 -

ENTRANCE FLOOR MATS AND FRAMES (COURTYARD)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: **COURTYARD**
   1. Frames to be set in concrete floors to receive recessed floor mats
   2. Recessed floor mats of the following type:
      a. Carpet-type mats.

1.3 RELATED REQUIREMENTS

A. Pertinent Sections specifying Volatile Organic Compound (VOC) Content Restrictions.

B. Section 01 6116 “Volatile Organic Compound (VOC) Restrictions”.

C. Division 03 Sections for concrete work, including forming, placing, and finishing concrete floor slabs and grouting frames into recess.

D. Division 9 for various finish flooring materials.

1.4 REFERENCES

A. “Phoenix Building Construction Code”, International Building Code 2006, with City of Phoenix administrative provisions and amendments.

B. 36 CFR 1191 - Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities; Final Rule; Federal Register, July 26, 1991; updated 2010.

C. ASTM International (ASTM) Publications: (Former American Society for Testing and Materials)
   1. B221 "Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes".

2. D2047 “Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine”.
3. E648/NFPA 253 “Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source”.

1.5 SUBMITTALS

A. General: Submit in accordance with Section 01 3300.

B. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

C. Product Data: For each type of product indicated, demonstrate compliance with specified attributes.

D. VOC Submittals:
1. Product Data – VOC Limits: For adhesives sealants, fillers and primers, documentation including printed statement of VOC contents, comply with limits specified in Section 01 6116.

E. Submit “Letter of Conformance” in accordance with Section 01 3300 indicating specified items selected for use in project with the following supporting data.
1. Product data for each type of floor mat and frame specified, including manufacturer's specifications and installation instructions, details of construction relative to materials, dimensions of individual components, profiles, and finishes.
2. Samples for initial selection purposes in form of manufacturer's color charts consisting of actual sections of floor mat and frame materials, showing full range of colors, textures, finishes, and patterns available, for each type of floor mat and frame indicated.
3. Maintenance data in the form of manufacturer's printed instructions for cleaning and maintaining floor mats.

1.6 QUALITY ASSURANCE

A. Single Source Responsibility: Obtain floor mats and frames from one source of a single manufacturer.

1.7 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements of Section 01 6000.

1.8 PROJECT CONDITIONS

A. Field measurements: Check actual blocked-out openings in floors by accurate field measurements before fabricating frames and mats show recorded measurements of final shop drawings. Coordinate fabrication schedule with construction progress to avoid a delay of the Work.

1.9 SEQUENCING AND SCHEDULING

A. Install mat frames integrally with principal pour of concrete floor system. Locate, align, and level frame members accurately, but recess in-fill by at least 1 -inch for placement of concrete topping promptly after principal pour has hardened.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Limits for adhesives sealants, fillers and primers. Comply with limits specified in Section 01 6116.

B. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648 or NFPA 253.

2.2 MANUFACTURERS

A. Recessed Floor Mats:
   1. Avendra, LLC Preferred Manufacturers:
      a. None
   2. Approved Manufacturers:
      a. "Pedimat **-** Model M1" with recessed frame, Grand Entrance, A Division of Construction Specialties, Inc. (888-424-6287).

B. Size: Refer to drawings, varies.

2.3 MATERIALS

A. Drawing Designation:
   1. "CPT-8"

B. Assembly:
   1. Carpet Tread Inserts: Unitary fusion bonded nylon with a pile height of 1/4 -inch and a minimum yarn weight of 30 ounces per square yard.
      a. Each carpet fiber and monofilament shall be fusion-bonded to a rigid two-ply backing to prevent fraying and supplied in continuous splice-free lengths.
      b. Color: Refer to Interior Finish Index
   2. Tread Rails:
      a. Materials:
         1) Vinyl/Acrylic: High-impact PVC alloy.
         2) Aluminum Hinge Rail Connectors
      b. Finish: M-M12C22A42, Class 1 anodized, color as shown on Interior Finish Index.
      c. Spacing: 2 -inch on center, connected by vinyl hinge
      d. 7/16 –inch thick mat.
   3. Recess-Mounted Aluminum Tapered Angle Frame (TNG):

a. Material: 6063-T5 aluminum alloy
b. Finish: M-M12C22A42, Class 1 anodized, frame color as shown on Interior Finish Index.
   1) Mill finish frames in contact with concrete shall be primer coated.
c. 1/2 -inch deep recess.
   1) Coordinate with floor slab installation so frame is flush with the finished floor.

2.4 FABRICATION

A. Shop-fabricate units of floor mat work to greatest extent possible in sizes as indicated.
   1. Where not indicated otherwise, provide single unit for each mat installation, but do not exceed manufacturer's maximum size recommendation for units intended for removal and cleaning.
   2. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes.
   3. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.
   4. Where possible, verify sizes by field measurement before shop fabrication.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install recessed frames and mats complying with manufacturer's instructions.
   1. Set mat tops at height recommended by manufacturer for most effective cleaning action; coordinate top of mat surfaces with bottom of doors that swing across mats to provide clearance between door and mat.

3.2 PROTECTION

A. After completing frame installation and concrete work, provide temp
   1. Maintain protection until construction traffic has ended and Project is near time of Substantial Completion.

B. Defer installation of floor mats until time of Substantial Completion for Project.

- END OF SECTION -

- SECTION 12 5413.13 -

HOSPITALITY FURNITURE INSTALLATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. The complete installation of all furniture and fixtures which are furnished by Owner.

1.3 RELATED REQUIREMENTS

A. Pertinent Sections specifying Volatile Organic Compound (VOC) Content Restrictions.

B. Section 01 6116 “Volatile Organic Compound (VOC) Restrictions”.

C. Section 06 1053 “Miscellaneous Rough Carpentry” for blocking for wall mounted furniture and fixtures, refer to Drawings.

D. Section 09 2216 “Non-Structural Metal Framing” for blocking for wall mounted furniture and fixtures, refer to Drawings.

1.4 REFERENCES

A. “Phoenix Building Construction Code”, International Building Code 2006, with City of Phoenix administrative provisions and amendments.

1.5 QUALITY ASSURANCE

A. Qualified installer shall have experience in installation methods similar to work of this section.

1.6 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements of Section 01 6000.

B. The Contractor shall receive and store all items furnished by Owner.

C. The storage area shall be secure and dry with temperatures maintained above 40 degrees F. at all times.

D. For each delivery, the Contractor shall fill out receiving reports. Each delivery shall be inspected for damage. All damage shall be noted on the carriers delivery slip as well as the receiving report. Receiving reports and carriers delivery slips shall be forwarded to the Owner immediately upon receipt of delivery. If damaged material is not reported when discovered, the Contractor assumes full responsibility.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Headboard Mounting Items:
1. 2 ea 3 -inch x 3/16 -inch toggle bolts.
2. Silicone adhesive.
3. Lead shields (concrete walls only).
4. 2 ea 2 -inch #10 pan head screws for each cleat.

B. Box Spring and Bed Frame Mounting Items:
1. 4 ea #10 x 3/4 -inch pan headed screws.

C. Artwork and Framed Mirror Mounting Items:
1. 2 ea 1/8 -inch x 3 -inch toggle bolts for each item.
2. Lead shields (concrete walls only)
3. 2 each 2 -inch #10 pan head screws (concrete walls only).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Contractor shall exercise care when installing items so as not to damage or soil adjacent areas and surface.

B. Headboard Installation:
1. Mount cleat to wall using toggle bolts as required.
2. Apply three (3) 1 -inch spots of silicone adhesive to bottom rail of headboard.
3. Set headboard on wall cleat and press firmly into place.
4. Clean excess adhesive from wall with approved cleaner.

C. Box Spring and Bed Frame Installation:
1. Be sure box spring is properly set in bed frame.
2. Drill 4 ea. - (2 to each side of box springs). Three holes provided in bed frame.
3. Install screw to each hole and tighten in a workmanship manner until box spring is secured to frame.

D. Artwork: Install using picture wire, or security cleats and silicone adhesive.

E. Lamps and shades: Install complete with bulbs, if directed by Owner's representative, staple excess lamp cord to the back of furniture.

- END OF SECTION -

- SECTION 12 9300 -

SITE FURNISHINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes;
   1. Pre-Cast Concrete Benches.

1.3 RELATED REQUIREMENTS

A. Pertinent Sections specifying Volatile Organic Compound (VOC) Content Restrictions.

1.4 REFERENCES

A. “Phoenix Building Construction Code”, International Building Code 2006, with City of Phoenix administrative provisions and amendments.

B. 36 CFR 1191 - Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities; Final Rule; Federal Register, July 26, 1991; updated 2010.

1.5 SUBMITTALS

A. Product Data: Submit product data for manufactured materials and products.

B. Shop Drawing
   1. Show in-place location, fabrication details, plans, elevations, anchorages, reinforcement, connection details and methods, dimensions, finishes, relationships to adjacent materials, and erection and placement.
   2. Show location of Skate Board deterrents for approval.

C. Samples: Nominal size 6 -inch square by appropriate thickness, of each type of unit and finished facing shown and specified for approval of quality, color, and texture of surface finish. Submit prior to fabrication.

D. Mix Design(s): Propose concrete mix design for each type and color of concrete mix utilizing;

1. 21 percent recycled material.

E. Test Reports:
1. Compressive Strength.
a. Supply 12 test results from the last year showing the required results of 5000 PSI.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For site furnishings to include in maintenance manuals.

B. Closeout Submittals:
1. Submit under provisions of Section 01 7700.
2. Warranty: Submit specified warranty.

1.7 QUALITY ASSURANCE

A. Fabricator's Qualifications: Firm shall have a minimum of ten (10) years experience in producing units similar to those required for this Project, with sufficient production capacity to produce and deliver required units without causing delay in Work.
1. Fabricating plant shall be a certified plant and member of one of the following:
a. Architectural Precast Association (APA).
b. Precast/Prestressed Concrete Institute (PCI), Group A1.

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver units to the Project site in such quantities and at such times to ensure continuity of installation.

B. Deliver on a truck owned by the manufacturer. Truck to have a crane or a forklift for placement. Driver to be trained to use applicable equipment. Placement where possible. Owner to place product not reachable by manufacturer's equipment.

1.9 WARRANTY

A. Fabricator will provide their One (1) year warranty against manufacturer's defects.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved Fabricators:
1. **Quick Crete Products Corp.** P.O. Box 639 Norco, CA 92860. (951)737-6240 (main office), www.quickcrete.com Attn: Scott Ulrich, sulrich@quickcrete.com
2. Substitutions, refer to Section 01 2500

2.2 BENCHES

A. Model: 'Edge' #QZEDGE84B

B. Size:
1. Length: ` 84 -inch
2. Height: ` 18 -inch
3. Depth: ` 18 -inch

C. Color: China

D. Texture: Smooth

2.3 ACCESSORIES

A. Skate board and roller blade deterrents: BoardBuster:

2.4 MATERIALS

A. Concrete Materials:
1. Designation: SRC.
2. Portland Cement: ASTM C 150, Type III (gray), to achieve desired finish colors.
   a. Use only one brand, type, and color from the same mill.
3. Aggregates: ASTM C 33, gradation may differ to achieve desired finish characteristics. Select coarse and fine aggregate colors and screen sizes to match approved sample(s). Verify that adequate supply, from one pit or quarry, for each type of aggregate is available for the entire Project. If possible obtain entire aggregate supply prior to starting Work, or have aggregate supply held in reserve by aggregate supplier.
4. Water: Potable. Clean, clear, and free from deleterious amounts of salts, acids, alkali's, organic materials, oils, detergents, or other matter that may interfere with color, curing, or strength of concrete.
5. Admixtures: Select to be compatible in specified mix.
   a. Air Entraining: ASTM C 260.
   b. Water Reducing: ASTM C 494, Type A,B,C,F. or G.
   c. Coloring Agent: ASTM C 979, compatible with other concrete materials.

B. Formwork:
1.
2. Provide forms with acceptable form facing materials that are non-reactive with concrete or form release agents and will produce required finish surfaces.
3. Construct and maintain forms to produce precast concrete units of shapes, lines, and dimensions indicated, within specified tolerances.

C. Reinforcing Materials:
1. Reinforcing Bars: ASTM A 615, Grade 40

D. Connection Materials:
   1. Bolts, washers, nuts to be zinc plated.

2.5 MIXES

A. Design mixes for each type of concrete specified may be prepared by an independent testing agency or by architectural precast manufacturing plant personnel at precast fabricator's option.

B. Proportion mixes by either testing agency trial batch or field test data methods in accordance with ACI 211.1, using materials to be used on the project, to provide normal weight concrete with properties as follows:
   1. Compressive Strength: 5,000 psi when tested in accordance with ASTM C 39.
   2. Maximum water cement ratio 0.47 at point of placement.
   3. Add air-entrainment admixture to result in air content at point of placement complying with ACI 533 requirements.

2.6 FABRICATION

A. General:
   1. Fabricate precast concrete units with manufacturing and testing procedures, quality control recommendations, and dimensional tolerances as specified in ACI 533, unless more stringent requirements are shown or specified.
   2. Fabricate units straight, smooth and true to size and shape, with exposed edges and corners precise and square, unless otherwise indicated.
   3. Benches must be made without any visible lift points.

B. Reinforcement: Comply with CRSI "Manual of Standard Practice" and ACI 318 recommendations. Reinforce architectural precast concrete units to resist handling, transportation stresses, and to comply with specified performance criteria.

C. Comply with ACI-533 requirements for measuring, mixing, transporting, and placing concrete.

D. Consolidate concrete using equipment and procedures complying with ACI 533.

E. Discard units that are warped, cracked, broken, spalled, stained, or otherwise defective unless repairs are approved by the Owner and meet specified requirements.

F. Fabrication Tolerances: Fabricate to tolerances listed in ACI-533.

2.7 FINISHES

A. Color: As herein indicated or as selected by Architect from manufacturer's standard colors.

B. Texture: As herein indicated or as selected by Architect from manufacturer's standard textures.
   1. Surface finish free from pockets, sand streaks, honeycomb, with uniform color and texture.
   2. Bug holes larger than 1/4 -inch in diameter are not acceptable and must be filled.

C. Seam lines to be stoned neatly to minimize appearance.
   1. Products with wide or uneven seam lines could be subject to rejection.

2.8 SEALERS

A. All surfaces to be sealed with three coats of a water based acrylic sealer, which has graffiti-resistant qualities.
   1. Must be non-sacrificial so most graffiti can be cleaned with lacquer thinner and not require resealing.
      a. MT – Matte

2.9 SOURCE QUALITY CONTROL

A. Inspect and test architectural precast concrete in accordance with ACI 533.

B. Defective Work: Discard units that do not conform to requirements as shown or specified. Replace with units which meet requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.

B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.

C. Install site furnishings level, plumb, true, and securely anchored at locations indicated on Drawings.

D. Post Setting: Set cast-in support posts in concrete footing with smooth top, shaped to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.
   1. Refer to Drawings.

E. Posts Set into Voids in Concrete: Form or core-drill holes for installing posts in concrete to depth recommended in writing by manufacturer of site furnishings and 3/4 -inch (19 mm) larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.
   1. Refer to Drawings.

F. Pipe Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.
   1. Refer to Drawings.

G. Skate board / Roller Blade deterrents.
   1. Installed at locations as directed by Architect.
      a. Coordinate during Shop Drawing review for approval.

3.3 ADJUSTING

A. Seating shall be level and adjusted to proper height.

3.4 CLEANING

A. Materials shall be clean and free of defects.

- END OF SECTION -

DIVISION 13 – SPECIAL CONSTRUCTION

TABLE OF CONTENTS

- SECTION 13 1133 -

ELEVATED SWIMMING POOL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions apply to this Section.

1.2 DESCRIPTION

A. This Section includes Pool Contractor Qualifications and Responsibility.

1.3 SUMMARY

A. Extent of swimming pool work includes complete engineering design, fabrication, and installation of fully operating pool of dimensions shown on Drawings, and incorporating features shown and specified. Work includes but is not limited to following:
   1. Reinforcing Steel
   2. Pneumatically placed concrete as Specified in Section 03 3719
   3. Construction and Removal of Forms
   4. Trimming and Finishing
   5. Swimming Pool Ceramic Tile as Specified in Section 09 3013
   6. Deck Equipment and Accessories as Specified in Section 13 1146
   7. Cutouts for Steps, Inserts, and Mechanical Equipment
   8. Building waterproofing as specified in Section 07 1413
   9. Waterproofing as Specified in Section 07 1416 for the pool specific application
   10. Interior Pool Finish as Specified in Section 09 9723
   11. Complete Swimming Pool Filtration and Water Treatment Systems Including Pumps, Valves, Vacuum System, Connectors, and Necessary Pipe and Fittings, and Incidental Components as Specified in Section's 13 1146 and 13 1149.
   12. Pool Start-Up and Initial Maintenance.

B. Related Sections
   1. 03 3719 “Pneumatically Placed Concrete (Swimming Pool)”
   2. 07 1413 “Hot Fluid-Applied Rubberized Asphalt Waterproofing” for building waterproofing prior to additional waterproofing specific to swimming pools
   3. 07 1416 “Cold Fluid-Applied Waterproofing (Swimming Pool)” for additional waterproofing at swimming pools

4. 09 3013 “Swimming Pool Ceramic Tile”
5. 09 9723 “Concrete and Masonry Coatings (Swimming Pool)”
6. 13 1146 “Swimming Pool Accessories”
7. 13 1149 “Swimming Pool Cleaning Equipment”

1.4 POOL CONTRACTOR RESPONSIBILITY

A. The Pool Contractor shall have control and responsibility to the General Contractor for the work required to result in a fully functioning commercial-institutional Public Use Swimming Pool as defined in the Contract Documents.
   1. The General Contractor shall not subcontract any part of the specified Swimming Pool construction or pool equipment to anyone other than a bonded pool subcontractor meeting all requirements of this and related Sections.

B. Pool Contractor shall submit evidence of qualifications to General Contractor with or in advance of his bid to General Contractor so that General Contractor can be assured prior to bid that Pool Contractor complies with following qualification requirements.
   1. Evidence of ability of Pool Contractor to provide Performance and Labor/Maintenance Payment Bond for 100 percent of value of Pool Contract.
   2. Evidence of successful experience in construction of not less than three (3) Public/Semi-Public Use Pools in last five (5) years, (3) suspended pools in last ten (10) years, similar in scope and complexity to pool required for this project with respect to:
      a. Not less than 2000 square feet of water surface area.
      b. Automated chemistry control systems.
      c. Suspended Pool Construction.
   3. Provide list of not less than three (3) comparative Public/ Semi-Public Use Pool facilities complete with verified names, addresses, telephone numbers of Owner representative, Contracting Officer, mechanical, electrical, and plumbing subcontractors, and general contractor.
   4. Provide narrative description of each comparative listed pool facility, including but not limited to date of construction start and completion, water surface area, type of deck or skim gutter system, type and size of filtration system, type and size of water treatment system, and type of automatic control and interlock system.
   5. General Contractor shall submit qualification data provided by Pool Contractor to Contracting Officer not more than ten (10) working days after date of bid opening for evaluation by Government/Owner.
      a. If, in opinion of Owner, submitted data does not provide sufficient evidence Pool Contractor complies with qualification requirements listed, then Contracting Officer may require General Contractor to withdraw initial Pool Contractor and within ten (10) additional working days submit qualification data for substitute Pool Contractor, at no change in bid amount, until qualified Pool Contractor is provided.

1.5 PRODUCT DATA SUBMITTAL

A. Includes manufacturer's material and finish data, installation instructions, and general recommendations for each specified product.
   1. Submit each product item with a completed Submittal Form Cover page to Aqua Design International for review to approve.

2. Aquatic System Submittal Form
   a. www.aquadesigninternational.com/downloads/AquaticSystemSubmittalForm.pdf
3. Aquatic System Submittal Form Example
   a. www.aquadesigninternational.com/downloads/AquaticSystemSubmittalFormExample.pdf

1.6 SHOP DRAWING SUBMITTAL

A. Shop Drawings of each item specified showing layout, profiles, methods of joining, and anchorage details.
   1. Submit each shop drawing with a completed Submittal Form Cover page to Aqua Design International for review to approve.
      a. Use forms called out in "1.5 Product Data Submittal

1.7 WARRANTY

A. The shell of the Swimming Pool and all related work shall be warranted against cracking or failure to hold water for a period of one (1) year from the date of Substantial Completion, provided the pool is kept full of water except for a period of 10 days per year for maintenance, the water table is not above the lowest point of the pool, the structure is not damaged by earthquake, earth or earth fill movement, or conditions not occasioned by the Contractor.

B. All equipment shall be warranted by the manufacturer for a minimum of two (2) years following the date of Substantial Completion.

C. Warrant finish surfaces and finishes for two (2) years against delamination.

D. Organize warranty documents into an orderly sequence based on the table of contents.
   1. Bind warranties in heavy-duty, three-ring, vinyl-covered, loose-leaf binder, thickness as necessary to accommodate contents, and sized to receive 8-1/2 –inch by 11 –inch paper.
   2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide typed description of the product or installation, including the name of the product and the name, address, and telephone number of the installer.
   3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project Name, and name of Contractor.
   4. Scan warranties and assemble complete warranty submittal package into a single indexed electronic PDF file. Provide table of contents at beginning of document.

1.8 OPERATION AND MAINTENANCE MANUALS

A. MANUALS, GENERAL
   1. Organization: Organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
      a. Title page
      b. Table of contents
      c. Manual contents

2. Title Page: Include the following information:
   a. Subject matter included in manual
   b. Name and address of Project
   c. Name and address of Owner
   d. Date of submittal
   e. Name, address, and telephone number of Contractor
   f. Name and address of Architect
   g. Name, address and telephone number of Aquatic Consultant
3. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume and crossed reference to written Specification Section Number.
4. Manual Contents: Organize into manageable size. Arrange contents alphabetically by system, subsystem, and equipment.
   a. Binders: Heavy-Duty, 3-Ring, Vinyl Covered, Loose Leaf. Sized to hold 8-1/2 by 11-1/2 –inch paper with clear plastic sleeve on spine to hold label-describing contents and with pockets inside covers to hold folded oversize sheets.
   b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL", Project title or name. Indicate volume number if more than one manual required.
5. Dividers: Heavy-paper dividers with plastic cover tabs for each section.
6. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for electronic equipment.
7. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

B. OPERATION MANUALS
1. System, subsystem, and equipment descriptions
2. Operating standards
3. Operating procedures
4. Operating logs
5. Wiring diagrams
6. Piped systems diagrams
7. Precautions against improper use

C. MAINTENANCE MANUALS
1. Product information
2. Maintenance Procedures
3. Repair Instructions, materials and sources
4. Re-ordering information
5. Spare Parts List

PART 2 - PRODUCTS

2.1 REFER TO 1.3.B RELATED SECTIONS (THIS DOCUMENT).

PART 3 - EXECUTION

3.1 SECTION NOT USED

- END OF SECTION –

THIS PAGE INTENTIONALLY LEFT BLANK

- SECTION 13 1146 -

SWIMMING POOL ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of Contract, including General and Supplementary Conditions apply to Work in this Section.

B. Related work not in this section:
1. 03 3719 “Pneumatically Placed Concrete (Swimming Pool)”
2. 07 1413 “Hot Fluid-Applied Rubberized Asphalt Waterproofing” for building waterproofing prior to additional waterproofing specific to swimming pools
3. 07 1416 “Cold Fluid-Applied Waterproofing (Swimming Pool)” for additional waterproofing at swimming pools
4. 09 3013 “Swimming Pool Ceramic Tile”
5. 09 9723 “Concrete and Masonry Coatings (Swimming Pool)”
6. 13 1133 “Elevated Swimming Pool”
7. 13 1149 “Swimming Pool Cleaning Equipment”

1.2 DESCRIPTION

A. This Section includes pool equipment and accessories located above bond beam of pool though unrelated to effective circulation, filtration, and sanitation of pool.

1.3 SUMMARY

A. This section includes following Pool Equipment and Accessories:

1. Main Drains
2. Skimmer
3. Wall Inlet Fittings
4. Auto Fill
5. Pool Light
6. Junction Box
7. Pool Light Niche
8. Perimeter Cap Stone
9. Handrail
10. Ladder

11. Compression Anchor
12. ADA Access Lift & Cover
13. Safety Signage
14. Chemical Signage
15. Safety Equipment
16. Portable Pool Vacuum

1.4 QUALITY ASSURANCE

A. Performance: This Section is based on use of products of certain listed manufacturers. However, materials or products by other manufacturers that are specifically prior approved by written Addendum may be used provided they meet specified requirements in respects. Submit requests for Prior Approval (prior to bid) or for Substitutions (after bid) in accordance with Instructions to Bidders.

B. Codes and Standards: Comply with applicable codes and regulations including compliance with requirements of Maricopa County Environmental Services Department (MCESD) for Swimming Pools. Secure necessary stamps of approval there from. Provide only UL labeled electrical components. Provide grounding for equipment in accordance with local building code and National Electric Codes.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's printed data for materials, equipment, and accessories.

B. Shop Drawings: Submit complete shop drawings for fabricated equipment in accordance with Section 13 1133.

C. Product Data: Submit complete product data for manufactured equipment in accordance with Section 13 1133.

D. Proof of Contractor Qualifications: Refer to Section 13 1133 for Pool Contractor Qualifications Requirements.

E. Manuals: Upon completion of this portion of Work, and as condition of its acceptance, submit five (5) copies of maintenance manual compiled in accordance with provisions of Sections 13 1133.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect equipment and accessories during delivery, storage and handling to prevent damage, deterioration, or loss.

1.7 WARRANTY

A. Refer to Section 13 1133 for Warranty requirements on pool work.

PART 2 - PRODUCTS

2.1 MAIN DRAINS

A. Main Drains shall be product of Aqua Star Pool Products. Model: 32CDFL101, White, 32 -inch length, VGB compliant, ANSI/APSP 16-2011 and NSF 50-2008 Rated.
   1. 32 -inch channel drain flat grate anti-entrapment suction outlet cover and 3-port sump.
   2. Floor install: 316 GPM @ 3.90 FT/Sec. (each)
   3. Additional information can be found at: www.aquastarpoolproducts.com

2.2 SKIMMER

A. The skimmer shall be a white U-3 variety with a 2" NPT and 1-1/2" NPT reducers and shall include both float and check valves and a basket. The skimmer shall be the catalogued product of Sta-Rite Industries, part no. 08650-1404-White.
   1. U-3 Skimmer lid to be replaced by product of Stetson Development Inc. Product name: "Pour-A-Lid". www.pouralid.com
      a. Series Model: 201-PAL. Color choice available; Tan, Gray, Frosted & White.
   2. Add deck material to poured area on lid for skimmer lid to match new construction deck.

2.3 WALL INLET FITTINGS

A. Pentair: Complete Insider Inlet Fittings for Concrete Pools; #08429

B. Variable orifice "Eyeball" inlet fitting(s) shall be provided consisting of a Cycolac body, retainer ring, directional ball type nozzle variable orifice inserts and construction shield. The body shall have a 1-1/2", (38.1 mm NOM., I.P.S.) solvent weld connection and provided with an integrally molded "knock-out" membrane to facilitate line pressure testing. A 1-1/4" (31.75mm NOM. I.P.S.) threaded connection provided for a winterizing plug if needed.

C. The directional ball shall be secured to the body with a retainer ring with four 18-8 stainless steel screws and have an adjustment of 45° (0.7854) off centerline in any direction.

D. The directional ball shall have a 1" (25.4mm) diameter orifice. Four additional inserts shall be included; one 3/16" (4.8 mm) dia. orifice; one ½" (12.7mm) dia. orifice; one ¾" (19.1mm) dia. orifice; and one 90° baffled orifice. The inserts shall be secured to the directional ball by two 18-8 stainless steel screws.

2.4 AUTO FILL

A. The auto fill system is a product of “Pour-a-lid Water Level System”
System Includes:

   1. 10" Pour-a-lid with detachable color matched plastic lid.
   2. 1/2 ABS Auto Fill Standard.
   3. 3/4" PVC fitting.
   4. Coordination item: Watts; reduced pressure zone assembly, 1” – Model by MEP.

B. Description:
   1. 10" Pour-a-lid pool and Pond Automatic Water Level System with 1/2" ABS Auto Fill.
   2. Up to 70 psi of water pressure on the float.

C. Part Number: SDI WF 420 PAL White

2.5 POOL LIGHT

A. Pool lights shall be a product of Pentair Pool products; 120 volts, 100 watt, IntelliBrite 5g LED, Model #640142, 100-foot cable.
   1. Lights, niches, and face ring of 300 stainless steel, with water stop on niche. Pool lights shall be UL listed with three No. 16 conductors and waterproof cords of required lengths. Underwater lights shall conform to NEC Article 680-20.

      Verify electrical loads and include values in submittals. Grounding and bonding underwater lights shall conform to NEC Article 680-20. Each light shall be tested and verified with a GFI tester, prior to filling the pool.
   2. For additional information, refer to: www.pentairpool.com

2.6 JUNCTION BOX

A. Junction box for lights shall be a product of Intermatic, Model: PJB-4175.
   1. Polymeric, water tight, multi-fixture Junction Box, especially designed for pools, pool-spa combinations. The PJB4175 provides a safe and reliable connection for up to four lights. Will accommodate flexible cords from #16-3 up to #12-3 and #10-3 in any combination and non-metallic conduits from 1/2 to 1 inch, including one for supply conductor feed.
   2. Each waterproof light cord from light fixture shall be connected to Junction Box with ¾" minimum Red Brass conduit.
   3. Junction Box to be located in Pool Equipment Room.
   4. For additional information, refer to: www.Intermatic.com

2.7 POOL LIGHT NICHE

A. Niche for lights shall be a product of Pentair Pool Products. Small SS Niche, 3/4 -inch Rear Hub. Model: 78244200.
   1. Small stainless steel niches are formed with brass fittings. All niches have internal and external bonding lugs and can be used with either metal or PVC conduit.
   2. For additional information, refer to: www.pentairpool.com

2.8 PERIMETER COPING STONE

A. Coping Stone shall be the cataloged product of Artistic Paver Mfg. with no known equal.

B. Each Coping Stone shall cover the width of the spa beam, plus two (2) inches as a cantilever edge to wet side of spa beam, and maintain a uniform thickness of 1-5/8”.
   1. Coordinate with Architect for best model to match surrounding deck.

C. Coping Stone design criteria:

1. Shall undergo and pass a 50-cycle freeze-thaw test in compliance with ASTM C-67 methods.
2. Shall have a coefficient of friction of 0.70 (dry) and 0.61 (wet) as measured using the Horizontal Diameter Pull Meter methods in accordance with ASTM C1028-84.
3. Shall have a compressive strength of 9,036 psi in accordance with ASTM C-67.
4. Shall have a flexural strength of (717 psi for 24”x24”; 701 psi for 16”x16”, 734 psi for 12”x12”) using the ASTM C-67 testing criteria

D. Quantity: Perimeter of Pool per plans.

2.9 HANDRAIL

A. Hand Rail shall be product of Spectrum Aquatics. Custom design per plans. Alternate models of hand rails will not be considered unless equal to specified product in every respect and must be submitted for approval not less than ten (10) calendar days prior to bid due date. Submittal data must include complete documentation relating to specified features and include manufacturer’s sales literature, specification sheets, installation/operation/maintenance manuals and engineering drawings www.spectrumproducts.com .

1. Handrails shall be configured and positioned in accordance with pool construction drawings.
2. Handrails: shall be fabricated of 1.50 –inch O.D., .120 -inch wall thickness, and series 316 stainless steel.
3. Warranty: Two-year warranty shall be provided for handrails.
4. Spectrum Aquatics: www.spectrumproducts.com

2.10 LADDER

A. The ladder shall be the product of Spectrum Aquatics. Custom design per plans. Alternate models of ladders will not be considered unless equal to the specified product in every respect and must be submitted for approval not less than ten (10) calendar days prior to bid due date. Submittal data must include complete documentation relating to all the specified features and include manufacturer’s sales literature, specification sheets, installation/ operation/ maintenance manuals and engineering drawings.

1. The ladder shall be fabricated of 1.50 inches O.D. x .120 inches wall thickness 316 stainless steel. It is to be provided with two (2) rubber bumpers.
2. Steps: Three (3) step treads shall be provided. They shall be 20 inches wide, have an integral non-slip top surface, and shall be rotationally molded using U.V. stabilized high-density polyethylene.
3. Warranty: The ladder and steps shall each be warranted for two years.
4. Ladder is custom design and shall be configured and positioned in accordance with pool construction drawings.

2.11 COMPRESSION ANCHOR

A. Anchor shall be standard catalogued product of Spectrum Pool Products. Model: 24093.

B. Alternate anchor sockets will not be considered unless equal to specified product in every respect and must be submitted for approval not less than ten (10) calendar days prior to bid due date. Submittal data must include complete documentation relating to specified features and include manufacturer's sales literature, specification sheets, and installation, operation, maintenance manuals.

1. Anchor shall be 6 -inch, Stainless Steel Compression Anchor. 1.50 -inch I.D.
2. Anchor body: anchor body and compression nut shall be fabricated from grade 300 series stainless steel. Anchor compression nut shall incorporate four (4) counter sunk holes to accommodate three-point spanner wrench. Anchor body shall incorporate stainless steel anti-rotation fin. Fin shall be located on anchor body and will prevent anchor from spinning in concrete deck.
3. Bonding: bonding screw shall be provided in anti-rotation fin. Bonding screw shall be 10-24 x 0.50-brass machine screw.
4. Spanner wrench: Anchor spanner wrench sold separately. It shall be fabricated of stainless steel and shall incorporate three hardened roll pins for compression nut contact and tightening. Provide one spanner wrench to owner at pool start up.
5. Warranty: Compression anchor shall be warranted for one year.

2.12 ADA ACCESS LIFT

A. The ADA Access Lift with Anchor shall be a product of Aqua Creek Products. Model: Aqua Creek "Pro Pool" Lift; #F-004PLB-AT1. Lift Cover: #F-422PPC. Lift Transport Cart: #F-428HT.

B. Alternate model lifts not be considered unless equal to the specified product in every respect. Alternative units must be submitted for approval no less than ten (10) calendar days prior to bid due date. Submittal data must include complete documentation relating to all the specified features and include manufacturer’s sales literature, specification sheets, installation/operation/maintenance manuals, engineered drawings and documents supporting the strength, service capacity and the ability to meet the appropriate federal regulatory standards associated with the proposed lift.

C. Manufacturers Qualifications: The assisted access lift shall be the standard product of a company regularly engaged in the manufacture of commercial grade swimming pool and spa accessibility equipment and shall be specifically designed for use in swimming pools and spas.

D. The lift shall be Independently verified to meet the guidelines as specified in section 1009 of the 2010 ADA Accessibility Standards for Buildings and Facilities, ANSI/AAMI ES 60601-1:2005 and clause 27 of the standard for polymeric materials UL 746C by a registered ISO 9001 independent testing laboratory.

E. Lifting Capacity: 450-pounds.

F. Static Load Capacity: 675-pounds.

G. The lifts main structure manufactured of type 304 stainless steel, no dissimilar metallic components shall be allowed. The main structure shall also be coated with a minimum 4-mil thick, UV resistant white epoxy powder coat finish. All fastening hardware shall be of type 316 stainless steel. The lift shall be supplied with a separate wall mounted battery charger, handheld controller and 24-volt battery.

H. The chair of the lift shall be of a rigid one-piece molded design with both a seat bottom and seat back and made of a UV Stabilized Polyethylene material with a minimum seat width of 18-

inches (45.72-cm) and seat back height of 17.5-inches (44.45-cm). The seat shall have both an inner and outer flip-up arm and shall be supplied with a 2-inch wide (5.08-cm) adjustable safety belt with Velcro-type clasps.

I. A footrest shall be provided with the lift and shall be able to be removed, retracted and/or turned out/in so as to provide free movement of user's feet as they enter or exit the seat. The footrest support arm shall be made of 1-inch square tubing, type 304 stainless steel with an epoxy powder coat finish minimum of 4-mils thick and attached to the bottom of the molded seat using a type 316 stainless steel pull-pins. The footrest itself shall be of a one-piece molded design, manufactured of a UV Stabilized Polyethylene material.

J. Warranty: The lift shall be provided with a limited lifetime warranty on the frame and a 5-year warranty on all other structural components and a 5-year pro-rated warranty on all electrical components from the date of purchase.
   1. Lifetime Structural Warranty: (labor and freight excluded)
      a. 100%coverage on replacement or repaired parts
   2. Pro-rated Electronic Component warranty: (labor and freight excluded)
      a. Year 1-2 = 100%coverage on replacement or repaired parts
      b. Year 3 = 60%coverage on replacement or repaired parts
      c. Year 4 = 50%coverage on replacement or repaired parts
      d. Year 5 = 40%coverage on replacement or repaired parts

K. Quantity: One (1) Lift

L. Contact National Aquatic Compliance: www.nationalaquaticcompliance.com

2.13 SAFETY SIGNAGE

A. The following Pool Safety Signs to be provided for installation per code:
   1. Pool Rules – Order from Recreonics #12-202
   2. No Diving – Order from Recreonics #12-206
   3. Warning No Life Guard on Duty – Order from Recreonics #12-213
   4. Emergency Dial 911 – Order from Recreonics #12-205
   5. Pool Person capacity – Order from Recreonics #12-152

2.14 CHEMICAL SIGNAGE

A. The following Pool Chemical Signs to be provided for installation per code:
   1. Authorized personnel Only – Order from Recreonics #12-160
   2. Caution Pool Chemical Storage – Order from Recreonics #12-117

2.15 SAFETY EQUIPMENT

A. The following Safety Equipment to be provided for installation per code:
   1. Shepherds Crooks with 16 ft Pole – Order from Recreonics #12-237
   2. Ring Buoy 24 -inch, White – Order from Recreonics #12-252
   3. Stainless Steel Holder for Ring Buoy – Order from Recreonics #12-259

4. Ring Buoy 30 foot Throw Line – Order from Recreonics #12-260
5. First Aid Kit (Medium) – Order from Recreonics #12-044

2.16 PORTABLE POOL VACUUM

A. Spectra Clean Series, product of Spectrum Pool Products, Wildcat E 1.0, part number 10670. Portable filtration system shall consist of following components:

1. Cart
   a. Portable filtration system cart shall be constructed of 1.25 -inch x .065 -inch wall thickness stainless steel. Metallic components shall be passivated for maximum corrosion resistance. Finished surface shall be polished, number 6 finish. Cart shall be fitted with two (2) 13 -inch pneumatic wheels.
2. Filter
   a. Stainless steel filter canister shall be provided with portable filtration system. It shall be designed to receive 155 square foot single cartridge filter and shall have removable lid.
3. Pump
   a. A 1 horsepower Sta-Rite Dyna Max pump shall be provided. It shall be pre-plumbed to the filter canister and mechanically fastened to the cart.
   b. Shall be pre-wired with 100-foot electrical cord, GFCI shock protector, and 110 Volt AC Switch.
   c. 2" Shut off valves and quick-connect hose fittings shall be provided with the unit.
4. Warranty
   a. Two year limited warranty.
5. Quantity: One (1) required.

PART 3 - EXECUTION

3.1 SECTION NOT USED

END OF SECTION

- SECTION 13 1149 -

SWIMMING POOL CLEANING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of Contract, including General and Supplementary Conditions apply to Work in this Section.

1.2 DESCRIPTION

A. This Section includes pool equipment related to effective circulation, filtration, and sanitation of pool.

B. Related work not in this section:

1. 03 3719 “Pneumatically Placed Concrete (Swimming Pool)”
2. 07 1413 “Hot Fluid-Applied Rubberized Asphalt Waterproofing” for building waterproofing prior to additional waterproofing specific to swimming pools
3. 07 1416 “Cold Fluid-Applied Waterproofing (Swimming Pool)” for additional waterproofing at swimming pools
4. 09 3013 “Swimming Pool Ceramic Tile”
5. 09 9723 “Concrete and Masonry Coatings (Swimming Pool)”
6. 13 1133 “Elevated Swimming Pool”
7. 13 1146 “Swimming Pool Accessories”

1.3 SUMMARY

A. This section includes following Pool Equipment and Accessories:

1. Circulation Pump
2. Circulation Filter
3. Filter Backwash Valve
4. Chlorine Generator
5. CO2 pH Control System
6. Chemistry Controller
7. Backup Chlorine System
8. Ozone System
9. Time Clock

10. Surge Tank
11. Multiport Valves
12. Flow Meter/Check Valve
13. Ball Valves
14. Pipe Insulation
15. Structural Foam

1.4 QUALITY ASSURANCE

A. Performance: This Section is based on use of products of certain listed manufacturers. However, materials or products by other manufacturers that are specifically prior approved by written Addendum may be used provided they meet specified requirements in respects. Submit requests for Prior Approval (prior to bid) or for Substitutions (after bid) in accordance with Instructions to Bidders.

B. Codes and Standards: Comply with applicable codes and regulations including compliance with requirements of Maricopa County Department of Environmental Services for Swimming Pools and Spa. Secure necessary stamps of approval there from. Provide only UL labeled electrical components. Provide grounding for equipment in accordance with local building code and National Electric Codes.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's printed data for materials, equipment, and accessories.

B. Shop Drawings: Submit complete shop drawings for fabricated equipment in accordance with Section 13 1133.

C. Product Data: Submit complete product data for manufactured equipment in accordance with Section 13 1133.

D. Proof of Contractor Qualifications: Refer to Section 13 1133 for Pool Contractor Qualifications Requirements.

E. Manuals: Upon completion of this portion of Work, and as condition of its acceptance, submit five (5) copies of maintenance manual compiled in accordance with provisions of Sections 13 1133.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect equipment and accessories during delivery, storage and handling to prevent damage, deterioration, or loss.

1.7 WARRANTY

A. Refer to Section 13 1133 for Warranty requirements on pool work.

PART 2 - PRODUCTS

2.1 CIRCULATION PUMP

A. The Pool circulation pump shall be the cataloged product of Pentair Pool Products, Model: Whisperflo, Part: WFE-4, #011513. Horse Power: One (1), Voltage: 208. Amperage: 7.8-7.4, Port Size: 2 Inch x 2 Inch.

1. Type: Self priming, extra close coupled, horizontally mounted, single-stage, centrifugal pump with non-overloading characteristics for capacity, head and service as indicated and complying with the following requirements.
2. Pump Casing: Centerline discharge, foot supported, back pull-out design, threaded connections, and constructed of Noryl thermoplastic. Casing shall be provided with tapped and plugged holes for venting, drain, and gauge connections.
3. Impeller: Noryl thermoplastic single-suction enclosed type, statically and hydraulically balanced.
4. Seal: Pump shall be provided with a heavy duty ceramic and carbon mechanical shaft seal for leak less operation with suitable arrangement to provide an adequate portion of the pumped liquid to lubricate and cool the sealed faces. Mechanical seal shall be suited for the service indicated.
5. Hair & Lint Strainer: Noryl thermoplastic body, with commercial size 6-inch diameter basket type strainer having an open area equal to 5-times the suction port unless otherwise shown.
6. Pump Base: Integral with single piece strainer pot and volute.
    a. Pump Motor: Commercial grade 56 frame, energy efficient, continuous duty swimming pool motor, shaft of rust proof 303 grade stainless steel, sealed and permanently lubricated ball bearings, horsepower and voltage indicated. Motor horsepower's' shown are estimated minimum and larger motors shall be furnished if necessary to meet the non-overloading requirements.

2.2 CIRCULATION FILTER

A. Filter shall be Pentair Pool Product, Triton Sand, 4.9 SqFt TR100C, product number: 140315.

B. Media: Graded filter media shall be washed, cleaned and properly graded to allow greater distribution during backwash and reduce head loss through filter bed while filtering. Media shall be of quartzite or silica in nature, hard, not smooth, and free of insoluble particles. 90-95% insoluble in warm muriatic acid. It must have uniformity coefficient of 1.7 in .45-.55 mm fine sand. Not more than 1% clay, loam dust, or other foreign materials allowable. Media shall be shipped in 100 lbs. or 50 lbs. bags and properly labeled showing grade therein. Tank shall be carefully loaded with media to prevent damage to effluent header/lateral assembly. Each grade of media shall be struck smooth with straight edge and level before placing next grade of media in tank. Media shall consist of three (3) grades in required quantities. Filter media shall be .45-.55 mm in size with support gravel of 1/8"-1/4", followed by bottom layer of 1/4 -inch-1/2 -inch rock.

C. Entire filter system shall be National Sanitation Foundation (NSF) listed.

D. Filter Sight Glass

1. The backwash sight glass shall be the cataloged product of Hayward Pool Products, model no. SP1074S. The sight glass shall be 2" in diameter with and shall be in-line, constructed of ABS material.

2.3 FILTER BACKWASH VALVE

A. Backwash Valve shall be Pentair Pool Product, PVC Slide Valve, Model # 263010. 2 inch, 7-1/2 -inch center. Full flow valve works only on the TR100C Filter.

2.4 CHLORINE GENERATOR

A. The chemical sanitizer shall for the pool or spa shall be sodium hypochlorite, generated on-site in an off-line installation. The ChlorKing® chlorination system shall be NSF International Standard 50 listed, UL 1081 listed, and certified for use in pools and spas. The electrical wiring, breakers, and disconnect boxes provided at the facility shall be UL listed components. The chlorination system shall be ChlorKing® Model No. CHLOR-2.5. maximum primary amps: 9.9, 110 volts, 20 amp breaker required.

1. The chlorination system is charged by the addition of salt (sodium chloride) into the body of water to a concentration of 0.5% (5000ppm) saline (40lbs/1000 gallons of water).
2. The chlorination system will produce 2.5 lbs per day of equivalent chlorine as a dilute solution of sodium hypochlorite.
3. The chlorination system is capable of functioning in temperatures between 15C and 40C. The chlorination system is capable of functioning with salt concentrations between 4000ppm and 6000ppm.
4. Chlorine delivery is controlled by a bypass side stream, plumbed into the return line, using a bypass valve to optimize flow. The minimum amount of flow through the ChlorKing® cell is 20gpm, the flow switch is activated at 3gpm. The maximum amount of pressure through the cell is 30psi per NSF International specification.
5. The chlorination system shall be pre-mounted on an aluminum backboard with dimension of: 42-1/2" x 16" (Electrical) / 8"x5" (Cell Housing). The system shall be pre-wired, ready for field connection of power tied to the pool pump and control circuits. The chlorination system shall be bonded via the bonding lug to the local common bonding grid. The bonding connector shall be conductively connected to the grounding means. The chlorinator power supply shall be water cooled and shall have no fans. The plumbing of the cell shall be done at the time of installation.
6. The ChlorKing® system shall be capable of satisfactory performance if installed as per the manufacturer's recommendations (reference the ChlorKing® installation manual). An authorized representative shall be located within a reasonable distance of the facility and shall be available to install and service the system as required.
7. The ChlorKing® system shall have salt concentration displayed in PPM measured using a toroidal probe.
8. The manufacturer warrants the electrical components of the ChlorKing® system to be free of defects for one year from the date of installation. The manufacturer warrants the electrode plates of the ChlorKing® system to be free of defects for one year from the date of installation. The manufacturer warrants assembly of electrical components and cell housings of the ChlorKing® system to be free of defects in workmanship for three years.

2.5 CO2 PH SYSTEM:

A. System components: Storage Tank, Fill Box, Regulator, CO2 Injection, Flow Meter, Ball Valve, CO2 Monitor.

B. Storage Tank

1. Pool: Mizer-300, 300 lb/ 32 Gallon fill capacity, Part #20680774
2. Source: Chart Industries

C. Fill Box – Coordinate Fill Box location

1. Flush Mount, P/N# 9722279
2. Source: Chart Industries

D. Regulator:

1. Pressure Regulator, Hayward-Cat: AC005.
2. CO^2 Regulator on pool, spa & fountain shall be cataloged product of Hayward Pool Products (CAT Controllers), model no. AC005 with operating voltage of 120V and amperage draw of one amp. CO^2 pH Control System shall be manufactured from machined brass allowing for inlet pressure of 0 – 1500 PSIG and outlet pressure of 80 PSIG using piston and PTFE actuation seat with internal safety relief valve. CO^2 pH Control System shall include 6 foot SJTW grounded power cord, 30 feet of installation tubing, stainless steel, normally-closed solenoid valve, and ¼" NPT injector check valve.
3. Source: Hayward Commercial
4. Quantity: Two (2) required.

E. CO2 Injection

1. Static Mixer
   a. Product of "Koflo Corporation"; Static Mixer constructed of schedule 80 grey PVC with 12-inch mixing element
   b. Model 1-80-4-12-2
   c. Refer to: www.koflo.com for further information

F. Flow Meter

1. Blue White Flow Meter, D-300 Series
   a. Mounting on Vertical Pipe, 1-1/2 inch pipe size, 9 – 30 GPM Flow Range.
   b. Product of Blue-White, Model: D-30150-PR
   c. www.blue-white.com

G. Ball Valve

1. True Union Ball Valves, Product of Spears manufacturing.
   a. All thermoplastic ball valves shall be True Union type produced from PVC Type I, ASTM D-1784 Cell Classification 12454 or CPVC Type IV, ASTM D-1784 Cell Classification 23447. All O-rings shall be EPDM or Viton®. All valves shall have Safe-T-Shear® stem and double stop Polypropylene or CPVC handle. All valve union nuts shall have Buttress threads. All seal carriers shall be Safe-T-Blocked.

b. All valve components shall be replaceable. All EPDM valves shall be certified for potable water use by NSF International. All 1/2" through 2" socket and threaded valves shall be pressure rated to 235 psi, all 2-1/2" through 6" valves and all flanged valves shall be pressure rated to 150 psi for water at 73°F, as manufactured by Spears® Manufacturing Company.

2. True Union Ball Valve, CPVC, 1-inch, #2329-010C

3. Quantity: Two (2) required.

4. www.spearsmfg.com

H. CO2 Monitor

1. Shall be a product of Chart Industries, Model# Analox 50. Each kit includes Detector, Repeater with high-intensity LED alert, and Relay on Alert 1, 25' plug-in repeater cable (standard networking cable), installation kit, and two warning signs.

2. Specifications

a.	Ranges:	0.1 – 5%
b.	Repeatability:	2% Full Scale
c.	Technique:	Infrared Absorption
d.	Response Time:	<45 seconds T90
e.	Dual Alarms Visual:	Alarm 1 & 2 Visual Red
f.	Audio:	80 db audio alarm
g.	Operating Temp:	23 to 113° F
h.	Power:	110/240 VAC or 9-24 VDC
i.	Dimensions:	6.9 x 4.3 x x3.0 (In)
j.	Protection:	IP 65. CE Marke.

3. Quantity: One (1) required.

I. CHART Industries: 1-770-704-8615. Contact: Bob Brantley for supplier and installer in local area. Refer to: www.chartindustries.com

2.6 CHEMISTRY CONTROLLER

A. Water Chemistry Controller Package - microprocessor based water chemistry controller shall be provided to automatically monitor and adjust water chemistry based on pH and ORP electrodes. System will include controller, pH and ORP sensors, temperature sensor, flow cell, and flow sensor pre-mounted on PVC backboard. System shall be CAT 2000, 208 Volt, as manufactured by CAT Controllers, Inc. Hayward Commercial Pool Products (800-657-2287), or approved equal, which meets or exceeds these bid specifications.

1. Inputs - inputs to controller shall be made by connectors permanently mounted on unit. No user access to inside of housing is required to connect sensors during installation. pH sensor input will cover range 1.0-9.95 pH with .1 resolution. Controller shall be capable of activating chemical feeders to increase and decrease pH based on set point. ORP sensor input will cover range 5-995 mV with resolution and accuracy of 1mV. Controller shall be capable of activating chemical feeders to increase sanitizer levels. No calibration of ORP is allowed.

2. Display - controller programming and functions shall be displayed on alphanumeric display of two (2) lines by twenty (20) characters vacuum florescent display. Vacuum florescent display provides bright blue-green light emitting display easily read in outdoor or indoor installations.
3. Operating Menu - Setup features are accessible by second menu level and include: pH control mode, pH priority, pH feed, pH set point, pH overfeed timeout, ORP feed, ORP high and low alarm points, ORP overfeed timeout, Display System Information, System Reset, Restore Factory Defaults, two (2) programmable auxiliary relays.
4. Alarms - Audible, visual and email, and text message alarm notifications will be provided for alarm conditions and will be enumerated on controller display.
5. Sensors - Heavy-duty long life combination pH and ORP sensors will be provided with minimum warranted life expectancy of two (2) years.
   a. Package - controller, flow cell, and flow sensor will come pre-mounted on 16"x18" white PVC backboard to facilitate installation. 30 -feet of 3/8 -inch OD flexible tubing and 1/4 -inch NPT connectors will be provided for installation.
6. Warranty - controller shall be housed in non-metallic NEMA 12X rated enclosure suitable for outdoor use. Controller shall be warranted for 5-years.

2.7 BACKUP CHLORINE SYSTEM

A. Feed Pump.

1. Manufacturer: Stenner Pump Company, model number 45MPHP10
2. 100 psi (6.9 bar) Single Head Fixed Output Pump maximum 10 gallons per day (gpd).
3. Stenner's fixed output metering pump is built with two detachable components: the motor and pump head. Outputs are dependent upon the rpm of the motor gears and the size of the peristaltic pump tube. The fixed rate pump has no output adjustment. All Stenner metering pumps have a 3-point roller design in the pump head, which acts as a check valve to prevent back flow, siphoning, overdosing and loss of prime.
4. The motor's output shaft rotates at a fixed rpm which drives the roller assembly within the pump head. The chemical solution in the pump tube is captured between the rollers as they rotate and compress the tube. As the rollers advance, the squeezed tube section regains its original form and generates a vacuum, creating the self-priming feature that delivers a constant flow unaffected by the outlet pressure.
5. Quantity: One (1) required.
6. www.stenner.com.

B. Feed Pump Tank

1. The feed tank shall be a product of Stenner Pump Company, model number STS15GC - 15 gallon.
2. The tank shall be manufactured with Polyethylene and shall be NSF/ANSI 61 approved. It shall be manufactured using Viton grommets, and stainless steel screws with a polypropylene, child resistant locking lid.
3. The STS tank shall be made available in Gray.
4. Quantity: One (1) required.

2.8 OZONE SYSTEM

A. CLEARWATER TECH OZONE GENERATOR

1. Ozone Generator shall be product of Clear Water Technologies; Model: CD12, Apex VI package.

    a. Pressurized, corona discharge ozone generator with dual reaction chamber design. Delivering high ozone output, it operates at 10-PSI cell pressure with built-in pressure gauge and flow meter. 120 volt, 60 Hz, 4.25 amps, single phase.
    b. Dedicated 20 Amp Service.
    c. Dimensions: 21.5" h x 11.5" w x 5.0" d, 14.5 lbs.
    d. Ozone Output: 8 grams/hour @ 8 SCFH on oxygen
    e. Contact Clear Water Technologies for additional information www.cwtozone.com.

2. Ozone Off-Gas Unit; Model OCD11, (Two Components): Two-stage ozone system is an efficient way to properly vent the contact vessel for indoor applications.
    a. Ozone Destruct Unit. A heated chamber filled with manganese dioxide and copper oxide.
    b. Water Trap.

B. OZONE SOLUTIONS OZONE DETECTION SYSTEM

1. Ozone Detector shall be product of Ozone Solutions Inc. Model: C-30ZX Mounted in EE-2 Enclosure allows placement in harsh environments; still providing accurate ozone readings. Ozone Detection Monitor is easy-to-use monitor and controller for low-ozone environments.

    a. Range: 0.02 - 0.14 ppm (20 - 140 ppb)
    b. Accuracy: +/- 10% 10 to 20%
    c. Resolution: 0.01 ppm (10 ppb)
    d. Display Units: ppm
    e. Response Time: 10 Seconds
    f. Detection Methods: HMOS
    g. Display: Bar Graph
    h. Alarm: Audible; 85db Audible
    i. Internal Data logging: Yes
    j. Analog Outputs: 0-3 V
    k. Digital Outputs: None
    l. Temperature Range: 60 to 80°F (15.56 to 26.67°C)
    m. Humidity Range: 0 to 80%
    n. Battery: 12 - 24 VDC 0.3
    o. Electrical: 120 VAC 60 Hz
    p. Dimensions: 3.5 x 1.5 x 2.5 inches (8.9 x 3.8 x 6.4 cm)
    q. Weight: 0.31 lbs (0.14 kg)

2. Ozone Detection system includes Remote Alarm panel, product of Ozone Solutions Inc. Model: RAP-2. Alarms when signals from ozone monitors or ozone sensor reaches preset limit or set-point. Alarms are red strobe light and loud audible alarm. RAP-2 also

outputs its input signal in 4-20 mA form for building automation systems.

a. Electrical: 14 - 30 VAC 60 Hz or DC power
b. Dimensions: 7 x 5 x 5.8 inches (17.8 x 12.7 x 14.7 cm)
c. Additional information can be found at: www.ozonesolutions.com

2.9 TIME CLOCK

A. Time Clock, product of Intermatic. Series PF1100.

1. Suitable for Pool Lighting Control.
2. Input voltage: 120 volt - 60 hz or 240 volt - 60 hz.
3. Electrical rating: 1.5 hp - 120-volt ac, 3 hp - 240 volt ac.

2.10 SURGE TANK

A. Surge Tank a product of Vak-Pak, www.vakpak.com, Model CT350. Used to support back washing.

2.11 MULTIPORT VALVES

A. Jandy 2”-2-1/2”, 2-Port NeverLube Valve, Max working pressure: 50 psi. Chlorine, Acid & Ozone resistant.

B. Jandy 2”-2-1/2”, 3-Port NeverLube Valve, Max working pressure: 50 psi. Chlorine, Acid & Ozone resistant.

2.12 FLOW METER/CHECK VALVE

A. Flow Meter-Check Valve shall be product of H2Flow. Model: FlowVis. FlowVis is specifically designed for use in swimming pools, spas, fountains and water feature operations.

1. FlowVis is not affected by flow stream disturbances caused by its proximity to pumps, elbows, tees and valves. FlowVis does not require specific straight pipe lengths before or after its point of installation and can be installed close to, or even adjacent to other plumbing fittings. FlowVis can be installed either horizontally or vertically.
2. Materials used:
   a. Valve Cover: Screws Stainless Steel
   b. Valve Body: CPVC Plastic, Chlorine, Acid resistant
   c. Valve Lid: Poly Carbonate (PC), Chlorine, Ozone resistant
   d. Calibrated Spring: Stainless Steel
   e. Pivot Pin: Stainless Steel
   f. O’ Ring: Silicone-Lubricated Elastomer.

3. Operation:
   a. Design Accuracy: +/- 2 GPM over operating range
   b. Design Life: Greater than 7 years
   c. Minimum operating ambient temperature: 32°F (0°C)
   d. Maximum operating ambient temperature: 140°F (60°C)
   e. Periodic Calibration: None required

2.13 BALL VALVES

A. Ball Valves shall be True Union and a product of Hayward Pool Products. PVC, (1” to 2-1/2”), with Viton Seals and Teflon Seats.

2.14 PIPE INSULATION

A. Swimming Pool and Spa pipe insulation shall be product "Micro-Lok HP", high performance fiber glass pipe insulation by Johns Manville, www.specJM.com.

B. All piping shall be insulated with pre-formed fiber glass pipe insulation, complying with ASTM C 547, Class 3 (to 850°F [454°C]), rigid, molded pipe insulation, noncombustible.
   1. Thermal Conductivity (“k”): 0.23 Btu•in/(hr•ft2•°F) at 75°F mean temperature (0.033 W/m•°C at 24°C) per ASTM C 518.
   2. Maximum Service Temperature: 850°F (454°C).
   3. Rated 25/50 per ASTM E 84, UL 723 and NFPA 255.
   4. When being used over stainless steel, product must comply with the requirements of ASTM C 795.
   5. All-Service (ASJ) Vapor-Retarder Jacket: A white, kraft paper, reinforced with a glass fiber yarn and bonded to an aluminum foil, with self-sealing longitudinal closure laps (SSL) and butt strips.

C. Field-Applied Jackets:
   1. PVC Plastic: Zeston® 2000 Series. One piece, molded type fitting covers and jacketing material, gloss white.
      a. Connections: Tacks, pressure sensitive, color matching, vinyl tape.
   2. Aluminum Jacket: 0.016" (0.41 mm) thick sheet, (smooth/ embossed) finish, with longitudinal slip joints and 2" (51 mm) laps, die-shaped fitting covers with factory-attached protective liner.
   3. Stainless Steel Jacket: Type 304 stainless steel, 0.10" (2.54 mm), (smooth/ corrugated) finish.

D. FITTINGS, VALVES, TEES, ETC.
   1. All fittings, valves, tees, flanges, connections, etc. shall be insulated and covered with the appropriate Zeston 2000 PVC insulated fitting cover.
      a. Fittings shall be manufactured from ultraviolet- resistant PVC.
      b. Connections: Tacks, pressure sensitive, color matching, vinyl tape, Perma-Weld® Adhesive.

2.15 STRUCTURAL FOAM

A. MANUFACTURERS

1. Acceptable Manufacturer: Insulfoam, a Carlisle Company, which is located at: 6004 N. Westgate Blvd. Suite 120 ; Tacoma, WA 98406; Toll Free Tel: 800-248-5995; Tel: 253-572-5111; Fax: 425-251-8405; Email: request info (info@insulfoam.com); Web: www.insulfoam.com.

B. MATERIALS

1. Geo-Synthetic Fill: InsulFoam GF shall conform to ÅSTM D 6817 and may be fabricated using material with recycled content. Blocks shall have a height of at least 36 inches (.91 m), a width of at least 48 inches (1.22 m), and length of at least 96 inches (2.44 m). Blocks shall be within tolerances of 0.5 percent of respective height, width and length dimensions. Additional field and/or shop trimming and cutting shall be required as necessitated by the geometry of the fill being constructed.
   a. Type EPS29: Physical Properties when tested in accordance with ÅSTM D 6817 shall be:
      1) Density shall be a minimum of 1.80 lb/ft3 (28.8 kg/m3), when tested in accordance with ÅSTM D 1622.
      2) Compressive Resistance at 1 percent deformation shall be a minimum of 10.9 psi (75 kPa) when tested in accordance with ÅSTM D 1621.
      3) Flexural Strength shall be a minimum of 50.0 psi (345 kPa) when tested in accordance with ASTM C 203.
      4) Elastic Modulus shall be a minimum of 1090 psi (7500 kPA) when tested in accordance with ÅSTM C 203.
      5) Oxygen Index shall have a minimum volume of 24.0 percent when tested in accordance with ASTM C 2863.
   b. Connectors: Connectors shall be galvanized steel multi-barbed connectors or a urethane adhesive as recommended by the manufacturer. Each connector shall have a lateral holding strength of at least 60 lbs (27.22 kg) when tested with an EPS15 Geofoam.

PART 3 - EXECUTION

3.1 SECTION NOT USED

- END OF SECTION –

THIS PAGE INTENTIONALLY LEFT BLANK

DIVISION 14 – CONVEYING EQUIPMENT

TABLE OF CONTENTS

- SECTION 14 2100 -

ELECTRIC TRACTION ELEVATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes multiple electric traction passenger and service elevators controlled with a non-proprietary control system.

1.3 RELATED REQUIREMENTS

A. Marriott Standards; Module 12 Elevators as follows:
   1. Marriott, Courtyard, Module 12 Elevators. Revised January 2011.
   2. Marriott, Residence Inn, Module 12 Elevators. Revised July 2011.

B. Section 01 5000 "Temporary Facilities and Controls" for temporary use of elevators for construction purposes.

C. Section 03 3000 "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.

D. Section 05 1200 "Structural Steel Framing" for the following:
   1. Attachment plates, angle brackets, and other preparation of structural steel for fastening guide-rail brackets.
   2. Divider beams.
   3. Hoist beams.

E. Section 05 5000 "Metal Fabrications" for the following:
   1. Structural-steel shapes for subsills.
   2. Pit ladders.
   3. Divider screens between adjacent elevator pits.

F. Section 05 5300 "Metal Gratings" for the following:
   1. Pit sump grating.

G. Division 9 for finish flooring in elevator cars. See Architectural Drawings for specific floor finishes.

H. Division 22 for piping, valves and sump pumps in elevator pits. See Plumbing Drawings, including Sheets P3.0 and P7.1 for additional direction.

I. Division 27, Section 27 1000 "Structured Cabling" for telephone service for elevators and for Internet connection to elevator controllers for remote monitoring of elevator performance.

J. Division 28, Section 28 3000 “Fire Alarm and Detection System” for smoke detectors in elevator lobbies to initiate emergency recall operation and heat detectors in shafts and machine rooms to disconnect power from elevator equipment before sprinkler activation and for connection to elevator controllers.

1.4 DEFINITIONS

A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.

B. Service Elevator: A passenger elevator that is also used to carry freight.

1.5 ACTION SUBMITTALS

A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for car enclosures, hoistway entrances, and operation, control, and signal systems.

B. Shop Drawings:

1. Include plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment.
2. Include large-scale layout of car-control station and standby power operation control panel.
3. Indicate maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.

C. Samples for Initial Selection: For finishes involving color selection.

D. Samples for Verification: For exposed car, hoistway door and frame, and signal equipment finishes; 3-inch (75-mm-) square Samples of sheet materials; and 4-inch (100-mm) lengths of running trim members.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Seismic Qualification Certificates: For elevator equipment, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service including standby power generator, as shown and specified, are adequate for elevator system being provided.

D. Sample Warranty: For special warranty.

E. Flame spread and Smoke developed ratings for all cab interior finishes.

F. Radiant Flux (CRF) ratings for cab interior flooring assembly.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 01 7823 "Operation and Maintenance Data," include diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.

B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

C. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard two (2) year maintenance agreement, starting on date initial maintenance service/warranty is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1. Submit the Continuing Maintenance Proposal at the time of Bid to include all elevators on this project.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Elevator manufacturer or an authorized representative who is trained and approved by manufacturer to install or service the elevator equipment with not less than five (5) years of satisfactory experience installing.

B. Manufacturer Qualifications: An approved manufacturer with minimum (5) years experience in engineering and manufacturing elevators of the type required for the project. The entire elevator installation shall be manufactured, installed and maintained by an acceptable manufacturer as listed in Part 2 of this Section.

1. The manufacturer shall manufacturer the machines and control systems which must be available for sale to any elevator contractor. Likewise, any elevator contractor must be able to purchase replacement materials at a published price and be able to obtain technical support service from the manufacturer.

a. Equipment proposed must have a history of successful operation under similar conditions for the last two (2) years

2. The manufacturer shall have a documented, on-going quality assurance program.

C. Maintenance Qualifications: Performed by manufacturer installing elevator:
   1. Show evidence of successful experience in complete maintenance of elevators.
   2. Directly employ sufficient competent personnel within 50 miles of project to handle service.
   3. Maintain local stock of parts adequate for replacement on permanent or emergency basis.
   4. Respond to trouble calls within one hour.
   5. Offer the Owner agreement for continuing maintenance after expiration of maintenance period under this contract.

D. Requirements of Regulatory Agencies:
   1. Codes: In accordance with the latest applicable edition requirements of the following and as specified:
      a. ASME A17.1 Safety Code for Elevators and Escalators, latest edition or as required by the local building code.
      b. NFPA 70 National Electrical Code.
      c. NFPA 80 Fire Doors and Windows.
      d. NEC: National Electric Code.
      e. Americans with Disabilities Act - Accessibility Guidelines (ADAAG)
      f. IBC: International Building Code.
         1) “Phoenix Building Construction Code”, International Building Code 2006, with City of Phoenix administrative provisions and amendments.
      g. CCR: Titles 8; California Code of Regulations.
      h. Section 407 in ICC A117.1, when required by local authorities.
   2. Permits: Arrange and pay for inspections by governing authorities and obtain operating permits.

E. Fire-Rated Entrance Assemblies: Opening protective assemblies including frames, hardware, and operation shall comply with ASTM E2074, UL10 (b), and NFPA Standard 80. Provide entrance assembly units bearing Class B or 1 1/2 hour label by a Nationally Recognized Testing Laboratory.

F. Inspection and Testing:
   1. Elevator Installer shall obtain and pay for all required inspections, tests, permits and fees for elevator installation.
   2. Arrange for inspections with the AHJ and make required tests.
   3. Deliver to the Owner and Architect upon completion and acceptance of elevator work.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

1.10 COORDINATION

A. Coordinate installation of sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates,

sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.

B. Coordinate locations and dimensions of other work relating to electric traction elevators including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways, pits, and machine rooms.

C. Coordinate with interior Cab architectural finishes as indicated on Drawings.

1.11 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
2. Warranty Period: One (1) year from date of Substantial Completion.
3. Tile floor warranty in accordance with Division 9 tiling specifications.

1.12 MAINTENANCE

A. Furnish maintenance and call back service for a period of 12 months for each elevator from date of Substantial Completion.

1. Service shall consist of periodic examination of the equipment, adjustment, lubrication, cleaning, supplies and parts to keep the elevators in proper operation. Maintenance work, including emergency call back repair service, shall be performed by trained employees of the elevator contractor. Elevator installer shall provide 24 hour emergency service at no cost to the Owner.
2. Service shall include 24 hour telephone technical support for length of warranty period.
3. Submit parts catalog and show evidence of local parts inventory with complete list of recommended spare parts. Parts shall be produced by manufacturer of original equipment.
4. Special tools required in the maintenance of the elevators shall be turned over to the Owner. Special tools include, but are not limited to, software and codes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers shall be one of the following:

1. Motion Control Engineering
2. Fujitec Elevator Company
3. KONE Elevator Company.
4. Otis Elevator Company.
5. ThyssenKrupp Elevator Company.

B. Source Limitations: Obtain elevators, including hydraulic passenger elevators specified in Section 14 2400, from single manufacturer.

1. Major elevator components, including driving machines, signal fixtures, door operators, car frames, cars, and entrances, shall be manufactured by single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.

B. Accessibility Requirements: Comply with Section 407 in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.

C. Elevator Cab Finishes: (Flame Spread, Smoke Developed and CRF)

1. Compliance Standards:
   a. ASME A17.1 Safety Code for Elevators and Escalators.
   b. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
   c. ASTM E648 Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
   d. ANSI/UL 723 “Test For Surface Burning Characteristics of Building Materials” and Flammability Ratings.
   e. NFPA 252 Standard Methods of Fire Tests of Door Assemblies.
2. Performance: (High Rise buildings)
   a. Walls and Ceilings:
      1) FS (Flame Spread): 0-25
      2) SD (Smoke Developed): 0-100
   b. Floors:
      1) FS (Flame Spread): 0-300
      2) SD (Smoke Developed): 0-300
      3) CRF (Radiant Flux: 0.45 W/cm² as measured by ASTM E648 for floor covering, underlayment and adhesive

2.3 MATERIALS, GENERAL

A. Aluminum: Alloy and temper best suited for anodizing finish specified.

B. Glass: Laminated Safety Glass meeting ANSI Z97.1.

C. Nickel Silver: CDA Alloy 796, leaded nickel silver.

D. Plywood: PS-1, A-D exterior Grade Douglas Fir, fire retardant treated.

E. Sheet Steel: ASTM A366, uncoated, pickled, free from defects.

F. Sound Deadener: Fire retardant; spray, roller or adhesive applied; 3/16 inch thick.

G. Stainless Steel: ASTM A167; type 302 or 304.

2.4 ELEVATORS

A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturer's standard components shall be used, as included in standard elevator systems and as required for complete system.

B. **Passenger Elevators No. E-1 & E-2**

1.	Basis of Design:	MCE Freedom, MR Series
2.	Type:	OHT; Gearless Electric Traction, Passenger
3.	Capacity:	3500 lb (1589 kg)
4.	Speed:	500 fpm
5.	Stops:	19, (ground floor thru 19th floor)
6.	Openings	
	a. Front	19
7.	Travel:	219’- 4”
8.	Control:	ACPM gearless
9.	Operation System:	Motion 4000 or iControl non-proprietary controls with regenerative drives.
10.	Operation:	Group automatic operation with demand-based dispatching (combined with E-3)
11.	Machine Location:	Overhead, 21st floor (Machine Rm./Mechanical Roof)
12.	Special Operations:	
	a. Independent Service	
	b. Fire Emergency Service	
	c. Standby Emergency Power	
	d. Anti-Nuisance Service	
	e. Tenant Security, Card Reader	
	f. Car-to-Lobby Feature	
13.	Car Enclosure Type:	Passenger
	a. Inside Clear	6’-9” W by 5’-8” D by 9’-0” H
	b. Platform Size	7’-0” W by 6’-2” D by 10’-0” H
14.	Signals and Fixtures	Design as Specified
	a. Car Operating Panels	1 Per Car; Applied Type
	1) Style:	Prestige (PB30), by Freedom
	b. Car Position Indicator	Integral with Each Car Panel
	c. Communication Sys.	Integral with Car Panel
	d. Service Cabinet	Integral with Car Panel
	e. Hall Pushbuttons	1 Riser
	f. Hall Lanterns	All Floors
	g. Hall Pos. Indicators	Main Floor
15.	Passenger Entrance Type	Center Open, Single Speed
	a. Size	3’-6” W by 8’-0” H
	b. Frames	Satin Stainless Steel
	c. Doors	Satin Stainless Steel

	d.	Sills	Nickel silver, polished
16.	Power Characteristics:		480v, 3 Phase, 60Hz.
17.	Miscellaneous Items:		
	a.	Disabled Access Requirements	
	b.	Key Operated Hoistway Access	
	c.	Dual Smart/Magnetic Stripe Car Reader	

C. **Passenger Elevator No. E-3** (Gurney Compliant)

1.	Basis of Design:		MCE Freedom, MR Series
2.	Type:		OHT; Gearless Electric Traction, Passenger
3.	Capacity:		3500 lb (1589 kg)
4.	Speed:		500 fpm
5.	Stops:		20, (basement thru 19th floor)
6.	Openings		
	a.	Front	20
7.	Travel:		229'- 4"
8.	Control:		ACPM gearless
9.	Operation System:		Motion 4000 or iControl non-proprietary controls with regenerative drives.
10.	Operation:		Group automatic operation with demand-based dispatching (combined with E-1 & E-2)
11.	Machine Location:		Overhead, 21st flr. (Machine Rm./Mechanical Roof)
12.	Special Operations:		
	a.	Independent Service	
	b.	Fire Emergency Service	
	c.	Standby Emergency Power	
	d.	Anti-Nuisance Service	
	e.	Security Features: Card Reader	
	f.	Car-to-Lobby Feature	
13.	Car Enclosure Type:		Passenger
	a.	Inside Clear	6'-9" W by 5'-8" D by 9'-0" H
	b.	Platform Size	7'-0" W by 6'-2" D by 10'-0" H
14.	Signals and Fixtures		Design as Specified
	a.	Car Operating Panels	1 Per Car; Applied Type
		1) Style:	Prestige (PB30), by Freedom
	b.	Car Position Indicator	Integral with Each Car Panel
	c.	Communication Sys.	Integral with Car Panel
	d.	Service Cabinet	Integral with Car Panel
	e.	Hall Pushbuttons	1 Riser
	f.	Hall Lanterns	All Floors
	g.	Hall Pos. Indicators	Main Floor
15.	Passenger Entrance Type		Two-speed side sliding
	a.	Size	3'-6" W by 8'-0" H

	b.	Frames	Satin Stainless Steel
	c.	Doors	Satin Stainless Steel
	d.	Sills	Nickel silver, polished
16.	Power Characteristics:		480v, 3 Phase, 60Hz.
17.	Miscellaneous Items:		
	a.	Star of Life Symbol (Emergency Medical Access, Gurney Compliant)	
	b.	Disabled Access Requirements	
	c.	Key Operated Hoistway Access	
	d.	Dual Smart/Magnetic Stripe Car Reader	

D. **Service (Housekeeping) Elevator No. E-5**

1.	Basis of Design:		MCE Freedom, MR Series H4500
2.	Type:		OHT; Gearless Electric Traction, Hospital
3.	Capacity:		4500 Pounds
4.	Speed:		500 FPM
5.	Stops:		21, (basement thru 20th floor/roof level)
6.	Openings		
	a.	Front	21
7.	Travel:		244’-0”
8.	Control:		ACPM gearless
9.	Operation System:		Motion 4000 or iControl non-proprietary controls with regenerative drives.
10.	Operation:		Selective-collective automatic operation
11.	Machine Location:		Overhead, 21st floor (Machine Rm./Mechanical Roof)
12.	Special Operations:		
	a.	Independent Service for service elevator	
	b.	Fire Emergency Service	
	c.	Standby Emergency Power	
	d.	Anti-Nuisance Service	
	e.	Car-to-Lobby Feature	
13.	Car Enclosure Type:		Service
	a.	Inside Clear	5’-9” W by 8’-1” D by 9’-0” H
	b.	Platform Size	6’-0” W by 8’-4” D by 10’-0” H
14.	Signals and Fixtures		Design as Specified
	a.	Car Operating Panels	1 Per Car; Applied Type; Vandal Resistant
		1) Style:	Bruiser (PB23), by Freedom
	b.	Car Position Indicator	Integral with Each Car Panel
	c.	Communication Sys.	Integral with Car Panel
	d.	Service Cabinet	Integral with Car Panel
	e.	Hall Pushbuttons	1 Riser
	f.	Hall Lanterns	All Floors
	g.	Hall Position Indicators	Main Floor
15.	Service Entrance Type		Center Open, Dual Speed

a. Size 4’-0” W by 7’-0” H
b. Frames Satin Stainless Steel
c. Doors Satin Stainless Steel
d. Sills Nickel silver, polished

16. Power Characteristics: 480v, 3 Phase, 60Hz.
17. Miscellaneous Items:
    a. Key Operated Hoistway Access

E. Description, general

1. **CAR ENCLOSURES: Typical E-1, E-2 & E-3** (except Service Elevator No. E-5)
    a. Assembly and installation:
        1) System: Elevator Interior System by SnapCab, www.snapcabs.com
            a) Contact: Eric Farah, 480.438-0696c, efarah@snapcab.com
        2) Elevator manufacturer provided materials as specified.
    b. Design Name: (SnapCab)
        1) “Modified Resilient”
    c. Front Walls (Return Panels): Stainless steel patterned metal cladding:
        1) Mfgr: RIGIDIZED METALS, www.ridigized.com
        2) Pattern: Ridigized® 5 WL®
        3) Type: Embossed surface with woven fabric look
        4) Material: 20 gauge stainless steel
        5) Finish: Satin
        6) Installation: Cladding on door by Elevator manufacturer.
    d. Car Fixtures:
        1) Satin stainless steel, No. 4 finish.
    e. Side and Rear Wall Panels: Custom:
        1) Wood Veneer Panels:
            a) System: SnapCab
            b) Installer: SnapCab
            c) Designation: WD-1
            d) Veneer Finish: Wood Stained to match “WD-1”, refer to ID0.7 Drawing.
            e) Veneer Species: Oak
            f) Veneer Cut: Rift
            g) Substrate: Fire rated MDF
            h) Overall thickness: 5/8 -inch
        2) Glass Panels:
            a) System: SnapCab
            b) Installer: SnapCab
            c) Glass Designation: “GL-3”
            d) Glass Mfgr: Corning®, Gorilla® glass

e) Glass color backing: Vinyl in color to match PULP Studio, Pintura, Medium Grey as approved by Architect.

f) Panel assembly backing: Fire rated Solid Phenolic

g) Overall thickness: 5/8 -inch

3) Fabric wrapped panels:

a) System: SnapCab

b) Installer: SnapCab

c) Drawing Designation: SF-3

d) Covering Material: Fabric, see SF-3 material

e) Panel assembly backing: Fire rated Solid Phenolic or MDF

f) Overall thickness: 5/8 -inch

f. Reveals: 1/8 –inch (Shadow) black gap between panels as part of SnapCab system as approved by Architect.

g. Base Trim: Satin stainless steel, No. 4 finish.

1) Height: 6 –inches.

2) Adjust/add vent holes in cab shell for 6 –inch tall base

h. Door Faces (Interior): Stainless steel patterned metal.

1) Mfgr: RIGIDIZED METALS, www.ridigized.com.

2) Pattern: Ridigized® 5 WL®.

3) Type: Embossed surface with woven fabric look.

4) Material: 20 gauge stainless steel or approved alternate.

5) Finish: Satin.

i. Door Sills: Nickel silver, polished.

j. Ceiling: Satin stainless steel, No. 4 finish.

1) System: SnapCab

2) Installer: SnapCab

3) Model: 9 Panel “Island” with LED fixtures

k. Handrails:

1) Mfgr: SnapCab

2) Material: Solid stainless steel

3) Size:

a) Rectangular 3/8 –inch (9.5mm) thick by 4 -inch (101mm) wide

4) Finish: Satin stainless steel, No. 4 finish.

5) Location: At sides and rear of car.

6) Attachment: Stainless steel satin finish Standoffs with concealed fastening.

l. Floor prepared to receive ceramic tile floor border over plywood substrate (specified in Section 09 3013 "Tiling" and as specified below).

1) Thin set an “Uncoupling Mat” (sheet material) to the wood subfloor prior to installing tile :

a) Mfgr: Laticrete

b) Product: STRAT-MAT

c) Thickness: +/-1/8 –inch.

d) Data Sheet: 026.0

2) Thinset Mortar: Refer to Section 09 3013 “Tiling”

3) Install sealant at tile joints :

a) Mfgr: Laticrete

b) Product: Refer to Section 09 3013 “Tiling”

c) Color: As selected by Architect

4) Refer to Drawings and confirm with Architect.

m. Floor prepared to receive carpet (specified in Section 09 6800 " Carpeting").

1) Shim floor with continuous solid backing as required to align surface of carpet with surface of tile.

a) Provide details as part of shop drawings for review and approval.

2) Refer to Drawings and confirm with Architect.

n. Floor Thickness, Including Setting Materials and Uncoupling Mat: Thickness required for floor finish above plywood subfloor.

1) Floor finish, Cab door sill and Lobby floor shall align.

2) Refer to Drawings.

2. CAR ENCLOSURES: Service Elevator No. E-5

a. Assembly and installation:

1) System: Elevator Interior Systems by SnapCab, www.snapcabs.com

a) Contact: Eric Farah, 480.438-0696c, efarah@snapcab.com

2) Elevator manufacturer provided materials as specified.

b. Design Name: “Vertical Industrial I” by SnapCab

c. Front Walls (Return Panels): Stainless steel clad patterned metal:

1) Mfgr: RIGIDIZED METALS, www.ridigized.com

2) Pattern:

a) RTP

3) Type: Embossed surface with diamond plate look.

4) Material: 20 gauge stainless steel

5) Finish: Satin

6) Installation: Cladding on door by Elevator manufacturer.

d. Car Fixtures:

1) Satin stainless steel, No. 4 finish.

e. Side and Rear Wall Panels: Metal clad phenolic panels~~Custom:~~

1) System: SnapCab

2) Installer: SnapCab

3) Cladding: RIGIDIZED METALS, www.ridigized.com

4) Pattern: As selected by Architect from the following:

a) RTP

5) Type: Embossed surface with Diamond Plate look.

6) Material: 20 gauge stainless steel

7) Finish: Satin

8) Substrate: Fire rated Solid Phenolic

9) Overall thickness: 5/8 -inch

10) Installation: Panels hung and secured to cab enclosure per SnapCab

f. Reveals: 1/8 –inch (Shadow) black gap between panels as part of SnapCab system as approved by Architect.

g. Base Trim: Satin stainless steel, No. 4 finish.

1) Height: 4 –inches.

h. Door Faces (Interior): Stainless steel clad patterned metal:

1) Mfgr: RIGIDIZED METALS, www.ridigized.com

2) Pattern: As selected by Architect from the following:

a) RTP

3) Type: Embossed surface with Diamond Plate look.

4) Material: 20 gauge stainless steel

5) Finish: Satin

6) Substrate: Fire rated Solid Phenolic

7) Overall thickness: 5/8 -inch

8) Installation: Cladding on door by Elevator manufacturer.

i. Door Sills: Nickel silver, polished.

j. Ceiling: 14 gauge drop ceiling, Satin stainless steel, No. 4 finish tee bar frame with florescent lights over polygal diffuser.

1) System: By elevator mfgr.

k. Handrails:

1) Mfgr: SnapCab

2) Material: Solid stainless steel

3) Size:

a) Rectangular 3/8 –inch (9.5mm) thick by 4 -inch (101mm) wide, at sides and rear of car.

4) Finish: Satin stainless steel, No. 4 finish.

5) Location: At sides and rear of car.

6) Attachment: Stainless steel satin finish Standoffs with concealed fastening.

l. Flooring: (Over plywood subfloor)

1) Material: Vinyl VCT

2) Mfgr: Armstrong World Industries, www.armstrong.com

3) Product: Excelon Imperial Texture

4) Size: 12 –inches by 12 –inches

5) Color: As selected by Architect.

6) Adhesive: Armstrong S-515 Clear Thin Spread or approved equal.

7) Refer also to Section 09 9600 “Resilient Flooring”

8) Floor finish, Cab door sill and Lobby floor shall align.

3. Hoistway Entrances:

a. Passenger Elevators: (E-1, E-2, E-3)

1) Width: 42 -inches (1067 mm).

2) Height: 96 -inches (2438 mm).

3) Type: As Scheduled.
4) Frames: Satin stainless steel, No. 4 finish.
a) Confirm with Architect.
5) Doors and Transoms: Stainless steel clad patterned
a) Mfgr: RIGIDIZED METALS, www.ridigized.com
b) Pattern: Ridigized® 5 WL®.
c) Type: Embossed surface with woven fabric look.
d) Material: 20 gauge stainless steel.
e) Finish: Satin.
f) Installation: Cladding on door by Elevator manufacturer.
6) Sills: Nickel silver, polished.

b. Service Elevator: (E-5)
1) Width: 48 inches (1219 mm).
2) Height: 84 inches (2134 mm).
3) Type: Two-speed center opening.
4) Frames: Satin stainless steel, No. 4 finish.
5) Doors and Transoms: Satin stainless steel, No. 4 finish.
6) Sills: Nickel silver, polished.

4. Hall Fixtures: Satin stainless steel, No. 4 finish.
5. Additional Requirements:
a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, No. 4 finish.
b. Provide hooks for protective pads in all passenger cars and four complete set(s) of full-height protective pads.

2.5 TRACTION SYSTEMS

A. Elevator Machines: Variable-voltage, variable-frequency, ac-type hoisting machines or variable-voltage dc-type hoisting machines and solid-state power converters.
1. Provide regenerative system.
2. Limit total harmonic distortion of regenerated power to 5 percent per IEEE 519.
3. Provide means for absorbing regenerated power when elevator system is operating on standby power.
4. Provide line filters or chokes to prevent electrical peaks or spikes from feeding back into building power system.

B. Fluid for Hydraulic Buffers: If using hydraulic buffers, use only fire-resistant fluid.

C. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work. Device installation is specified in another Section.

D. Machine Beams: Provide framing to support elevator hoisting machine and deflector sheaves from the building structure. Comply with Section 05 5000 "Metal Fabrications" for materials and fabrication.

E. Car Frame and Platform: Bolted- or welded-steel units.

F. Guides: Roller guides or polymer-coated, nonlubricated sliding guides. Provide guides at top and bottom of car and counterweight frames.

2.6 OPERATION SYSTEMS

A. General: Provide a non-proprietary microprocessor-controlled dispatching system designed to monitor all types of traffic and sufficiently flexible so that it can be modified to accommodate changes in traffic patterns.

1. Basis of Design: Microprocessor based controller, non-proprietary, “iControl” or “Motion 4000 Hydraulic Elevator Controller” with solid state starter as manufactured by Motion Control Engineering, Inc. in Rancho Cordova, CA 95742, tel: (916) 463-9200, web: www.mceinc.com.
    a. The system shall continuously monitor the demand based on real time calculations to assign and reassign the elevators to handle the traffic in the most efficient manner.
    b. Provide "anti-nuisance service" whereby all car calls will be cancelled if the load-weighing device detects that an abnormal number of calls are registered given the number of passengers in the car. System using false call answering to accomplish this is not acceptable.
    c. Serial Link Communications: Provide a distributed processing network consisting of localized processors located in machine rooms, car stations, hall stations and top of car to allow system to make fast decisions based on data shared by the processor involved in the different operations of the elevators. For group dispatch operations, all elevators in the group shall be capable of acting as a group common dispatcher as the need arises.
    d. Fault Diagnostic System: Provide Owner with all hardware such as on-board LED. Diagnostics, hand held device or laptop computer, as standard with manufacturer, and supporting software documentation. Diagnostic system shall be capable of determining faults most difficult to find.

B. Controller: Single unit installed in Machine room. The elevator control system shall be microprocessor based, software oriented, and programmable by Owner. The system shall operate with duplex collective operation in real time, continuously analyzing the car’s changing position, condition, and work load. Control of the elevator shall be automatic in operation by means of push buttons in the car numbered to correspond to floors served, for registering car stops, and by "up-down" push buttons at each intermediate landing and "call" push buttons at terminal landings.

1. Momentary pressing of one or more buttons shall dispatch the car to the designated landings in the order in which the landings are reached by the car, irrespective of the sequence in which the buttons are pressed. Each landing call shall be canceled when answered.
2. When the car is traveling in the up direction, it shall stop at all floors for which car buttons or "Up" hall buttons have been pressed. The car shall not stop at floors where "down" buttons have been pressed, unless the stop for that floor has been registered by a car button or unless the down call is at the highest floor for which any buttons have been pressed. Pressing the "Up" button when the car is traveling in the down direction shall not intercept the travel unless the stop for that floor has been registered by a car button or unless the up call is the lowest for which any button has been pressed.

3. When the car has responded to its highest or lowest stop, and stops are registered for the opposite direction, its direction of travel shall reverse automatically and it shall then answer the calls registered for that direction. If both up and down calls are registered at an intermediate floor, only the call corresponding to the direction of car travel shall be canceled upon the stopping of the car at the landing.
4. A car that is stopping for the last hall call in the preference direction and that hall call is for the opposite direction with no onward car calls, shall reverse preference when the selector position advances to the landing at which the car is committed to stop. A car that is stopping for the last hall call in the preference direction, and that hall call is for the same direction, shall hold its preference until the door is almost closed allowing time for a passenger to register an onward car call which will maintain the preference. If no car call is registered before the door is almost closed, the car will lose its preference and shall be available to accept calls in either direction.

C. Group Automatic Operation with Demand-Based Dispatching: Provide reprogrammable group automatic system that assigns cars to hall calls based on a dispatching program designed to minimize passenger waiting time. System automatically adjusts to demand changes for different traffic conditions including heavy incoming, heavy two-way, heavy outgoing, and light off-hours as variations of normal two-way traffic.
1. The system is optimized to get a car to the floor where a hall call has been registered, in the shortest time. The system receives input information from standard call pushbuttons located in the hall, car position and car load information from individual car loadweighers.
    a. When group operation is required, the group supervisory operation shall be embedded within selected car controllers. No separate group controller shall be supplied. The microprocessor shall constantly scan the system for hall calls. When hall calls are registered, the control system shall immediately calculate the estimated time for arrival using such information as, number of floors to travel from the current position, the time it takes to travel one floor at top speed, calls assigned to a car, and car reversal time to respond to a call in the opposite direction of travel. When a car's status changes or additional hall calls are registered, the estimated time of arrival shall be recalculated and calls reassigned if necessary.
    b. Traffic Pattern: The microprocessor shall provide flexibility to meet well defined patterns of traffic, including up peak, down peak, and heavy interfloor demands, and adjust for indeterminate variations in these patterns which occur in buildings.

D. Load Weighing Device: Provide a load weighing device on each car which, when the particular car is filled to an adjustable percentage of the capacity load, shall cause the car to bypass landing calls but not car calls. The passed landing calls shall remain registered for the next following car.
1. The device shall be unaffected by the action of compensating chain or rope.
2. The load sensor shall use a strain gauges attached to the ropes to accurately measure the weight in the car. The information shall be transferred via a serial link to the elevator controller.

E. Anti-Nuisance Call Control: The microprocessor control system shall evaluate the number of people on the car and compare that value to the number of car calls registered. If the number of car calls exceeds the number of people by a field programmable value, the car calls shall be canceled after the first call has been answered.

F. Position Selector: The position selector shall be part of the microprocessor system. The car position in the hoistway shall be digitized through a primary position encoder. The microprocessor control system shall store the floor position and slow down points in memory.

G. Motion Control: The drive control system shall be dual-loop feedback system based primarily on car position. The velocity profile shall be calculated by the microprocessor control system producing extremely smooth and accurate stops. The velocity encoder shall permit continuous comparison of machine speed to velocity profile and to actual car speed. This accurate position/velocity feedback shall permit a fast and accurate control of acceleration and retardation.

H. Motor Pre-Torque: Current shall be applied to the elevator drive before the brake is released and the speed pattern is dictated to eliminate roll back and sling shot effects of unbalanced loads in the car. The electronic loadweigher shall determine the load on the car determining a pre-torque reference to send to the drive.

I. Emergency Power Operation: Building emergency generator.

1. Single-Car Standby Power Operation: On activation of standby power, each car is returned to a designated floor and parked with doors open. Car can be manually put in service on standby power, either for return operation or for regular operation, by switches in control panel located at fire command station. Manual operation causes automatic operation to cease.

J. Automatic Light and Fan Shut Down: The control system shall evaluate the system activity and automatically turn off the cab lighting and ventilation fan during periods of inactivity. The settings shall be field programmable.

K. Security Features: Provide the following security features, where indicated. Security features shall not affect emergency firefighters' service.

1. Card-Reader Operation: System uses card readers at car-control stations to authorize calls. Security system determines which landings and at what times calls require authorization by card reader. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers. Provide Elevator Controller, with smart card/RFID Proximity card reader integral with each car-control station.
    a. Security access system equipment to be coordinated with security door access equipment specified in Section 08 7100 “Door Hardware". Elevator security system equipment to provide an "On-Line" connection with equipment at registration desk.
    b. Provide card reader integral to cab control panel to allow authorized guest cards to access authorized floors. Canceled cards must not access floors.
        1) Audit trail in lock of last 8,000 entries - time, date, and card identification
        2) Non-volatile memory lock will not lose program even if the power source is lost.
        3) ADA Compliant.
2. Keyswitch Operation: Push buttons are activated and deactivated by security keyswitches at car-control stations. Key is removable only in deactivated position.
3. Car-to-Lobby Feature: Feature, activated by keyswitch at main lobby, which causes all cars in a group to return immediately to lobby and open doors for inspection. On deactivation by keyswitch, calls registered before keyswitch activation are completed and normal operation is resumed.

2.7 DOOR REOPENING DEVICES

A. Infrared Array: Provide door reopening device with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams shall cause doors to stop and reopen.

B. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door reopening device, a loud buzzer shall sound and doors shall begin to close at reduced kinetic energy.

2.8 CAR ENCLOSURES

A. General: Provide steel-framed car enclosures with nonremovable wall panels, with car roof, access doors, power door operators, and ventilation.

1. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.

B. Materials and Finishes:

1. Subfloor: Exterior, C-C Plugged grade plywood, not less than 7/8-inch (22.2-mm) nominal thickness.
2. Finishes: As specified and refer to Articles:
   a. 2.4, E, 8
   b. 2.4, E, 9
   c. 2.4, E, 10.
3. Fabricate car with recesses and cutouts for signal equipment.
4. Fabricate car door frame integrally with front wall of car.
5. Stainless-Steel Doors: Finish and cladding as specified.
6. Sight Guards: Provide sight guards on car doors.
7. Sills: Finish as specified, with grooved surface, 1/4 -inch (6.4 mm) thick.
8. Metal: As specified.
9. Handrails: As specified.
10. Luminous Ceiling: As specified

2.9 HOISTWAY ENTRANCES

A. Hoistway Entrance Assemblies: Manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Frame size and profile shall accommodate hoistway wall construction.

1. Where gypsum board wall construction is indicated, frames shall be self-supporting with reinforced head sections.
2. Door cladding as specified.

B. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies shall comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing at as close-to-neutral pressure as possible according to NFPA 252 or UL 10B.

1. Fire-Protection Rating: 1-1/2 hours with 30-minute temperature rise of 450 deg F (250 deg C).

C. Materials and Fabrication: Manufacturer's standards, but not less than the following:

1. Steel Subframes: Formed from cold- or hot-rolled steel sheet, with factory-applied enamel finish or rust-resistant primer. Fabricate to receive applied finish as indicated.
2. Stainless-Steel Frames: Formed from stainless-steel sheet.
3. Star of Life Symbol: Identify emergency elevators with star of life symbol, not less than 3 -inches (76 mm) high, on both inside surfaces of hoistway door frames.
4. Stainless-Steel Doors and Transoms: Flush, hollow-metal construction; fabricated from stainless-steel sheet and door clad with decorative metal:
   a. Finishes: As specified and refer to Article:
      1) 2.4, E, 10
5. Sight Guards: Provide sight guards on doors matching door edges.
6. Sills: Finish as specified with grooved surface, 1/4 -inch (6.4 mm) thick.
7. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M.

2.10 CAR OPERATING STATION

A. Car Operating Station, General: The car control in each car shall contain the devices required for specific operation mounted in an integral swing return panel requiring no applied faceplate. Swing return shall have a clad decorative stainless steel finish as specified, secured tightly to eliminate rattles. The main car operating panel shall be mounted in the return and comply with ADA requirements. Pushbuttons that illuminate using long lasting LED's shall be included for each floor served, and emergency buttons and switches shall be provided per code.

1. Provide card reader integrally designed and installed in car operating station of each car, ADA compliant, along with signage to instruct guest to swipe card prior to floor selection. Provide power for card readers from cab power (batteries not accepted).
2. Polycarbonate pushbuttons shall be manufactured with Microban antimicrobial protection. Switches for car light and accessories shall be provided.

B. Provide a locked service cabinet containing the key switches required to operate and maintain the elevator including, but not limited to:

1. Light switch
2. Independent service key
3. Duplex OFT receptacle

C. Emergency Communications System: Integral phone system provided.

2.11 SIGNAL EQUIPMENT

A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements with LEDs.

B. Car-Control Stations: Provide manufacturer's standard recessed car-control stations. Mount in return panel adjacent to car door unless otherwise indicated.

1. Mark buttons and switches for required use or function. Use both tactile symbols and Braille.

2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.

C. Emergency Communication System: Two-way voice communication system, with visible signal, which dials preprogrammed number of monitoring station and does not require handset use. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.

D. Firefighters' Two-Way Telephone Communication Service: Provide telephone jack in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in Section 27 1000 "Structured Cabling".

E. Car Position Indicator: Provide illuminated, digital-type car position indicator, located above car door or above car-control station. Also, provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served. Include travel direction arrows if not provided in car-control station.

F. Hall Push-Button Stations: Provide one hall push-button station at each landing for each single elevator or group of elevators, but not less than one station for each two elevators in a group.
1. Provide units with flat faceplate for mounting with body of unit recessed in wall.
2. Equip units with buttons for calling elevator and for indicating desired direction of travel.

G. Provide telephone jack in each unit for firefighters' two-way telephone communication service specified in Section 27 1000 "Structured Cabling".
1. Possibly insert a provision for either an "In Use" signal or a digital display of car position for single elevators.

H. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Provide the following:
1. Units with flat faceplate for mounting with body of unit recessed in wall and with illuminated elements projecting from faceplate for ease of angular viewing.

I. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.

J. Standby Power Elevator Selector Switches: Provide switches, as required by ASME A17.1/CSA B44, where indicated. Adjacent to switches, provide illuminated signal that indicates when normal power supply has failed. For each elevator, provide illuminated signals that indicate when they are operational and when they are at the designated emergency return level with doors open.

K. Fire-Command-Center Annunciator Panel: Provide panel containing illuminated position indicators for each elevator, clearly labeled with elevator designation; include illuminated signal that indicates when elevator is operational and when it is at the designated emergency return level with doors open. Provide standby power elevator selector switch(es), as required by ASME A17.1/CSA B44, adjacent to position indicators. Provide illuminated signal that indicates when normal power supply has failed.

L. Emergency Pictorial Signs: Fabricate from materials matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire, elevators

are out of service and exits should be used instead. Provide one sign at each hall push-button station unless otherwise indicated.

2.12 FINISH MATERIALS

A. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.

B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.

C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.

D. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.

E. Stainless-Steel Bars: ASTM A 276, Type 304.

F. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.

G. Nickel Silver Extrusions: ASTM B 151/B 151M, Alloy UNS No. C74500 or No. C77600.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Examine hoistways, hoistway openings, pits, and machine rooms as constructed; verify critical dimensions; and examine supporting structure and other conditions under which elevator work is to be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions.

B. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.

C. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.

D. Lubricate operating parts of systems, including ropes, as recommended by manufacturers.

E. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.

F. Leveling Tolerance: 1/8 -inch (3 mm), up or down, regardless of load and travel direction.

G. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.

H. Locate hall signal equipment for elevators as follows unless otherwise indicated:

1. For groups of elevators, locate hall push-button stations between two elevators at center of group or at location most convenient for approaching passengers.
2. Place hall lanterns either above or beside each hoistway entrance.
3. Mount hall lanterns at a minimum of 72 -inches (1829 mm) above finished floor.

3.3 TEMPORARY ELEVATOR USE DURING CONSTRUCTION

A. General: Should the Contractor require the use the **Service Elevator (E-5)** during construction, Contractor shall make arrangements directly with the Elevator Installer to coordinate temporary facilities and pay all costs associated with the protection, operation and use of elevators.

B. Maintenance: Elevators shall be maintained on a regular basis during the temporary construction use. A minimum of two hours per week per elevator shall be spent on examination, lubrication, adjusting and cleaning the elevator equipment.

C. Damage: The Owner is entitled to receive new elevator equipment and finishes upon final acceptance of the entire project. The Owner's representative will thoroughly examine all elevator equipment upon completion of temporary use and provide a punch-list outlining items that must be repaired or replaced to ensure the equipment is in new condition. Final acceptance and payment will not be made until all items have been satisfactorily completed.

D. Schedule: Sufficient time must be allowed to prepare and adjust temporary elevators so that the entire elevator installation is ready for final acceptance.

3.4 FIELD QUALITY CONTROL

A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.

B. Operating Test: Load one elevator of each type, capacity, speed, and travel distance to rated capacity and operate continuously for 60 minutes over full travel distance, stopping at each level and proceeding immediately to the next. Record temperature rise of elevator machine during 60-minute test period.

1. Record failure to perform as required.
    a. Stop car at each floor in each direction.
    b. Provide well-shielded thermometers for motor and verify that temperatures do not exceed 50 degrees Centigrade above ambient. Infrared Temperature thermometers' are acceptable.

c. Performance and leveling tests shall be made before and after heat and run test.

d. Check and verify operation of all safety features and special operations.

2. Demonstrate and verify to the Owner's Representative the following

a. Measure horizontal acceleration for a full speed, full rise up and down run.

b. Measure acoustical output levels in machine room, lobbies and cars for a full speed, full rise up and down run.

c. Measure voltage transients and harmonics feedback into building electrical system for a full speed, full rise up and down run

C. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

D. Make corrections to defects or discrepancies at no cost to Owner. Should discrepancies be such that re-examination and retesting is required, the Contractor shall pay for all costs including those of the Architect and Owner's representative fees.

E. Final acceptance of the installation will be made only after all corrections are complete, final submittals and certificates received and the Owner is satisfied and the installation is complete in all respects.

3.5 PROTECTION

A. Temporary Use: Limit temporary use for construction purposes to one elevator (Service Elevator E-5). Comply with the following requirements for elevator used for construction purposes:

1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.

2. Provide strippable protective film on entrance and car doors and frames.

3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.

4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.

5. Do not load elevators beyond their rated weight capacity.

6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate, adjust, and maintain elevator(s).

B. Check operation of each elevator with Owner's personnel present before date of Substantial Completion and again not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

3.7 MAINTENANCE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include twelve (12) months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Perform maintenance during normal working hours.
2. Include 24-hour-per-day, 7-day-per-week emergency callback service with response time of two hours or less.
3. Maintain the performance standard set forth in this Specification and maintain correct operation of the dispatching system.
4. Maintain smooth starting and stopping, smooth riding qualities and accurate leveling at all times.

B. Service: Include systematic examination, adjustment, and lubrication of elevator equipment whenever required and replacement of defective parts with parts of same manufacture as required for proper operation. Contractor not responsible for repairs to car enclosures, door panels, frames, sills or platform flooring resulting from normal usage or misuse, accidents and negligence for which Contractor did not cause. Service shall be performed expending a minimum of the following per unit per visit performing preventative maintenance service.

1. Traction Elevators serving 6-20 Floors: 2.0 hours per unit twice per month.

C. Elevator Shutdowns: Should any elevator become inoperative, repair within 24 hours of notification of such failure. Breakdown of major components shall be completed and service restored within 72 hours.

1. Failure to comply with above, Owner may order the work done by other contractors at the Contractor's expense.
2. Devices repaired or replaced by others shall, nevertheless, be provided with maintenance by the Contractor who shall become completely responsible for correct operation of such devices for lifetime of this contract

D. Follow-Up Tests: Test all safety devices and emergency operations at six (6) month intervals or oftener and submit written report on each test. Make tests at times which do not interfere with building operation.

E. Maintenance Materials:

1. Expendable Parts: Provide a metal cabinet in at least one machine room on project premises containing the following expendable parts required for prompt replacement. Parts used for routine maintenance shall be replenished and stored in machine room to ensure an adequate supply is available.
    a. Two field replaceable resistors of each type installed.
    b. One set hanger sheaves for car and hoistway doors.
    c. Two relays and relay bases of each type installed.
    d. Twenty-four lamps of each type installed.
    e. Car and hall buttons with identical graphics installed; six for manufacturer's standard buttons, one of each type for special buttons.
    f. Twelve fuses of each type installed.
    g. Any other parts required for prompt replacement.

h. Lubricants and cleaners of all types used for maintenance.

2. Replacement Parts: Keep the following parts in a warehouse within 50 miles of the project premises.
   a. One door operator motor of each type used.
   b. Transformers of each type installed.
   c. Two complete door interlocks.
   d. Parts for motor drive units.
   e. One complete motor drive of each size installed.
   f. One encoder of each type installed.
   g. Parts for door protective devices.
   h. Such other parts as are needed to insure prompt replacement in event of elevator shutdown such as spare control boards for computer-operated systems.

F. Maintenance Data: After completion and prior to final acceptance, submit three sets of complete and accurate maintenance data specific for each elevator.

G. Maintenance Manuals: Describe proper use and maintenance of equipment, lubrication points, types of lubricants used and frequency of lubricant application, manufacturer's literature describing system maintenance and troubleshooting as specified.
   1. Owners Manuals: Describe operation of each feature, i.e. Independent Service, Security Operation, Guard Station Equipment, etc…that is specifically used by the owner or end user. Include details of what to do and what not to do with the elevator equipment In Case of Emergency, Seismic, Fire, Evacuation etc.,
   2. Parts Catalogs: Complete listing of all parts of equipment and components used in the installation.
   3. Wiring Diagrams: One set mounted in machine room, one bond drawing set and one electronic version on CD delivered to Owner. Wiring diagrams shall be as built, specific for this installation, and reference identification on drawings shall match points identified on terminals of controllers.
   4. Maintenance Tool and Software Manuals: Provide maintenance tools and supporting software documentation required for the complete maintenance of the entire system including diagnostics ad adjusting. Maintenance tool may be hand held or built into control system and shall be of the type not requiring recharging or reprogramming nor of the automatic destruct type. The tool and supporting software may be programmed to operate only with this project's identification serial numbering. If control system is of the type that the software is field up loadable, both a copy of the control software and the parameters shall be clearly marked and submitted to the owner on CD.

H. Final Service and Inspection: Two weeks before expiration of the year's maintenance, the equipment shall be lubricated, fully serviced, adjusted to the standards designated and emergency service operation devices shall be checked. A representative of the Owner will make a complete inspection.

- END OF SECTION -

- SECTION 14 2400 -

HYDRAULIC ELEVATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. In accordance with this Performance based specification, section includes holed-hydraulic kitchen service elevator with a non-proprietary control system.

1.3 RELATED REQUIREMENTS

A. Marriott Standards; Module 12 Elevators as follows:
   1. Marriott, Courtyard, Module 12 Elevators. Revised January 2011.
   2. Marriott, Residence Inn, Module 12 Elevators. Revised July 2011.

B. Section 01 5000 "Temporary Facilities and Controls" for temporary use of elevators for construction purposes.

C. Section 03 3000 "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.

D. Section 04 2000 "Unit Masonry" for setting sleeves, inserts, and anchoring devices in masonry and for grouting elevator entrance frames installed in masonry walls.

E. Section 05 1200 "Structural Steel Framing" for the following:
   1. Attachment plates, angle brackets, and other preparation of structural steel for fastening guide-rail brackets.
   2. Divider beams.
   3. Hoist beams.

F. Section 05 5000 "Metal Fabrications" for the following:
   1. Structural-steel shapes for subsills.
   2. Pit ladders.

G. Section 05 5300 "Metal Gratings" for the following:
   1. Pit sump grating.

H. Division 9 for finish flooring in elevator cars.

I. Division 22 for piping, valves and sump pumps in elevator pits. See Plumbing Drawings, including Sheets P3.0 and P7.1 for additional direction.

J. Division 27, Section 27 1000 "Structured Cabling" for telephone service for elevators and for Internet connection to elevator controllers for remote monitoring of elevator performance.

K. Division 28, Section 28 3000 “Fire Alarm and Detection System” for smoke detectors in elevator lobbies to initiate emergency recall operation and heat detectors in shafts and machine rooms to disconnect power from elevator equipment before sprinkler activation and for connection to elevator controllers.

L. Section 31 0200 “General Provisions for Earthwork” and civil drawings for excavating well hole to accommodate cylinder assembly.

1.4 DEFINITIONS

A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.

B. Service Elevator: A passenger elevator that is also used to carry freight.

1.5 ACTION SUBMITTALS

A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for car enclosures, hoistway entrances, and operation, control, and signal systems.

B. Shop Drawings:

1. Include plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment.
2. Include large-scale layout of car-control station and standby power operation control panel.
3. Indicate maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.

C. Samples for Initial Selection: For finishes involving color selection.

D. Samples for Verification: For exposed car, hoistway door and frame, and signal equipment finishes; 3-inch (75-mm-) square Samples of sheet materials; and 4-inch (100-mm) lengths of running trim members.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer as specified in this Section under “Quality Requirements”.

B. Seismic Qualification Certificates: For elevator equipment, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service including standby power generator, as shown and specified, are adequate for elevator system being provided.

D. Sample Warranty: For special warranty.

E. Flame spread and Smoke developed ratings for all cab interior finishes.

F. Radiant Flux (CRF) ratings for cab interior flooring assembly.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.
1. In addition to items specified in Section 01 7823 "Operation and Maintenance Data," include diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.

B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

C. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard two (2) year maintenance agreement, starting on date initial maintenance service/warranty is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.
1. Submit the Continuing Maintenance Proposal at the time of Bid to include all elevators on this project.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Elevator manufacturer or an authorized representative who is trained and approved by manufacturer to install or service the elevator equipment with not less than five (5) years of satisfactory experience installing.

B. Manufacturer Qualifications: An approved manufacturer with minimum (5) years experience in engineering and manufacturing elevators of the type required for the project. The entire elevator installation shall be manufactured, installed and maintained by an acceptable manufacturer as listed in Part 2 of this Section.
1. The manufacturer shall manufacturer the machines and control systems which must be available for sale to any elevator contractor. Likewise, any elevator contractor must be able to purchase replacement materials at a published price and be able to obtain technical support service from the manufacturer.
a. Equipment proposed must have a history of successful operation under similar conditions for the last two (2) years
2. The manufacturer shall have a documented, on-going quality assurance program.

C. Maintenance Qualifications: Performed by manufacturer installing elevator:
   1. Show evidence of successful experience in complete maintenance of elevators.
   2. Directly employ sufficient competent personnel within 50 miles of project to handle service.
   3. Maintain local stock of parts adequate for replacement on permanent or emergency basis.
   4. Respond to trouble calls within one hour.
   5. Offer the Owner agreement for continuing maintenance after expiration of maintenance period under this contract.

D. Requirements of Regulatory Agencies:
   1. Codes: In accordance with the latest applicable edition requirements of the following and as specified:
      a. ASME A17.1 Safety Code for Elevators and Escalators, latest edition or as required by the local building code.
      b. NFPA 70 National Electrical Code.
      c. NFPA 80 Fire Doors and Windows.
      d. NEC: National Electric Code.
      e. Americans with Disabilities Act - Accessibility Guidelines (ADAAG)
      f. IBC: International Building Code.
         1) "Phoenix Building Construction Code", International Building Code 2006, with City of Phoenix administrative provisions and amendments.
      g. CCR: Titles 8; California Code of Regulations.
      h. Section 407 in ICC A117.1, when required by local authorities.
   2. Permits: Arrange and pay for inspections by governing authorities and obtain operating permits.

E. Fire-Rated Entrance Assemblies: Opening protective assemblies including frames, hardware, and operation shall comply with ASTM E2074, UL10 (b), and NFPA Standard 80. Provide entrance assembly units bearing Class B or 1 1/2 hour label by a Nationally Recognized Testing Laboratory.

F. Inspection and Testing:
   1. Elevator Installer shall obtain and pay for all required inspections, tests, permits and fees for elevator installation.
   2. Arrange for inspections with the AHJ and make required tests.
   3. Deliver to the Owner and Architect upon completion and acceptance of elevator work.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials, components and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

1.10 COORDINATION

A. Coordinate installation of sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish

templates, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.

B. Furnish well casing and coordinate delivery with related excavation work.

C. Coordinate locations and dimensions of other work relating to hydraulic elevators including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways, pits, and machine rooms.

D. Coordinate with interior Cab architectural finishes as indicated on Drawings.

1.11 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials, defective materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
2. Warranty Period: One (1) year from date of Substantial Completion.
3. Resilient floor warranty in accordance with Division 9 resilient flooring specifications.

1.12 MAINTENANCE

A. Furnish maintenance and call back service for a period of 12 months for each elevator from date of Substantial Completion.

1. Service shall consist of periodic examination of the equipment, adjustment, lubrication, cleaning, supplies and parts to keep the elevators in proper operation. Maintenance work, including emergency call back repair service, shall be performed by trained employees of the elevator contractor. Elevator installer shall provide 24 hour emergency service at no cost to the Owner.
2. Service shall include 24 hour telephone technical support for length of warranty period.
3. Submit parts catalog and show evidence of local parts inventory with complete list of recommended spare parts. Parts shall be produced by manufacturer of original equipment.
4. Special tools required in the maintenance of the elevators shall be turned over to the Owner. Special tools include, but are not limited to, software and codes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers shall be one of the following:
   1. Motion Control Engineering
   2. Fujitec Elevator Company.
   3. KONE Elevator Company.
   4. Otis Elevator Company.
   5. ThyssenKrupp Elevator Company.

B. Source Limitations: Obtain elevators, including electric traction passenger elevators specified in Section 14 2100 "Electric Traction Elevators," from single manufacturer.
   1. Major elevator components, including pump-and-tank units, plunger-cylinder assemblies, signal fixtures, door operators, car frames, cars, and entrances, shall be manufactured by single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.

B. Accessibility Requirements: Comply with Section 407 in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.

C. Elevator Cab Finishes: (Flame Spread, Smoke Developed and CRF)
   1. Compliance Standards:
      a. ASME A17.1 Safety Code for Elevators and Escalators.
      b. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials
      c. ASTM E648 Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
      d. ANSI/UL 723 “Test For Surface Burning Characteristics of Building Materials” and Flammability Ratings
      e. NFPA 252 Standard Methods of Fire Tests of Door Assemblies
   2. Performance: (High Rise buildings)
      a. Walls and Ceilings:
         1) FS (Flame Spread): 0-25
         2) SD (Smoke Developed): 0-100
      b. Floors:
         1) FS (Flame Spread): 0-300
         2) SD (Smoke Developed): 0-300
         3) CRF (Radiant Flux: 0.45 W/cm² as measured by ASTM E648 for floor covering, underlayment and adhesive

2.3 MATERIALS, GENERAL

A. Aluminum: Alloy and temper best suited for anodizing finish specified.

B. Glass: Laminated Safety Glass meeting ANSI Z97.1.

C. Nickel Silver: CDA Alloy 796, leaded nickel silver.

D. Plywood: PS-1, A-D exterior Grade Douglas Fir, fire retardant treated.

E. Sheet Steel: ASTM A366, uncoated, pickled, free from defects.

F. Sound Deadener: Fire retardant; spray, roller or adhesive applied; 3/16 inch thick.

G. Stainless Steel: ASTM A167; type 302 or 304.

2.4 ELEVATORS

A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturers' standard components shall be used, as included in standard elevator systems and as required for complete system.

B. **Service Elevator No. E-4** (Kitchen Service)

1.	Type:	Hydraulic, holed
2.	Capacity:	2500 Pounds
3.	Speed:	200 FPM
4.	Stops:	4, (basement thru 3rd Floor)
5.	Openings	
	a. Front	3
	b. Rear	2
6.	Travel:	48’-8”
7.	Control:	AC/VVVF
8.	Operation:	Simplex Selective Collective automatic operation
9.	Machine Location:	Basement Level, adjacent
10.	Special Operations:	
	a. Independent Service	
	b. Fire Emergency Service	
	c. Standby Emerg. Power	
	d. Anti-Nuisance Service	
	~~e.~~ Car-to-Lobby Feature	
11.	Car Enclosure Type:	Service
	a. Inside Clear	6’-9” W by 4’-3-1/2” D by 8’-0” H
	b. Platform Size	7’-0” W by 4’-6” D by 9’-0” H
12.	Signals and Fixtures	Design as Specified
	a. Car Operating Panels	2 Per Car; Applied Type
	1) Style:	Bruiser (PB23), by Freedom
	b. Car Position Indicator	Integral with Each Car Panel

c. Communication Sys. Integral with Car Panel
d. Service Cabinet Integral with Car Panel
e. Hall Pushbuttons 1 Riser
f. Hall Lanterns All Floors
g. Hall Pos. Indicators Main Floor

13. Passenger Entrance Type Center Open, Single Speed
    a. Size 3'-6" W by 7'-0" H
    b. Frames Satin Stainless Steel
    c. Doors Satin Stainless Steel
    d. Sills Nickel silver, polished
14. Miscellaneous Items:
    a. Disabled Access Requirements
    b. Key Operated Hoistway Access

C. Description:
1. Type: Under-the-car single cylinder.
2. Rated Load: 2500 lb (1135 kg).
3. Freight Loading Class for Service Elevators: Class A.
4. Rated Speed: 200 fpm (1.0 m/s).
5. Operation System: Simplex Selective-collective automatic
6. Auxiliary Operations:
    a. Standby power operation.
    b. Nuisance call cancel.
7. Security Features: Keyswitch operation.

8. **CAR ENCLOSURE: Service Elevator No. E-4**
    a. Inside Width: 81 -inches (2057 mm) from side wall to side wall.
    b. Inside Depth: 51-1/2 inches (1308 mm) from back wall to front wall (return panels).
    c. Inside Height: 96 -inches (2438 mm) to underside of ceiling.
    d. Assembly and installation:
        1) System: Elevator Interior Systems by SnapCab, www.snapcabs.com
            a) Contact: Eric Farah, 480.438-0696c, efarah@snapcab.com
        2) Elevator manufacturer provided materials as specified.
    e. Design Name: "Vertical Industrial I" by SnapCab
    f. Front Walls (Return Panels): Stainless steel clad patterned metal:
        1) Mfgr: RIGIDIZED METALS, www.ridigized.com
        2) Pattern:
            a) RTP®
        3) Type: Embossed surface with diamond plate look.
        4) Material: 20 gauge stainless steel
        5) Finish: Satin
        6) Installation: Cladding on door by Elevator manufacturer.
    g. Car Fixtures: Satin stainless steel, No. 4 finish.

h. Side and Rear Wall Hung Panels: Metal clad phenolic panels
   1) System: SnapCab
   2) Installer: SnapCab
   3) Cladding: RIGIDIZED METALS, www.ridigized.com
   4) Pattern:
      a) RTP®
   5) Type: Embossed surface with Diamond Plate look.
   6) Material: 20 gauge stainless steel
   7) Finish: Satin
   8) Substrate: Fire rated Solid Phoenolic
   9) Overall thickness: 5/8 -inch
   10) Installation: Panels hung and secure to cab enclosure per SnapCab

i. Reveals: 1/8 –inch (Shadow) black gap between panels as part of SnapCab system.

j. Base Trim: Satin stainless steel, No. 4 finish.
   1) Height: 4 –inches.

k. Door Faces (Interior): Stainless steel clad patterned metal:
   1) Mfgr: RIGIDIZED METALS, www.ridigized.com
   2) Pattern: As selected by Architect from the following:
      a) RTP®
   3) Type: Embossed surface with Diamond Plate look.
   4) Material: 20 gauge stainless steel
   5) Finish: Satin
   6) Substrate: Fire rated Solid Phoenolic
   7) Overall thickness: 5/8 -inch
   8) Installation: Cladding on door by Elevator manufacturer.

l. Door Sills: Nickel silver, polished.

m. Ceiling: 14 gauge drop ceiling, Satin stainless steel, No. 4 finish tee bar frame with florescent lights over polygal diffuser.
   1) System: By elevator mfgr.

n. Handrails:
   1) Mfgr: SnapCab
   2) Material: Solid stainless steel
   3) Size: Rectangular 3/8 –inch (9.5mm) thick by 4 -inch (101mm) wide.
   4) Finish: Satin stainless steel, No. 4 finish.
   5) Location: At sides and rear of car.
   6) Attachment: Stainless steel satin finish Standoffs with concealed fastening.

o. Flooring: (Over plywood subfloor)
   1) Material: Vinyl VCT
   2) Mfgr: Armstrong World Industries, www.armstrong.com
   3) Product: Excelon Imperial Texture
   4) Size: 12 –inches by 12 –inches

5) Color: As selected by Architect.

6) Adhesive: Armstrong S-515 Clear Thin Spread or approved equal.

7) Refer also to Section 09 9600 “Resilient Flooring”

8) Floor finish, Cab door sill and Lobby floor shall align.

9. Hoistway Entrances:

a. Width: 42 -inches (1067 mm).

b. Height: 84 -inches (2134 mm).

c. Type: Single-speed center opening.

d. Frames: Satin stainless steel, No. 4 finish.

e. Doors and Transoms at Basement Floors: Satin stainless steel, No. 4 finish.

f. Doors and Transoms at Other Floors: Satin stainless steel, No. 4 finish.

g. Sills: Nickel silver, polished.

10. Hall Fixtures: Satin stainless steel, No. 4 finish.

11. Additional Requirements:

a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, No. 4 finish.

b. Provide hooks for protective pads in all cars and one complete set(s) of full-height protective pads.

2.5 SYSTEMS AND COMPONENTS

A. Pump Units: Positive-displacement type with a maximum of 10 percent variation between no load and full load and with minimum pulsations.

1. Pump shall be [submersible type with submersible squirrel-cage induction motor, and shall be suspended inside oil tank from vibration isolation mounts] [or] [shall be tank-top-mounted type with fan-cooled, squirrel-cage induction motor, and shall be mounted on oil tank with vibration isolation mounts and enclosed in prime-painted steel enclosure lined with 1-inch- (25-mm-) thick, glass-fiber insulation board].

2. Motor shall have solid-state starting.

3. Motor shall have variable-voltage, variable-frequency control.

B. Hydraulic Silencers: System shall have hydraulic silencer containing pulsation-absorbing material in blowout-proof housing at pump unit.

C. Piping: Size, type, and weight of piping as recommended by elevator manufacturer, with flexible connectors to minimize sound and vibration transmissions from power unit.

1. Cylinder units shall be connected with dielectric couplings.

2. Casing for Underground Piping: Schedule 40 PVC pipe complying with ASTM D 1785, joined with PVC fittings complying with ASTM D 2466 and solvent cement complying with ASTM D 2564.

D. Hydraulic Fluid: Elevator manufacturer's standard fire-resistant fluid with additives as needed to prevent oxidation of fluid, corrosion of cylinder and other components, and other adverse effects.

E. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work. Device installation is specified in another Section.

F. Protective Cylinder Casing: PVC or HDPE pipe casing complying with ASME A17.1/CSA B44, of sufficient size to provide not less than 1-inch (25-mm) clearance from cylinder and extending above pit floor. Casing shall have means of monitoring effectiveness to comply with ASME A17.1/CSA B44.

G. Corrosion-Protective Filler: A nontoxic, petroleum-based gel formulated for filling the space between hydraulic cylinder and protective casing. Filler shall be electrically nonconductive, displace or absorb water, and gel or solidify at temperatures below 60 deg F (16 deg C).

1. Hydro Safe Oil Division, Inc.
2. Union-Gard

H. Car Frame and Platform: Welded steel units.

I. Guides: Roller guides; polymer-coated, nonlubricated sliding guides; or sliding guides with guide-rail lubricators. Provide guides at top and bottom of car and counterweight frames.

2.6 OPERATION SYSTEMS

A. General: Provide a non-proprietary microprocessor-controlled dispatching system designed to monitor all types of traffic and sufficiently flexible so that it can be modified to accommodate changes in traffic patterns.

1. Basis of Design: Microprocessor based controller, non-proprietary, **"Motion 2000 Hydraulic Elevator Controller"** with solid state starter as manufactured by **Motion Control Engineering, Inc.** in Rancho Cordova, CA 95742, tel: (916) 463-9200, web: www.mceinc.com.
    a. The system shall continuously monitor the demand based on real time calculations to assign and reassign the elevators to handle the traffic in the most efficient manner.
    b. Provide "anti-nuisance service" whereby all car calls will be cancelled if the load-weighing device detects that an abnormal number of calls are registered given the number of passengers in the car. System using false call answering to accomplish this is not acceptable.
    c. Serial Link Communications: Provide a distributed processing network consisting of localized processors located in machine rooms, car stations, hall stations and top of car to allow system to make fast decisions based on data shared by the processor involved in the different operations of the elevators. For group dispatch operations, all elevators in the group shall be capable of acting as a group common dispatcher as the need arises.
    d. Fault Diagnostic System: Provide Owner with all hardware such as on-board LED. Diagnostics, hand held device or laptop computer, as standard with manufacturer, and supporting software documentation. Diagnostic system shall be capable of determining faults most difficult to find.

B. Simplex selective collective automatic operation shall be provided for all single car installations. Operation of one or more car or hall call pushbuttons shall cause the car to start and run automatically, provided the hoistway door interlocks and car door contacts are closed. The car shall stop at the first car or hall call set for the direction of travel. Stops shall be made in the order in which car or hall calls set for the direction of travel are reached, regardless of the order in which they were registered. If only hall calls set for the opposite direction of travel of the elevator exist ahead of the car, the car shall proceed to the most distant hall call, reverse direction, and start collecting the calls.

1. Provide a microprocessor-based control system to perform functions of elevator motion, car operation dispatching and door control.
2. Arrange for Simplex Selective Collective automatic operation. Operate elevators from a single riser of landing buttons and from operating device in car.
3. Momentary pressure of one or more car or landing buttons, other than those for landing at which car is standing, starts car, and causes car to stop at first landing for which a car or landing call is registered corresponding to direction in which car is traveling. Stops made in order in which landings are reached, irrespective of sequence in which calls are registered.

C. Auxiliary Operations: In addition to primary operation system features, provide the following operational features for elevators where indicated:
1. Single-Car Standby Power Operation: On activation of standby power, car is returned to a designated floor and parked with doors open. Car can be manually put in service on standby power, either for return operation or for regular operation, by switches in control panel located at main lobby or fire command station. Manual operation causes automatic operation to cease.
2. Automatic Dispatching of Loaded Car: When car load exceeds 80 percent of rated capacity, doors start closing.
3. Nuisance Call Cancel: When car calls exceed a preset number while car load is less than a predetermined weight, all car calls are canceled. Preset number of calls and predetermined weight can be adjusted.
4. Independent Service: Keyswitch in car-control station removes car from group operation and allows it to respond only to car calls. Key cannot be removed from keyswitch when car is in independent service. When in independent service, doors close only in response to door close button.

2.7 DOOR REOPENING DEVICES

A. Infrared Array: Provide door reopening device with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams shall cause doors to stop and reopen.

B. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door reopening device, a loud buzzer shall sound and doors shall begin to close at reduced kinetic energy.

2.8 CAR ENCLOSURES

A. General: Provide enameled-steel car enclosures to receive removable wall panels, with removable car roof, access doors, power door operators, and ventilation.
1. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.

B. Materials and Finishes: Manufacturer's standards, but not less than the following:
1. Subfloor: Exterior, C-C Plugged grade plywood, not less than 7/8-inch (22.2-mm) nominal thickness.
2. Finishes: As specified and refer to Articles:
   a. 2.4, C, 9
   b. 2.4, C, 10.

3. Fabricate car with recesses and cutouts for signal equipment.
4. Fabricate car door frame integrally with front wall of car.
5. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
6. Sight Guards: Provide sight guards on car doors.
7. Sills: Finish as specified with grooved surface, 1/4 -inch (6.4 mm) thick.
8. Luminous Ceiling: As specified.
    a. Fluorescent light fixtures and ceiling panels of translucent acrylic or other permanent rigid plastic.
9. Handrails: Manufacturer's standard handrails, of shape, metal, and finish indicated.

2.9 HOISTWAY ENTRANCES

A. Hoistway Entrance Assemblies: Manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Frame size and profile shall accommodate hoistway wall construction.
    1. Where gypsum board wall construction is indicated, frames shall be self-supporting with reinforced head sections.

B. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies shall comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing at as close-to-neutral pressure as possible according to NFPA 252 or UL 10B.
    1. Fire-Protection Rating: 1 hour with 30-minute temperature rise of 450 deg F (250 deg C).

C. Materials and Fabrication: Manufacturer's standards, but not less than the following:
    1. Stainless-Steel Frames: Formed from stainless-steel sheet.
    2. Stainless-Steel Doors and Transoms: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
        a. Finishes: As specified and refer to Article:
            1) 2.4, C, 10
    3. Sight Guards: Provide sight guards on doors matching door edges.
    4. Sills: Finish as specified with grooved surface, 1/4 -inch (6.4 mm) thick.
    5. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M.

2.10 CAR OPERATING STATION

A. Car Operating Station, General: The car control in each car shall contain the devices required for specific operation mounted in an integral swing return panel requiring no applied faceplate. Swing return shall have a clad decorative stainless steel finish as specified, secured tightly to eliminate rattles. The main car operating panel shall be mounted in the return and comply with ADA requirements. Pushbuttons that illuminate using long lasting LED’s shall be included for each floor served, and emergency buttons and switches shall be provided per code.
    1. Polycarbonate pushbuttons shall be manufactured with Microban antimicrobial protection. Switches for car light and accessories shall be provided.

B. Provide a locked service cabinet containing the key switches required to operate and maintain the elevator including, but not limited to:
   1. Light switch
   2. Independent service key
   3. Duplex OFT receptacle

C. Emergency Communications System: Integral phone system provided.

2.11 SIGNAL EQUIPMENT

A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled.
   1. Fabricate lighted elements with LEDs.

B. Car-Control Stations: Provide manufacturer's standard recessed car-control stations. Mount in return panel adjacent to car door unless otherwise indicated.
   1. Mark buttons and switches for required use or function. Use both tactile symbols and Braille.
   2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.

C. Emergency Communication System: Two-way voice communication system, with visible signal, which dials preprogrammed number of monitoring station and does not require handset use. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.

D. Firefighters' Two-Way Telephone Communication Service: Provide flush-mounted cabinet in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in Section 27 1000 “Structured Cabling”.

E. Car Position Indicator: Provide illuminated, digital-type car position indicator, located above car door or above car-control station. Also, provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served. Include travel direction arrows if not provided in car-control station.

F. Hall Push-Button Stations: Provide one hall push-button station at each landing.
   1. Provide manufacturer's standard units with flat faceplate for mounting with body of unit recessed in wall.
   2. Equip units with buttons for calling elevator and for indicating applicable direction of travel.
   3. Provide telephone jack in each unit for firefighters' two-way telephone communication service specified in Section 27 1000 "Structured Cabling".
      a. Possibly insert a provision for either an "In Use" signal or a digital display of car position for single elevators.

G. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Provide the following:
   1. Manufacturer's standard wall-mounted units, for mounting above entrance frames.
   2. Units mounted in both jambs of entrance frame.

H. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.

1. At manufacturer's option, audible signals may be placed on cars.

I. Fire-Command-Center Annunciator Panel: Provide panel containing illuminated position indicators for each elevator, clearly labeled with elevator designation; include illuminated signal that indicates when elevator is operational and when it is at the designated emergency return level with doors open. Provide standby power elevator selector switch(es), as required by ASME A17.1/CSA B44, adjacent to position indicators. Provide illuminated signal that indicates when normal power supply has failed.

J. Emergency Pictorial Signs: Fabricate from materials matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station unless otherwise indicated.

2.12 FINISH MATERIALS

A. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.

B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.

C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.

D. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.

E. Stainless-Steel Bars: ASTM A 276, Type 304.

F. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.

G. Nickel Silver Extrusions: ASTM B 151/B 151M, Alloy UNS No. C74500 or No. C77600.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Verify critical dimensions and examine supporting structure and other conditions under which elevator work is to be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Excavation for Cylinder: Drill well hole in elevator pit to accommodate installation of cylinder; comply with applicable requirements in Section 31 0200 “General Provisions for Earthwork."

B. Provide well casing as necessary to retain well-hole walls.

C. Install cylinder in protective casing within well hole. Before installing protective casing, remove water and debris from well hole and provide permanent waterproof seal at bottom of well casing.

1. Fill void space between protective casing and cylinder with corrosion-protective filler.
2. Align cylinders and fill space around protective casing with fine sand, as acceptable by AHJ.

D. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor. Seal between protective casing and pit floor with 4 inches (100 mm) of nonshrink, nonmetallic grout.

E. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS workmanship and welding operator qualification standards.

F. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.

G. Install piping above the floor, where possible. Install underground piping in casing.

H. Lubricate operating parts of systems as recommended by manufacturers.

I. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay installation of sills and frames until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.

J. Leveling Tolerance: 1/4 inch (6 mm), up or down, regardless of load and travel direction.

K. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.

L. Locate hall signal equipment for elevators as follows, unless otherwise indicated:

1. Place hall lanterns in jamb and either above or beside each hoistway entrance.
2. Mount hall lanterns at a minimum of 72 inches (1829 mm) above finished floor.

3.3 TEMPORARY ELEVATOR USE DURING CONSTRUCTION

A. General: Should the Contractor require the use the **Service Elevator (E-4)** during construction, Contractor shall make arrangements directly with the Installer to coordinate temporary facilities and pay all costs associated with the protection, operation and use of elevators.

B. Maintenance: Elevators shall be maintained on a regular basis during the temporary construction use. A minimum of two hours per week per elevator shall be spent on examination, lubrication, adjusting and cleaning the elevator equipment.

C. Damage: The Owner is entitled to receive new elevator equipment and finishes upon final acceptance of the entire project. The Owner's representative will thoroughly examine all elevator equipment upon completion of temporary use and provide a punch-list outlining items that must be repaired or replaced to ensure the equipment is in new condition. Final acceptance and payment will not be made until all items have been satisfactorily completed.

D. Schedule: Sufficient time must be allowed to prepare and adjust temporary elevators so that the entire elevator installation is ready for final acceptance.

3.4 FIELD QUALITY CONTROL

A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.

B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

1. Provide instruments, weights and personnel to conduct test required by regulatory agencies. Submit a complete report describing the results of the tests.

C. Examination and Testing: When installation is ready for final acceptance, notify the Architect and assist Owner’s Representative in making a walk-through review of entire installation to assure workmanship and equipment complies with contract documents. Provide equipment to perform the following tests:

1. One-hour heat and run test with full load in car. Perform for one car of each duty.
    a. Stop car at each floor in each direction.
    b. Provide well-shielded thermometers for motor and verify that temperatures do not exceed 50 degrees centigrade above ambient temperature.
    c. Performance and leveling tests shall be made before and after heat and run test.
2. Check and verify operation of all safety features and special operations.
    a. Measure horizontal acceleration.
    b. Measure acoustical output levels in machine room, lobbies and cars.
    c. Measure voltage transients and harmonics feedback into building electrical system.

D. Correction: Make corrections to defects or discrepancies at no cost to Owner. Should discrepancies be such that re-examination and retesting is required, the Elevator Contractor shall pay for all costs including those of Owner’s representative fees.

E. Final Acceptance: Final acceptance of the installation will be made only after all corrections are complete, final submittals and certificates received and the Owner is satisfied and installation is complete in all respects.

3.5 PROTECTION

A. Temporary Use: Limit temporary use for construction purposes to one elevator. Comply with the following requirements for elevator used for construction purposes:

1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
2. Provide strippable protective film on entrance and car doors and frames.
3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
5. Do not load elevators beyond their rated weight capacity.
6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate, adjust, and maintain elevator(s).

B. Check operation of elevator with Owner's personnel present before date of Substantial Completion and again not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

3.7 MAINTENANCE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include twelve (12) months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Perform maintenance during normal working hours.
2. Maintain the performance standard set forth in this Specification and maintain correct operation of the dispatching system.
3. Maintain smooth starting and stopping, smooth riding qualities and accurate leveling at all times.

B. Service: Include systematic examination, adjustment, and lubrication of elevator equipment whenever required and replacement of defective parts with parts of same manufacture as required for proper operation. Contractor not responsible for repairs to car enclosures, door panels, frames, sills or platform flooring resulting from normal usage or misuse, accidents and negligence for which Contractor did not cause. Service shall be performed expending a minimum of the following per unit per visit performing preventative maintenance service.

1. Hydraulic Elevators: 1.0 hour per unit twice per month.

C. Elevator Shutdowns: Should any elevator become inoperative, repair within 24 hours of notification of such failure. Breakdown of major components shall be completed and service restored within 72 hours.

1. Include 24-hour-per-day, 7-day-per-week emergency callback service with response time of two hours or less.
2. Failure to comply with above, Owner may order the work done by other contractors at the Contractor's expense.
3. Devices repaired or replaced by others shall, nevertheless, be provided with maintenance by the Contractor who shall become completely responsible for correct operation of such devices for lifetime of this contract

D. Follow-Up Tests: Test all safety devices and emergency operations at six (6) month intervals or more often and submit written report on each test. Make tests at times which do not interfere with building operation.

E. Maintenance Materials:

1. Expendable Parts: Provide a metal cabinet in at least one machine room on project premises containing the following expendable parts required for prompt replacement. Parts used for routine maintenance shall be replenished and stored in machine room to ensure an adequate supply is available.
    a. Two field replaceable resistors of each type installed.
    b. One set hanger sheaves for car and hoistway doors.
    c. Two relays and relay bases of each type installed.
    d. Twenty-four lamps of each type installed.
    e. Car and hall buttons with identical graphics installed; four for manufacturer's standard buttons, one of each type for special buttons.
    f. Six fuses of each type installed.
    g. Any other parts required for prompt replacement.
    h. Lubricants and cleaners of all types used for maintenance.
2. Replacement Parts: Keep the following parts in a warehouse within 50 miles of the project premises.
    a. One door operator motor of each type used.
    b. Transformers of each type installed.
    c. Two complete door interlocks.
    d. Parts for motor drive units.
    e. One complete motor drive of each size installed.
    f. One encoder of each type installed.
    g. Parts for door protective devices.
    h. Such other parts as are needed to insure prompt replacement in event of elevator shutdown such as spare control boards for computer-operated systems.

F. Maintenance Data: After completion and prior to final acceptance, submit three sets of complete and accurate maintenance data specific for each elevator.

G. Maintenance Manuals: Describe proper use and maintenance of equipment, lubrication points, types of lubricants used and frequency of lubricant application, manufacturer's literature describing system maintenance and troubleshooting as specified.

1. Owners Manuals: Describe operation of each feature, i.e. Independent Service, Security Operation, Guard Station Equipment, etc…that is specifically used by the owner or end user. Include details of what to do and what not to do with the elevator equipment In Case of Emergency, Seismic, Fire, Evacuation etc.,
2. Parts Catalogs: Complete listing of all parts of equipment and components used in the installation.
3. Wiring Diagrams: One set mounted in machine room, one bond drawing set and one electronic version on CD delivered to Owner. Wiring diagrams shall be as built, specific for this installation, and reference identification on drawings shall match points identified on terminals of controllers.
4. Maintenance Tool and Software Manuals: Provide maintenance tools and supporting software documentation required for the complete maintenance of the entire system including diagnostics ad adjusting. Maintenance tool may be hand held or built into control system and shall be of the type not requiring recharging or reprogramming nor of the automatic destruct type. The tool and supporting software may be programmed to operate only with this project's identification serial numbering. If control system is of the type that the software is field up loadable, both a copy of the control software and the parameters shall be clearly marked and submitted to the owner on CD.

H. Final Service and Inspection: Two weeks before expiration of the year's maintenance, the equipment shall be lubricated, fully serviced, adjusted to the standards designated and emergency service operation devices shall be checked. A representative of the Owner will make a complete inspection.

- END OF SECTION -

- SECTION 14 9133-

-LAUNDRY AND LINEN CHUTES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Linen (laundry) Chutes, doors, venting and accessories.

1.3 RELATED REQUIREMENTS

A. Pertinent Sections specifying Volatile Organic Compound (VOC) Content Restrictions.

B. Section 01 6116 “Volatile Organic Compound (VOC) Restrictions”

C. Section 03 3000 “Cast-In-Place Concrete”.

D. Section 05 5000 “Metal Fabrications”.

E. Section 07 6200 “Sheet Metal Flashing and Trim”.

F. Section 07 8413 “Penetration Firestopping”.

G. Section 09 2116 “Gypsum Board Assemblies”.

H. Section 09 2216 “Non-Structural Metal Framing”.

I. Section 21 1000 “Fire Suppression Systems” for fire sprinklers within chute.

J. Division 21: Connection to fire sprinklers.

K. Division 22: Hook-ups for water services – disinfecting and sanitizing unit.

L. Division 26: Hook-ups for electrical services.

M. Division 28: Smoke Detectors.

N. Marriott’s Fire Protection and Life Safety Design Standards (Module 14).

1.4 REFERENCES

A. "Phoenix Building Construction Code", International Building Code 2006, with City of Phoenix administrative provisions and amendments.

B. International Mechanical Code with City of Phoenix administrative provisions and amendments.American National Standards Institute (ANSI) Publications.

C. National Fire Protection Association (NFPA) Publications:
   1. 13 "Installation of Sprinkler Systems".
   2. 82. "Standard on Incinerators and Waste and Linen Handling Systems and Equipment".

D. Underwriter's Laboratories, Inc. (UL).

1.5 SUBMITTALS

A. General: Submit in accordance with Section 01 3300.

B. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

C. Product Data: For each type of product indicated, demonstrate compliance with specified attributes.

D. VOC Submittals:
   1. Product Data – VOC Limits: For adhesives sealants, fillers and primers, documentation including printed statement of VOC contents, comply with limits specified in Section 01 6116.

E. Submit "Letter of Conformance" in accordance with Section 01 3300 indicating specified items selected for use in project with the following supporting data.
   1. Mark each copy to identify applicable products, characteristics, models, options and other supplemental data to clearly communicate information specific to this project.
   2. Product Data: Submit manufacturer's product specifications, standard details, installation instructions and general recommendations for total pre-engineered chute system. Mark-up data sheets to indicate actual selections for sizes and other details of installation.
   3. Shop Drawings: Submit 1/4 -inch scale section/elevation drawing, 1/2 -inch scale typical landing plans, and 1-1/2 -inch scale details of chute fabrication. Distinguish between factory fabrication and field assembly work. Show required piping, wiring connections and conduit runs for wiring.
   4. Quality Control Submittals:
      a. Test Reports: Fire rating, in duplicate.
   5. Certifications:
      a. Contractor's Certification that:
         1) Manufacturer's certification that installer of manufacturer's product is approved.
      b. Applicable standards: NFPA 82, standards as referenced herein.

1.6 QUALITY ASSURANCE

A. Reference Standards: Applicable requirements of standards and specifications referenced herein apply to the Work of this Section.

B. Chute and Accessories: Conform to NFPA, UL and Local Code requirements.

C. Sprinklers: Comply with requirements of NFPA 13 and NFPA 82.

1.7 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements of Section 01 6000.

B. Deliver materials to job site in unopened containers bearing manufacturer's name and content identification.

C. Store materials as recommended by the manufacturer.

1.8 PROJECT CONDITIONS

A. Coordination: Coordinate this Work with the Work of other Sections to avoid any delay or interference with other Work.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Limits for adhesives sealants, fillers and primers. Comply with limits specified in Section 01 6116.

2.2 MANUFACTURERS

A. Avendra, LLC Preferred Manufacturers:
   1. None

B. Approved Manufacturers:
   1. Wilkinson-Hi-Rise, LLC., www.whrise.com (800-231-3888)
   2. Midland Chutes (847-678-4007)
   3. US Chutes Corp. (800-872-4883)
   4. Chutes International, Terra Pacific Waste Management, (800-882-4883)

2.3 LINEN CHUTE

A. Chute Sections: 16 gage aluminized steel per NFPA 82, 24 -inches diameter.
   1. Factory assemble sections to greatest extent possible. Disassemble only as necessary for shipping and handling limitations. Clearly mark for reassembly and coordinated installation.

2. Design sections to flash inside sections below, with no bolts, clips or other projections inside chute to snag flow of materials.
3. Except for joints required for shipment and installation, provide factory welded or lock-seamed tight joints.
4. Provide expansion joint in chute between supporting grid floor frames.

B. Vent: Extend full diameter chute section through roof; terminate top 4'-0" above roof unless required otherwise by Authority having Jurisdiction and approved by Architect. Equip 16 gage aluminized steel vent cap with ventilation air space around full diameter of vent riser, insect screen, condensation gutter, roof flashing.
1. Provide roof curb at low slope roofs, installed by roofing contractor.
2. Comply with NFPA Code 82.
3. Hinged metal safety cap.
4. Explosion cap design
5. Roof cap to allow 10 percent venting under normal use with hold down clips and hinges for manual release with 100 percent venting in case of file.
   a. In accordance with authority having jurisdiction.
6. Bird screen

C. Door Units:
1. UL Labeled Door Units: Provide UL 1-1/2 hour labeled door units with 30-minute temperature rise of 250 deg. F., (139 deg. C.), complete with closers.
2. Chute Intake Door/Frame Units:
   a. General:
      1) Provide self-closing units at each landing and at heights above floor as indicated.
      2) Use manufacturer’s recommended heights if not otherwise shown.
      3) Factory Bolt Doors to Intake Throat.
   b. Size: (Refer to Drawings and coordinate types with Shop Drawing review)
      1) Side Hinged: Provide 18 -inch by 18 -inch door size.
      2) Bottom Hinged: Provide 21 -inch by 18 -inch door size.
   c. Latching:
      1) Equip doors with positive latch, latch handle, and manufacturer's standard keyed cylinder locks.
      2) Provide manufacturer's standard stainless steel door units, ANSI Type 302/304 with standard satin finish or No. 3 directional polish.
   d. Locking: Architect shall select from the following;
      1) Push Button – fully pneumatic operation
         a) ADA compliant.
         b) Include interlock between all chute doors.
         c) Provide cylinder locks additionally.
3. Discharge Hopper: Horizontal rolling, UL 1-1/2 hour labeled, spring counterbalanced with fusible link. Provided with required offsets and reinforcing, structural angle door around discharged opening, 2 -inch IPS drain at low point of hopper, pipe pedestal support, 28 – inch wide by 36 -inch high x 14 gage stainless steel hopper door, manufacturer's standard self-latching devices.
4. Accessories:

a. Flushing Spray Head: (Sanitizing & Disenfecting) 3/4 -inch IPS; installed above top intake door.
   1) Provide and install required size stainless steel side hinged access door bearing a UL “B” label.
      a) Refer also to Section 08 3113 “Access Doors”
   2) Provide and install piping from Flushing Spray Head to location as directed by Architect.
      a) Coordinate with Plumbing contractor and division 22 specifications.

b. Sprinkler Heads: 1/2 IPS; located at or above top service opening of chute, at alternate floor levels in buildings over two stories in height, and at lowest service area, unless otherwise required by local code.
   1) Recess heads out of chute area through which linen travels, with recessed area designed to avoid collection of foreign matter.

c. Offsets (bends) in the chute, if required, shall be made the same diameter as the chute of 16 gage aluminized steel and have an additional layer of 13 gage aluminized steel reinforcing the impact area. Offsets are not to deviate more than 15 degrees off the vertical axis of the chute.

d. Adjustable discharge pedestal attached to Hopper with base place secure to floor.

5. Electrical Interlocks: Equip the intake door units with electrical interlocks. All doors are normally unlocked. When system is energized by opening one door, the remaining doors shall be automatically locked until system is de-energized. Provide manual control switch stations where indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas in which Work is to be performed. Report in writing, to Owner’s Representative, all prevailing conditions that will adversely affect satisfactory execution of Work. Do not proceed with work until unsatisfactory conditions have been corrected.

B. Starting Work constitutes acceptance of the existing conditions and this Contractor shall then, at their expense, be responsible for correcting all unsatisfactory and defective Work encountered.

3.2 INSTALLATION

A. General: Comply with chute manufacturer's instructions and recommendations. Assemble components with tight, non-leaking joints and anchor securely to supporting structure with sufficient anchorages to withstand impact and wind loading stresses on vent units. Provide for thermal expansion movement of chute sections. Except as otherwise indicated, install chutes plumb, without offsets of obstructions, for free fall of materials within chutes. Install chute systems complete with doors, and with safety and fire-resistive components and accessories.

B. Intake and Discharge Doors: Install doors at heights and locations indicated. Provide anchorages, wall/chute interfaces, self-closing operation, self-latching and similar features of installation to comply with labeling and fire-resistive requirements for fire-resistive door construction. Interface door units with throat sections of chutes in a manner which will ensure safe, snag-proof, sanitary depositing of materials in chutes by users.

1. Coordinate foot-pedal door operator installation with door and enclosure wall installation.

3.3 TESTING, ADJUSTING, CLEANING

A. Test operate components of chute system upon completion of installation; demonstrate use and safety features to Owner's personnel. Operate doors, locks and interlock system to demonstrate that hardware is adjusted and electrical wiring is connected correctly. Where possible, complete test operations prior to installation of shaft enclosures.

B. Cleaning: Following completion of enclosure walls and ceilings, clean exposed surfaces of finished metal components of chute system. Remove foreign substances and repair imperfections in finishes, but do not remove UL labels.

3.4 DEMONSTRATION

A. Arrange demonstration of system operation, conducted by manufacturer's representative, to Owner's maintenance personnel.

- END OF SECTION -

a. Flushing Spray Head: (Sanitizing & Disenfecting) 3/4 -inch IPS; installed above top intake door.
   1) Provide and install required size stainless steel side hinged access door bearing a UL "B" label.
      a) Refer also to Section 08 3113 "Access Doors"
   2) Provide and install piping from Flushing Spray Head to location as directed by Architect.
      a) Coordinate with Plumbing contractor and division 22 specifications.

b. Sprinkler Heads: 1/2 IPS; located at or above top service opening of chute, at alternate floor levels in buildings over two stories in height, and at lowest service area, unless otherwise required by local code.
   1) Recess heads out of chute area through which linen travels, with recessed area designed to avoid collection of foreign matter.

c. Offsets (bends) in the chute, if required, shall be made the same diameter as the chute of 16 gage aluminized steel and have an additional layer of 13 gage aluminized steel reinforcing the impact area. Offsets are not to deviate more than 15 degrees off the vertical axis of the chute.

d. Adjustable discharge pedestal attached to Hopper with base place secure to floor.

5. Electrical Interlocks: Equip the intake door units with electrical interlocks. All doors are normally unlocked. When system is energized by opening one door, the remaining doors shall be automatically locked until system is de-energized. Provide manual control switch stations where indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas in which Work is to be performed. Report in writing, to Owner's Representative, all prevailing conditions that will adversely affect satisfactory execution of Work. Do not proceed with work until unsatisfactory conditions have been corrected.

B. Starting Work constitutes acceptance of the existing conditions and this Contractor shall then, at their expense, be responsible for correcting all unsatisfactory and defective Work encountered.

3.2 INSTALLATION

A. General: Comply with chute manufacturer's instructions and recommendations. Assemble components with tight, non-leaking joints and anchor securely to supporting structure with sufficient anchorages to withstand impact and wind loading stresses on vent units. Provide for thermal expansion movement of chute sections. Except as otherwise indicated, install chutes plumb, without offsets of obstructions, for free fall of materials within chutes. Install chute systems complete with doors, and with safety and fire-resistive components and accessories.

B. Intake and Discharge Doors: Install doors at heights and locations indicated. Provide anchorages, wall/chute interfaces, self-closing operation, self-latching and similar features of installation to comply with labeling and fire-resistive requirements for fire-resistive door construction. Interface door units with throat sections of chutes in a manner which will ensure safe, snag-proof, sanitary depositing of materials in chutes by users.

1. Coordinate foot-pedal door operator installation with door and enclosure wall installation.

3.3 TESTING, ADJUSTING, CLEANING

A. Test operate components of chute system upon completion of installation; demonstrate use and safety features to Owner's personnel. Operate doors, locks and interlock system to demonstrate that hardware is adjusted and electrical wiring is connected correctly. Where possible, complete test operations prior to installation of shaft enclosures.

B. Cleaning: Following completion of enclosure walls and ceilings, clean exposed surfaces of finished metal components of chute system. Remove foreign substances and repair imperfections in finishes, but do not remove UL labels.

3.4 DEMONSTRATION

A. Arrange demonstration of system operation, conducted by manufacturer’s representative, to Owner’s maintenance personnel.

- END OF SECTION -

DIVISION 21 – FIRE SUPPRESSION

TABLE OF CONTENTS

Pages

- SECTION 21 1000 -

FIRE SUPPRESSION SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Pipe and Fittings.
2. Sprinklers.
3. Fire Pump & Accessories.
4. Standpipes.

B. Related Documents:

1. Marriott's Fire Protection and Life Safety Design Standards (Module 14):
   a. Marriott's Fire Protection and Life Safety Design Standards apply to all Marriott International Brands as well as Owned, Managed and Franchised properties.
   b. Marriott's Fire Protection and Life Safety Design Standards include Design Standards, performance criteria, reference standards and life safety process verification that define a comprehensive fire protection program.

C. References

1. International Building Code (IBC), 2006 Edition, with City of Phoenix Amendments.
2. International Fire Code (IFC), 2006 Edition, with City of Phoenix Amendments.
3. Marriott, Courtyard – "Module 14, Fire Protection & Life Safety" standards.
4. Marriott, Residence Inn – "Module 14, Fire Protection & Life Safety" standards.
5. National Fire Protection Association 13 (NFPA 13) – "Standard for the Installation of Sprinkler Systems," 2013 Edition.
6. National Fire Protection Association 14 (NFPA 14) – "Standard for the Installation of Standpipe and Hose Systems," 2013 Edition.
7. National Fire Protection Association 20 (NFPA 20) – "Standard for the Installation of Stationary Pumps for Fire Protection," 2013 Edition.
8. National Fire Protection Association 24 (NFPA 24) – "Standard for the Installation of Private Fire Service Mains and Appurtenances," 2013 Edition.
9. National Fire Protection Association 25 (NFPA 25) – "Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems," 2011 Edition.
10. National Fire Protection Association 101 (NFPA 101) – "Life Safety Code®," 2012 Edition

D. Related Sections:

1. Section 21 05 00 (15050) – Common Work Results for Fire Suppression
2. Section 28 31 00 (13850) - Fire Alarm and Detection Systems: Wire and connection of sprinkler flow and tamper switches

1.02 SYSTEM DESCRIPTION

A. The Fire Protection Subcontractor is responsible for code compliance, research, design, coordination, and installation of a complete and functional hydraulically calculated sprinkler system (and standpipe system, if required) that meets the approval of and is in accordance with all applicable regulations and requirements of the following and as further specified:

1. Current editions of NFPA 13, 14, 20, 25, and 96.
2. Applicable Codes.
3. Authorities having jurisdiction.

B. Alarm system devices including alarm valves, flow switches, pressure switches, tamper switches and coordination with Fire Alarm and Detection Subcontractor.

C. Shop drawings and calculations prepared and submitted in accordance with the requirements of all Authorities Having Jurisdiction.

D. Obtaining all permits and approvals of the fire protection system.

E. Field acceptance testing.

1.03 SUBMITTALS

A. Submit “Letter of Conformance” in accordance with Section 01 33 00 with the following supporting data:

1. Product Data:
   a. Mark each copy to identify applicable products, characteristics, models, options and other supplemental data to clearly communicate information specific to this project.
   b. Submit separate "Letter of Conformance" for each specified item.
2. Shop Drawings and calculations sealed by a registered Professional Engineer, NICET III or IV Sprinkler Designer, licensed in the state where the project is located.
3. Be responsible for code research and obtaining all required flow test data and hydraulically designing a fire protection system that meets all applicable requirements. Arrange for, and conduct the flow test.
4. Fire protection submittal data shall include the following:
5. Flow Test Data.
6. Complete Hydraulic Calculations.
7. Complete Stamped and Coordinated Shop Drawings.
8. Pipe and Fittings.
9. Valves.
10. Sprinkler Heads.
11. Escutcheons.

12. All Applicable Devices, Alarms, and Specialties.
13. Air Compressor and Accessories (If required)
14. Applicable Control/Wiring Diagrams.
15. Fire Department Connections
16. Valve Cabinets
17. Backflow Preventers.
18. Pressure-reducing valves.
19. Fire pump, fire pump data including certified pump performance curve.
20. Fire pump test header.
21. Jockey pump, jockey pump data
22. Controller and transfer switch data.

B. Submittal data shall be bound sets and be submitted at one time in accordance with Section 01330 (01 33 00) - Submittals and Substitutions.

C. Transmit fire protection submittal data to Zurich Services Corporation, Marriott's Fire Protection Department, and to the local and state Authorities having jurisdiction and licensing agencies for approval.

1. Mailing Addresses:

a. Marriott International, Inc.
Marriott Corporate Fire Protection, Dept. 52/924.36
1 Marriott Drive
Washington, D.C. 20058

b. Zurich Services Corporation
Risk Engineering Department
1818 Market Street, 21st Floor
Philadelphia, PA 19103
Attn: Mr. Richard Gallagher, Sr. Risk Engineer Consultant

D. Do not proceed with work without final approved submittal data bearing all approval stamps including Marriott's Fire Protection Department approval stamp.

E. Be responsible for delays caused by not following the above procedure and/or not completing the design portion of the work in a timely manner.

F. Record Documents:

1. Refer to Section 01 78 39 - Project Record Documents and Section 01 78 23 - Operating and Maintenance Data for required closeout documents to be provided at completion of Project. In addition to the documents listed in these Sections, the following documents shall be included:

a. Provide above/below ground test certificates.

b. Record Documents shall include System Drawings, Equipment Data and Operation Instructions, and Maintenance Instruction Manuals.

2. As-Built Drawings

a. Maintain at the site an up-to-date marked set of as-built drawings, which are required to be corrected and delivered to the Owner upon completion of work.

b. Upon completion, furnish the Owner with 3 sets of reproducible prints of each reviewed shop drawing, revised to show "as-built" conditions.

1.04 QUALITY ASSURANCE

A. Refer to Section 21 05 00 (15050) – Common Work Results for Fire Suppression.

B. Fire Pump: The manufacturer shall provide the services of a qualified Field Engineer to assist in the proper installation of equipment, make necessary mechanical adjustments, and align fire pump flexible coupling. Arrange, conduct and provide all required test equipment for Field Acceptance Test. Test shall be witnessed by the Fire Marshal and the authority having jurisdiction and the Owner.

C. MANUFACTURERS

1. All sprinkler system equipment is to be UL Listed.

1.05 DESIGN

A. Water supply data

1. A fire hydrant flow test was conducted on July 2, 2013 with the following results:
   a. Static – 78 pounds per square inch (psi)
   b. Residual – 76 psi
   c. Flow – 2,717 gallons per minute (gpm)
   d. Orifice – 4” Connection
2. Water supply data is to be reduced by 10 psi for hydraulic calculations.
3. Water supply data without reductions is to be used for sizing of the fire pump and determination of pressure regulating hose connection locations.

B. Zoning: At a minimum, the system shall be zoned by floor and coordinated with smoke control system zones, or as required to meet the approval of all applicable Codes and Authorities, whichever is most stringent.

C. Inspectors test connections: Locate at the remote end of each zone with discharge pipe to exterior.

D. High-Rise Buildings: Connect guest room floor sprinkler piping to two (2) risers at each floor with a control valve, waterflow switch, and valve tamper switch (at each connection and inspectors test connection). At non-guest room levels, locate inspector’s test connection at remote end of each zone with discharge pipe to exterior.

E. High-Rise Buildings are buildings exceeding 75 feet in height to the floor of the highest occupiable story from the lowest level of fire department access.

F. Design densities (based on NFPA 13 requirements):

1. Guest Rooms: Wet pipe system with 0.10 gpm per square foot, all heads (up to a maximum of 5) in the largest most remote guestroom plus 100 gpm for hose.

2. Public Spaces, Offices, and Dining Room: Wet pipe system with 0.10 gpm per square foot over the most remote 1,500 square feet plus 100 gpm for hose.
3. Kitchen Areas: Wet pipe system with 0.15 gpm per square foot over the most remote 1,500 square feet area plus 250 gpm for hose.
4. Mechanical rooms, Laundry, Storage, and Service Areas: Wet pipe system with 0.13 gpm per square foot over 2,500 square feet plus 250 gpm for hose.
5. Kitchen Exhaust Ductwork: Wet pipe system with 0.15 gpm per square foot over the entire cooking hood and duct plan area plus 100 gpm for hose.
6. Attics: Light hazard wet pipe system with 0.10 gpm per square foot to the most remote 1,500 square feet plus 100 gpm for hose.
7. Attics: Ordinary Hazard and Service Equipment Areas: Wet pipe system with 0.15 gpm per square feet over the most remote 1,500 square foot area plus 100 gpm for hose.

G. Laundry chutes are required to be sprinklered at the top level, bottom level and every other floor.

H. Class I Standpipe systems are required to provide 500 gpm to the hydraulically most remote hose connections and an additional 250 gpm to the top most outlets for each additional standpipe, up to a maximum of 1,000 gpm.

1.06 COORDINATION

A. The Fire Protection Subcontractor shall be responsible for reviewing the complete set of Contract Documents and coordinating his work with all other trades involved including building design loads.

B. Sprinkler head locations shall be as shown on the Architectural Reflected Ceiling Plans. If the Contractor finds that additional sprinklers are required to meet Codes, the Contractor shall proceed with the additional sprinklers at no additional cost to the Owner.

C. The fire protection piping and sprinkler layout shall function in such a manner so as not to interfere with lighting fixtures, air distribution devices, equipment, piping, beams, and ductwork. The work under this section shall yield to all other trades.

1.07 SPRINKLER/STANDPIPE SYSTEM

A. Provide the building with a complete, approved, operational sprinkler system in all areas.

B. Provide wet-pipe sprinklers for habitable spaces such as guestrooms, guestroom corridors, restaurants, meeting rooms, and public areas.

C. Design documents are for information only. The Sprinkler subcontractor shall be responsible for the actual layouts, routing of piping, and additional sprinkler heads to meet all requirements of the authority having jurisdiction as well as the provision of a fire pump as required.

D. Be responsible for freeze protection as follows:

1. A dry pipe system shall be provided in the attics and in any other unheated areas where necessary so as to prevent freezing. The dry pipe system shall be complete with a tank

mounted air compressor, storage tank, controls, valves, galvanized steel pipe, and all necessary appurtenances for a complete, functional system. Dry pipe system shall be pitched to avoid freezing. Termination of drains shall be approved by Marriott's Fire Protection Department.

a. The entire dry pipe system must utilize hot dipped galvanized steel pipe.

2. Dry type sprinklers may be provided off the wet system in unheated areas such as the landscape storage room, or laundry dryer enclosure.
3. Wet piping shall not be routed through unheated areas, such as attics, etc.
4. For repairing and/or all costs incurred from damage caused by freezing of the fire protection system.
5. Use of Heat-tape is not acceptable.
6. The dry pipe system is required to deliver water to the system test connection within 60 seconds, starting at the normal air pressure on the system and at the time of fully opened inspection test connection.
7. Anti-Freeze systems are not acceptable.

E. Provide a combination sprinkler/standpipe riser system.

F. Provide Class I standpipe hose connections in accordance with IBC Section 905 and NFPA 14, within all required exit stair enclosures.

G. The sprinkler layout for the guest rooms, suites, and corridors shall be as required to meet the approval of all applicable Codes, and Local Authorities whichever is most stringent.

H. The Contractor shall provide an electric-drive horizontal split-case fire pump complete with a jockey pump, controller, automatic transfer switch, and all devices necessary for a complete, approved functional system per NFPA 20, and City of Phoenix.

I. Guest Room Bathrooms: Sprinklers not required if less than 55 square feet unless combustible (with flame spread rating of greater than 25; i.e., fiberglass or plastic) tubs or shower enclosures are used.

J. Pressure Reducing Valves: Design system within maximum pressure of 175 psi without use of pressure reducing valves. If this is not possible and pressure reducing valves are required, consult Marriott Fire Protection.

K. Safety Factor: Provide a 10 psi hydraulic safety factor.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. All sprinkler system equipment and components are required to be used in accordance with the manufacturer's recommendations and its UL listing and/or FM approval.

2.02 PIPE AND FITTINGS

A. Schedule 40 steel piping is required for branch lines. Pipe ends are required to be threaded or roll grooved in accordance with NFPA 13.

B. Schedule 10 piping is required for mains. Pipe ends are required to be roll grooved in accordance with NFPA 13.

1. Screwed fittings are required to be cast iron, 175 pound class, black, and in accordance with ANSI B 16.4 or malleable iron, 175 pound class, black and in accordance with ANSI B 16.3. Bushings may not be used.
2. Weld fittings are required to be steel, standard weights, black, and in accordance with ASME B 16.9, ASME B 16.25, ASME B 16.5, ASME B 16.11 and ASTM A 234.
3. Grooved fittings and couplings are required to be produced by the same manufacturer.
4. Grooved couplings are required to be dimensionally compatible with pipe.

C. Listed CPVC pipe may be used in residential areas in accordance with NFPA 13 and manufacturers listings. Pipe within corridors and common areas is required to be black steel.

D. Hot dipped galvanized pipe is required when exposed to the exterior of the building.

E. Hot dipped galvanized pipe is required for all drain system piping downstream of any drain valves.

F. Exposed piping and fittings in kitchen suppression systems shall be chrome-plated.

2.03 KITCHEN HOOD AND DUCT FIRE SUPPRESSION

A. Where kitchen hood and duct systems are part of the sprinkler contractors scope of work, the following sections apply:

1. Provide a complete "Ansul Piranha" automatic, water-assisted, wet chemical, fier suppression system by Tyco Fire & Security for protection of the exhaust duct and all grease-producing cooking surfaces located under canopy hoods. The system, including all of its components shall be UL Standard 300 listed.
2. Kitchen hood and duct system flow switch (or control units of the Ansul fire suppression system) to perform these functions:
   a. Send fire alarm signal to FACP
   b. Disconnect gas and all electric for cooking appliances and lighting under the hood (manual reset is required).
   c. Shut-off kitchen hood make-up air handler.

2.04 SPRINKLERS

A. Sprinklers shall be UL Listed.

B. Sprinklers and escutcheons shall have a white finish unless noted otherwise.

1. Concealed sprinklers are not acceptable.

C. Sprinklers: Fast-response 68 degrees C – 74 degrees C (155 degrees F – 165 degrees F), recessed or semi-recessed type sprinklers throughout, except as follows:

Room/Space	Sprinkler Type	Temp. Rating
Attic Systems	Quick Response – ventilated	100 degrees C (212 degrees F)
	Quick Response – unventilated	141 degrees C (286 degrees F)

Drypipe Systems	Quick Response	100 degrees C (212 degrees F)
Mech./Elect.	Quick Response	68 degrees C – 74 degrees C
Elevator Machinery	Quick Response	100 degrees C (212 degrees F)
Swimming Pools	Corrosion - proof-	68 degrees C – 77degrees C
	Quick response	(155 degrees F –170 degrees F)
Porches	Dry-side wall, corrosion-proof / Quick response	100 degrees C (212 degrees F)
Balcony (combustible)	Dry-side wall, corrosion-resistant / Quick response	100 degrees C (212 degrees F)
Sauna/Steam Rooms	Corrosion-proof / Quick Response	141 degrees C (286 degrees F)
Walk-in Coolers/Freezers	Dry pendent / Quick response	74 degrees C (165 degrees F)
Parking Structures	Quick Response	100 degrees C (212 degrees F)

D. Sprinklers in unfinished areas are required to be rough brass finish. Sprinklers and escutcheons in finished areas are required to have white paint finish.

E. Pendent sprinklers installed in areas where ceilings are located are required to be semi-recessed and center or quarter point of tile.

F. Sidewall sprinklers installed in areas where ceiling treatment prevent pendent sprinklers from meeting coverage requirements.

2.05 FIRE HOSE VALVES

A. Hose threads shall match those used by the AHJ. Each hose valve shall be provided with an approved pressure-reducing device designed to limit nozzle pressure, where pressures exceed 175 psi.

1. Where it is not possible to design the system without the use of pressure reducing hose valves, consult Marriott Fire Protection.

2.06 SPRINKLER SYSTEM VALVES

A. Control valves shall be listed/approved indicating type:

1. OS & Y valves shall be resilient seat type.
2. Butterfly valves shall be gear operated.
3. Ball valves shall be gear operated with full port.
4. Drain, trim, and test valves shall be approved.

B. Check Valves and Back Flow Preventers:

1. Check valves for water supply, fire department connections and risers shall have removable covers for maintenance without removing the valve from the system.
2. Check valves in the trim shall be approved.

2.07 FIRE DEPARTMENT CONNECTION

A. Provide a wall-mounted flush connection with a minimum of three 2½-inch inlets in accordance with the Phoenix Fire Department.

B. Plate shall be permanently marked with “AUTO SPKR / STANDPIPE”.

C. Finish for plate and connector shall be coordinated with the Architect.

D. Locking stainless steel caps with swivel covers are required to be provided and approved by the AHJ.

2.08 WATERFLOW, ALARM, AND SUPERVISORY SWITCHES

A. Alarm Bells:

1. Electric bells and wiring diagrams shall be delivered to the alarm Contractor for installation and wiring.

B. Water Flow Switch

1. Description: FM approved and UL listed with two single pole double throw micro switch rated for 120 volt operation.

C. Alarm and Supervisory Switches:

1. Deliver wiring diagrams to alarm Contractor.
2. Install alarm water flow switches in accordance with switch and valve manufacturers’ instructions.
3. Install and adjust valve supervisory switches in accordance with switch manufacturers’ instructions.

2.09 FIRE PUMP

A. General Assembly

1. Pump assembly shall be a horizontal split case type fire pump, complete with driver, accessories, and controller, all conforming to the standards of NFPA 20, and in accordance with the requirements of UL listing and FM approval.
2. Provide a complete fire protection pumping system.
3. The assemblies shall include an electric motor-driven fire pump, and electric motor-driven jockey pump with integrated control system and all accessories necessary to complete the installation in every respect. All equipment shall be supplied as a package by the Contractor. Prior to shipment, pump and driver shall be thoroughly shop tested by the pump manufacturer. A characteristic curve showing the pump performance and speed variation based upon the results of the shop test shall be furnished by the manufacturer.
4. The test header shall be located on the north wall of the building at approximately 40 inches above grade.

B. Fire Pump

1. Pump

a. The pump shall be UL listed and FM approved, single stage, horizontal shaft, bronze fitted split case type, having a minimum discharge capacity of 1,000 gpm and a design head of 145 psi when operating at the rated speed. The pump and

driver shall both be mounted on a one-piece rigid cast iron or welded steel drip rim base. Pump casing shall be cast iron or welded steel drip rim base. Pump casing shall be cast iron and equipped with duplex angular contact radial and thrust outboard ball bearing and a single row, radial inboard ball bearing. Power shall be transmitted from the driver to the pump by means of a flexible coupling with cast aluminum or steel coupling guard.

2. Pump Controller

   a. The pump controller shall be manual and automatic type arranged for floor mounting, in a drip-proof NEMA 2 enclosure with front access, listed for the intended service. Pressure switch shall be low differential type with a range of 0 to 300 psi. Pressure switch settings and a program timer shall be adjusted at the time of initial fire pump acceptance test.

   b. The controller shall be wired for manual stop.

   c. The controller shall be provided with dry relay S.P.D.T. contacts (for connecting by the alarm contractor) for remote annunciation of the following supervisory functions separately:

   d. Control switch in “OFF” or “MANUAL” position.

   e. Phase reversal.

   f. A.C. power failure.

3. Jockey Pump

   a. Pump

      1) The pump shall be motor driven as herein specified, and motor mounted on a base plate.

      2) The jockey pump shall be a close-coupled, horizontal, turbine pump. Pump casing shall be cast iron, bronze fitted, equipped with mechanical shaft seal, stainless steel shaft and water lubricated sleeve bearing. Pump shall be furnished with 1¼-inch threaded suction inlet and 1¼-inch threaded discharge outlet.

   b. Jockey pump motor

      1) The motor shall be solid shaft, ball bearing, squirrel cage induction design not more than 4 horsepower suitable for operation on 480 volt, three phase A.C., of such capacity, that at rated voltage and frequency, pump will not exceed full load ampere rating of the motor under any condition of pump load.

   c. Jockey pump controls

      1) Provide a motor starter switch with hands-off-automatic selector switch mounted in the cover, and a low differential type pressure switch, 0 to 300 psi range.

   d. Provide a 1¼-inch OS & Y gate valve on suction side, one 1¼-inch OS & Y gate valve and one 1-inch check valve on discharge side of jockey pump.

   e. Provide a direct acting type relief valve on the discharge pipe between jockey pump and check valve.

   f. Provide waste piping from fire pump relief valve to reservoir, discharging away from pump suction.

4. Concrete pump pads are to be provided by the Contractor.

C. Accessories

1. The pump assembly includes, but is not limited to:

a. Pressure recorder required by FM and NFPA 20.
b. Concentric discharge increaser.
c. Eccentric reducer.
d. Discharge tee.
e. Suction and discharge gauges.
f. Capacity plate, automatic air release valve.
g. Circulation relief valve.
h. 6-inch test header.
i. Outside hose valve head and a minimum of four (4) 2½-inch hose valves with caps and chains.

2.10 SLEEVES FOR WALL/FLOOR PENETRATIONS

A. Sleeves through walls and floors are required to be of a type that can be made watertight and fire stopped.

B. Sleeve sizes are to be as required by NFPA 13 for Earthquake Protection.

2.11 HANGERS

A. All hanger components are to be of an approved and listed type.

PART 3 EXECUTION

3.01 PREPARATION

A. Product Delivery

1. Delivery of Materials: Delivery of all materials and equipment to the job site is required to be scheduled to assure compliance with the predetermined construction schedules.
2. Storage of Materials, Equipment, and Fixtures: Contractor will be responsible for storage of materials on job site, including furnishing of any storage facilities or structures required.
3. Handling Materials and Equipment: Contractor will be responsible for on-site handling of materials and equipment.

3.02 FABRICATION

A. Pipe Ends

1. Ream and remove burrs after cutting pipe. Standard wall pipe ends are required to be welded, threaded, cut grooved, or plain end.
2. Thin wall pipe ends are required to be plain end, welded or roll grooved in accordance with the fitting manufactures' recommendation.
3. Threads are required to be in accordance with ASME B1.20.1.

B. Grooved Ends

1. Pipe minimum thickness, squareness, and out-of roundness are required to be in accordance with the coupling manufacturer's specifications.
2. Pipe surface is required to be free of indentations, projections, or roll marks from the end of the pipe to the groove.

C. Welding

1. No field welding of sprinkler piping will be permitted.
2. Headers risers, feed mains, cross mains and branch lines may be shop welded using acceptable welding fittings. Welding methods are to comply with all the requirements of AWS B2.1.
3. Certified records are to be maintained upon the completion of each weld, welder is required to stamp an imprint of their identification into the side of the pipe adjacent to the weld.

3.03 INSTALLATION

A. General

1. A clean set of prints or shop drawings is required to be maintained at the site and marked up to show any changes.
2. Piping is required to be installed above ceilings except in areas where there is no ceiling. Install piping in exposed areas as high as possible using necessary fittings and auxiliary drains to maintain maximum clear head room.

B. Hangers, Supports, and Bracing

1. General
   a. All piping must be substantially supported from building structure and only approved types of hangers may be used. Piping lines under ducts may not be supported from duct work, but are required to be supported from building structure with trapeze hangers where necessary or from steel angles supporting duct work in accordance with NFPA 13.
   b. All thread rods may not be bent.
   c. Hanger components are required to be ferrous.

C. Sleevings, Wall & Floor Penetrations

1. Set Schedule 40 sleeves in place for all pipes passing through openings in fire resistance rated construction when required by UL listing for fire stopping method utilized.
2. Provide clearance between the sprinkler piping and sleeves in accordance with NFPA and/or FM. The space between sleeve and pipe is required to be filled with noncombustible, UL listed fire stopping materials. Provide chrome wall plates at each side of wall.

D. Install and support fire protection system to resist all applicable seismic forces per requirements.

E. Locate wet pipe and dry pipe inspector test valves and associated sight glasses at remote ends of system, in accessible locations. Provide drain pipes to exterior. Do not discharge onto sidewalks or landscaping.

F. Under no circumstance shall wet sprinkler pipes be routed through attics or other unheated spaces.

G. Access panels for service and access to valves in enclosed ceiling and walls.

3.04 TESTING

A. Before a property is opened to the public, the fire protection system shall be fully operational, contractor tested, and approval obtained from Marriott's Fire Protection Department. In order to obtain Marriott's approval, the fire protection system shall be operated by the contractor under simulated emergency conditions in the presence of Marriott Fire Protection personnel and the contractor shall demonstrate compliance with Marriott's standards.

B. Automatic Sprinkler System:

1. Contractor shall flush and pressure test system prior to Marriott's observation of the test of water flow and tamper switches.

C. Kitchen Hood and Duct Fire Suppression:

1. Contractor shall pre-test all coordinated components by activation of kitchen hood and duct flow switch or control unit.
2. Contractor shall demonstrate compliance by operating initiating devices, activating coordinated alarms, gas, electric, and hood supply air fan shut-downs.

D. Provide all equipment necessary to perform test.

E. Refer to Submittals Paragraph for required certifications and documents to be provided with closeout documents.

1. Furnish one copy of NFPA 25 and bound set of printed operating and maintenance instructions to the Owner, and adequately instruct the Owner's maintenance personnel in proper operation and test procedures of all fire protection components provided, furnished, or installed.

3.05 TRAINING

A. Conduct training as specified in Section 01 7900 - "Training".

B. Train Owner's maintenance personnel on procedures and schedules for troubleshooting, servicing, and maintaining system.

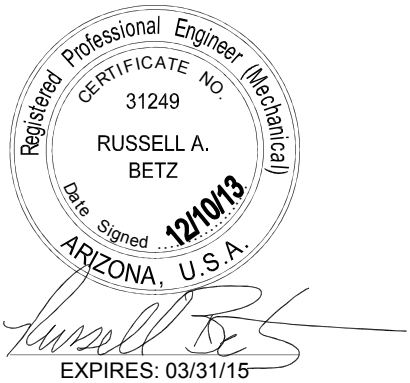
C. Schedule training with Owner with at least seven days' advance notice.

D. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate and maintain fire pump.

- END OF SECTION -

DIVISION 22 – PLUMBING

TABLE OF CONTENTS



EXPIRES: 03/31/15

- SECTION 22 0500 -

COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Piping materials and fittings.
2. Joining materials.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Piping Specialties
6. Grouting
7. Piping Insulation.
8. Equipment Installation.
9. Concrete Bases.
10. Erection of Metal Supports.
11. Erection of Wood Supports
12. Cutting and Patching

B. Related Sections:
1. Section 01 81 13 - Sustainable Design Requirements
2. Section 01 31 00 - Project Management and Coordination
3. Section 01 73 29 - Cutting and Patching
4. Section 01 78 43 - Spare Parts and Materials
5. Section 01 79 00 - Training
6. Section 01 78 23 - Operating and Maintenance Data
7. Section 03 30 00 - Cast-in-Place Concrete
8. Section 06 10 00 - Rough Carpentry
9. Section 07 62 00 - Sheet Metal Flashing and Trim
10. Section 07 84 00 - Firestopping
11. Section 08 31 00 - Access Doors
12. Section 09 90 00 - Painting

13. Section 22 05 53 – Identification for Plumbing Piping and Equipment: Labeling and identifying plumbing systems and equipment.
14. Section 31 20 00 – Earth Moving

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
1. Product Data: For dielectric fittings, flexible connectors, plumbing sleeve seals, and identification materials and devices.
2. Coordination Drawings: Detail major elements, components, and systems of plumbing equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:
    a. Planned piping layout, including valve and specialty locations and valve-stem movement.
    b. Clearances for installing and maintaining insulation.
    c. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
    d. Equipment and accessory service connections and support details.
    e. Exterior wall and foundation penetrations.
    f. Fire-rated wall and floor penetrations.
    g. Sizes and location of required concrete pads and bases.
    h. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.
    i. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

1.5 QUALITY ASSURANCE

A. Equipment Selection: Equipment of higher electrical characteristics, physical dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting plumbing and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. Additional costs shall be approved in advance by appropriate Contract Modification for these increases.

1. If minimum energy ratings or efficiencies of equipment are specified, equipment must meet design requirements. See drawings for equipment schedules and requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and prevent entrance of dirt, debris, and moisture.

B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.

C. Protect flanges, fittings, and piping specialties from moisture and dirt.

D. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 SEQUENCING AND SCHEDULING

A. Coordinate plumbing equipment installation with other building components.

B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for plumbing installations.

C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.

D. Sequence, coordinate, and integrate installations of plumbing materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.

E. Coordinate connection of plumbing systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

F. Coordinate requirements for access panels and doors if plumbing items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Section 08 31 13 - "Access Doors and Frames."

G. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

1.8 POSTED OPERATING INSTRUCTIONS

A. Provide and post operating instructions for all plumbing systems.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved Manufacturers:
   1. Dielectric Unions:
      a. Hart Industries, International, Inc. (800-769-0503)
      b. Watts Water Technologies, Inc. (978-688-1811)
      c. Zurn Plumbing Products Group of Jacuzzi Brands, Inc. (805-238-7100)
   2. Dielectric Flanges:
      a. Capitol Manufacturing Company, A member of The Phoenix Forge Group (800-848-1100)
      b. Central Plastics Co. (800-654-3872)
      c. Watts Water Technologies, Inc. (978-688-1811)
   3. Dielectric-Flange Insulating Kits:
      a. Central Plastics Co. (800-654-3872)
   4. Dielectric Couplings:
      a. Lochinvar Corp. (615-889-8900)
   5. Dielectric Nipples:
      a. Grinnell Mechanical Products, A Tyco International Company (800-500-4768)
      b. Perfection Corporation (800-544-6344)
      c. Victaulic Co. of America (800-742-5842)
   6. Plumbing Sleeve Seals:
      a. Metraflex Inc. (800-621-4347)
      b. PSI-Thunderline/Link-Seal (800-423-2410)

2.2 PIPE AND PIPE FITTINGS

A. Refer to individual Divisions 22 piping Sections for pipe and fitting materials and joining methods.
   1. Section 22 11 16 - Domestic Water Piping.
   2. Section 22 13 16 – Sanitary Waste and Vent Piping.
   3. Section 23 11 23 – Facility Natural Gas Piping.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, unless thickness or specific material is indicated.
      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
   2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Solder Filler Metals: ASTM B32.
   1. Alloy Sn95 or Alloy Sn94: Approximately 95 percent tin and 5 percent silver, with 0.10 percent lead content.
   2. Alloy E: Approximately 95 percent tin and 5 percent copper, with 0.10 percent maximum lead content.
   3. Alloy HA: Tin-antimony-silver-copper zinc, with 0.10 percent maximum lead content.
   4. Alloy HB: Tin-antimony-silver-copper nickel, with 0.10 percent maximum lead content.
   5. Alloy Sb5: 95 percent tin and 5 percent antimony, with 0.20 percent maximum lead content.

E. Brazing Filler Metals: AWS A5.8.
   1. BCuP Series: Copper-phosphorus alloys.
   2. BAg1: Silver alloy.
   3. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

F. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon-steel bolts and nuts.

G. Couplings: Iron-body sleeve assembly, fabricated to match OD of plain-end, pressure pipes.
   1. Sleeve: ASTM A126, Class B, gray iron.
   2. Followers: ASTM A47 malleable iron or ASTM A536 ductile iron.
   3. Gaskets: Rubber.
   4. Bolts and Nuts: AWWA C111.
   5. Finish: Enamel paint.

2.4 DIELECTRIC FITTINGS

A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.
   1. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.
   2. Insulating Material: Suitable for system fluid, pressure, and temperature.

B. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

C. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150-psig minimum working pressure as required to suit system pressures.

D. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
   1. Provide separate companion flanges and steel bolts and nuts for 150-psig minimum working pressure as required to suit system pressures.

E. Dielectric Couplings: Galvanized-steel coupling with inert and non-corrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

2.5 PLUMBING SLEEVES

A. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:
   1. Steel Sheet Metal: 0.0239-inch minimum thickness, galvanized, round tube closed with welded longitudinal joint.
   2. Steel Pipe: ASTM A53, Type E, Grade A, Schedule 40, galvanized, plain ends.
   3. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral water stop, unless otherwise indicated.
   4. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
      a. Underdeck Clamp: Clamping ring with set screws.

2.6 PLUMBING SLEEVE SEALS

A. Description: Modular design, with interlocking rubber links shaped to continuously fill annular space between pipe and sleeve. Include connecting bolts and pressure plates.

2.7 PIPING SPECIALTIES

A. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type if required to conceal protruding fittings and sleeves.
   1. ID: Closely fit around pipe, tube, and insulation of insulated piping.
   2. OD: Completely cover opening.
   3. Cast Brass: Split casting, with concealed hinge and set screw.
      a. Finish: Polished chrome-plate.
   4. Cast-Iron Floor Plate: One-piece casting.

B. Grout:
   1. Non-shrink, Nonmetallic Grout: ASTM C1107, Grade B.
      a. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, non-staining, non-corrosive, nongaseous, and recommended for interior and exterior applications.
      b. Design Mix: 5000-psig, 28-day compressive strength.
      c. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. General: Install piping as described below, unless piping Sections specifies otherwise. Individual Division 22 piping Sections specifies unique piping installation requirements.

B. General Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated, unless deviations to layout are approved on Coordination Drawings as required by Division 01 Sections and as outlined in Part 1 of this section.

C. Install piping at indicated slope.

D. Install components with pressure rating equal to or greater than system operating pressure.

E. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.

F. Install piping free of sags and bends.

G. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.

H. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.

I. Install piping to allow application of insulation plus 1-inch clearance around insulation.

J. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

K. Install fittings for changes in direction and branch connections.

L. Install couplings according to manufacturer's written instructions.

M. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:
   1. Chrome-Plated Piping: Cast brass, one piece, with set screw, and polished chrome-plated finish.
   2. Uninsulated Piping Wall Escutcheons: Cast brass or stamped steel, with set screw.
   3. Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.
   4. Insulated Piping: Cast brass with concealed hinge, set screws, and chrome-plated finish.
   5. Piping in Utility Areas: Cast brass or stamped steel, with set-screw or spring clips.

N. Install sleeves for pipes passing through concrete and masonry walls, and concrete floor and roof slabs.
   1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of plumbing equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping rings where required.

2. Build sleeves into walls and slabs as work progresses.

3. Install sleeves large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

   a. Steel Pipe Sleeves: For pipes smaller than 6-inch NPS (DN150).

   b. Steel, Sheet-Metal Sleeves: For pipes 6-inch NPS (DN150) and larger, penetrating gypsum-board partitions.

4. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Section 07 62 00 "Sheet Metal Flashing and Trim" for flashing.

   a. Seal space outside of sleeve fittings with non-shrink, nonmetallic grout.

5. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealant. Refer to Section 07 92 00 "Joint Sealants" for materials.

6. Use Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant, unless otherwise indicated.

O. Aboveground, Exterior-Wall, Pipe Penetrations: Seal penetrations using sleeves and plumbing sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing plumbing sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.

2. Install cast-iron "wall pipes" for sleeves 6 inches in diameter and larger.

3. Assemble and install plumbing sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.

P. Underground, Exterior-Wall, Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using plumbing sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing plumbing sleeve seals.

1. Assemble and install plumbing sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.

Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire stopping materials. Refer to Section 07 84 00 - "Firestopping" for materials.

R. Verify final equipment locations for roughing-in.

S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

T. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping specification Sections:

1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

3. Soldered Joints: Construct joints according to CDA's "Copper Tube Handbook."
4. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
5. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   a. Note internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
   b. Apply appropriate tape or thread compound to external pipe threads, unless dry seal threading is specified.
   c. Align threads at point of assembly.
   d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
   e. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
6. Welded Joints: Construct joints according to AWS D10.12, "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe," using qualified processes and welding operators according to "Quality Assurance" Article.
7. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.

U. Piping Connections: Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping 2-inch NPS (DN50) and smaller, adjacent to each valve and at final connection to each piece of equipment with 2-inch NPS (DN50) or smaller threaded pipe connection.
2. Install flanges, in piping 2-1/2-inch NPS (DN65) and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.2 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to provide maximum possible headroom, if mounting heights is not indicated.

B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Owner's Representative.

C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

D. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

E. Install equipment giving right of way to piping installed at required slope as specified in other Division 22 sections.

F. Clearance from Electrical Equipment: Piping is prohibited in electric rooms and closets, elevator machine rooms and installation over transformers, switchboards and motor control centers.

3.3 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000-psig 28-day compressive-strength concrete and reinforcement as specified in Section 03 30 00 - "Cast-in-Place Concrete."

3.4 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

B. Field Welding: Comply with AWS D1.1, "Structural Welding Code--Steel."

C. Prime and paint all metal supports per Section 09 90 00 requirements.

3.5 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage to support and anchor plumbing materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.6 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for plumbing installations. Perform cutting by skilled mechanics of trades involved.

B. Repair cut surfaces to match adjacent surfaces.

C. Refer to Division 01 Sections for additional requirements.

3.7 GROUTING

A. Install nonmetallic, non-shrink, grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's written instructions.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placing of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases to provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout according to manufacturer's written instructions.

- END OF SECTION -

- SECTION 22 0500.01 -

GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SCOPE

A. Provisions of this section apply to all work specified in all sections under Division 22.

B. In addition, work in Division 22 is governed by the provisions of the Bidding Requirements, Contract Forms, General Conditions, and all sections under Division 01, General Requirements.

1.3 PLUMBING CONTRACTOR

A. The Plumbing Contractor shall be licensed and hold a current contracting license that has been valid for a minimum of two years in the State of Arizona as a plumbing contractor.

1.4 REGULATIONS, PERMITS, FEES, CHARGES, INSPECTIONS

A. Regulations: Comply with all applicable codes, rules and regulations.

B. Fees and Permits: Pay all connection, installation, use, development, etc., fees and/or charges. Obtain and pay for all required permits and licenses. Refer to Division 01.

C. Inspections: All work must be inspected and approved by local authorities. Prior to final approval, furnish the Architect with certificates of inspections and approvals by the local authorities in accordance with Division 01.

1.5 DRAWINGS AND SPECIFICATIONS

A. Refer to Division 01 for additional information on submittals and shop drawings.

B. If a conflict exists on the drawings or between the drawings and specifications, promptly notify the Architect.

1.6 SUBMITTALS

A. Submittals are for information and coordination only. The Engineer will diligently review the submittals and attempt to verify compliance with the project requirements. Such review, however, does not constitute approval or disapproval of obligation to comply with all project requirements. The submittals are not to be construed to be contract documents. Any failure by the Engineer to note a point of non-compliance shall not be construed to be acceptance or approval of the discrepancy.

B. Product Information Sheets: Provide manufacturer's literature which includes the information required by the Product Data paragraph of the applicable Specification Section. Where Product Information Sheets show multiple models or options, clearly mark the model and options to be provided.

C. Assembly: Assemble all required submittal information for each specification section and submit in PDF format.
   1. Assemble PDF submittals in one PDF file for each Division. Separate and order sections within each file by corresponding specification number. Provide bookmarks at the first page of each section and label each bookmark with the specification number and name to allow for easy navigation of the submittal.
   2. Partial submittals will be returned without review.

D. Identification and Information:
   1. Name the PDF file with the Project name, Division number and sequential submittal number. (I.E. The first submittal shall be No. 1; the second submittal shall be No. 2.)
   2. Provide a cover sheet at the front of each submittal with the following information:
      a. Project name.
      b. Date.
      c. Name of Engineer.
      d. Name of Contractor.
      e. Name of subcontractor.
   3. Provide a cover sheet at the front of each submittal section with the following information:
      a. Name of supplier.
      b. Name of manufacturer.
      c. Number and title of appropriate Specification Section.
      d. Drawing number and detail references, as appropriate.
      e. Other necessary identification.

E. Options:
   1. Identify options requiring selection by the Engineer.
   2. Identify options included with submittal item.

F. Deviations: Identify deviations from the Contract Documents on submittals.

1.7 MATERIAL SAFETY DATA SHEETS

A. Provide current, Material Safety Data Sheets (MSDS), for all hazardous chemicals that are proposed for use at the project site.

1. Provide one complete set to the Owner for review and approval a minimum of one week prior to the delivery of any hazardous chemicals to the site.
2. Maintain a second complete set at the project location, readily accessible by both the Owner's personnel and the contractor's personnel.

1.8 REQUEST FOR INFORMATION

A. Request for Information:
1. A document submitted by the Contractor requesting clarification of a portion of the Contract Documents, hereinafter referred to as RFI.
2. A properly prepared request for information shall include a detailed written statement of the clarification, apparent conflict, or information requested that indicates the specific drawings or specification in need of clarification and the nature of the clarification requested.
   a. Drawings shall be identified by drawing number and location on the drawing sheet.
   b. Specifications shall be identified by section number, page, and paragraph.
3. Include a proposed solution, where appropriate, based upon the field conditions and best knowledge of the Contractor.

B. Improper or Frivolous RFIs: RFIs which are not properly prepared or that request information which is clearly shown in the contract documents will be returned unanswered. Processing time for multiple submissions of improper or frivolous RFIs will be billed at the Engineer's standard hourly rate to the Owner who may deduct an equal amount from the monies due the Contractor.

1.9 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings, Submittals and Shop Drawings.
1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Include underground and overhead piping. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
   a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
   b. Include dimensions both horizontally and vertically to permanent points of reference accurate within 6 inches. Include descriptors such as "below slab", "above ceiling", etc.
   c. Record data daily or as soon as possible after obtaining it.
   d. Record and check the markup before enclosing concealed installations.
2. Mark the Contract Drawings, Submittals and Shop Drawings completely and accurately. Utilize personnel proficient at recording graphic information in production of marked-up record prints.
3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
4. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints and newly prepared Record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Identification: As follows:
   a. Project name.
   b. Date.
   c. Designation "PROJECT RECORD DRAWINGS."
   d. Name of Engineer.
   e. Name of Contractor.
3. Remove or obscure Engineer's seal from Record Drawings.

1.10 OPERATION AND MAINTENANCE MANUAL

A. Prior to completion of the project, compile a complete equipment, operation and maintenance manual for all equipment supplied under Division 22.

B. Schedule:

1. Submit a preliminary copy of the manual not less than 30 days prior to substantial completion for review and comment.
2. Submit the final version the manual not more than four weeks after substantial completion of the project.

C. Format: Submit manuals in both of the following formats:

1. PDF electronic file. Assemble each manual into a composite electronically-indexed file. Submit on digital media acceptable to Engineer.
   a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically-linked operation and maintenance directory.
   b. Enable inserted reviewer comments on draft submittals.
   c. Provide one final copy to Engineer and two copies to Owner.
2. Three paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Engineer will return three copies.

D. Provide operating and maintenance manuals for all systems, subsystems, and equipment that requires operation and regular maintenance, or has replaceable parts.

E. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, product data, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below. In addition to requirements in this Section, include operation and maintenance data required in individual Specification Sections.

F. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

G. Product Data: Include the following information:
   1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
   2. Approved submittals.
   3. Include the following if not shown on approved submittals:
      a. Product name and model number. Use designations for products indicated on Contract Documents.
      b. Manufacturer's name.
      c. Equipment identification with serial number of each component.
      d. Equipment function.
      e. Operating characteristics.
      f. Limiting conditions.
      g. Performance curves.
      h. Engineering data and tests.

H. Operating Procedures: Include the following, as applicable:
   1. Startup procedures.
   2. Equipment or system break-in procedures.
   3. Routine and normal operating instructions.
   4. Regulation and control procedures.
   5. Instructions on stopping.
   6. Normal shutdown instructions.
   7. Seasonal and weekend operating instructions.
   8. Required sequences for electric or electronic systems.
   9. Special operating instructions and procedures. Including precautions against improper use.
   10. Operating logs.

I. Wiring Diagrams: Diagram of factory installed wiring including any options as well as any field modifications.

J. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

K. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification. Include valve locations and designations.

L. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
   1. Standard maintenance instructions and bulletins.
   2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
   3. Identification and nomenclature of parts and components.
   4. List of items recommended to be stocked as spare parts.

M. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

N. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

O. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

P. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

Q. Licenses: Include copies of any licenses with requirements including inspection and renewal dates.

R. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1.11 WORK AND MATERIALS

A. Unless otherwise specified, all materials must be new and of the quality specified. The workmanship shall be of a quality that is acceptable to the Architect, Engineer, and Owner, and is equal to the standards of the trades. Contractor must staff the project with sufficient skilled workmen, including a fully qualified construction superintendent, to complete the work in the time allotted. The superintendent must be qualified to supervise all of the work in his work category.

B. Uniformity: Unless otherwise specified, provide all equipment and products of same type or classification by the same manufacturer.

1.12 APPROVALS OF MATERIALS AND EQUIPMENT

A. Refer to Division 01 for description of material and equipment for prior approvals and substitutions.

1.13 COOPERATIVE WORK

A. Correct without charge any work requiring alteration due to lack of proper supervision or failure to make proper provision in time. Correct without charge any damage to adjacent work caused by the alteration. See Division 01 for additional requirements.

B. Cooperative Work Includes:
1. General supervision and responsibility for proper location, rough-in and size of work related to Division 22 but provided under other divisions of these specifications.

2. Installation of sleeves, inserts and anchors bolts for work under sections in Division 22.

1.14 CONSTRUCTION FACILITIES

A. General: Under this division of the specifications, execute all work in a manner to provide safe and lawful ingress and egress to the Owner's establishment and such facilities shall be kept clear of materials or equipment. Refer to Division 01 for additional requirements.

B. Furnish and maintain from the beginning to the completion of all work all lawful and necessary guards, railings, fences, canopies, lights, and warning signs. Take all necessary precautions required by city and state laws to avoid injury or damage to any and all persons and property.

1.15 GUARANTEE

A. Guarantee all material, equipment, installation and workmanship for all sections under Division 22 in writing to be free from defects of material and workmanship for one year from date of final acceptance as outlined in Division 01. Equipment warranties shall be a minimum of one year from date of substantial completion or as specified elsewhere. Replace without charge any material or equipment proving defective during this period. The guarantee shall include performance of the equipment under all conditions.

1.16 ELECTRICAL WORK

A. Electrical wiring, including power wiring and control wiring, except as otherwise specified under Division 22, all raceways, outlet and junction boxes, and labor for installation of the wiring and equipment shall be included in Division 26 of the specifications.

B. All loose starters and control devices for equipment furnished under Division 22, except as otherwise specified under Division 22, are to be furnished under that particular section of Division 22 and installed under Division 26.

C. Contractor shall be responsible for the checking and testing of all controls and the interlocks for a complete and satisfactory operating system.

D. Before ordering any motors and equipment, verify the available voltage and phase for all motors with the Division 26 Contractor.

E. Submit a complete list of all motors prior to final closeout of job indicating the location, horsepower, voltage, phase, and amperage draw of each motor.

F. All field wiring and equipment must conform to the applicable Division 26 specification sections.

PART 2 - PRODUCTS

2.1 EQUIPMENT DESIGN AND INSTALLATION

A. Design: Design all equipment in accordance with latest edition of ASME, AGA, UL and other applicable technical standards as follows:

1. Pressure Vessels: ASME Code constructed and stamped.

2. Electric Appliances: UL labeled.

PART 3 - EXECUTION

3.1 SUBMITTALS

A. Prepare submittals as directed for review by the Contractor, Owner, Architect, and Engineer.

B. Submit one copy of PDF submittals via email, project website or other electronic media.

3.2 RECORD DRAWINGS

A. Recording: Post changes and modifications to project record documents as they occur; do not wait until the end of Project.

B. Maintenance of Record Documents and Samples: Store record documents in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Engineer's reference during normal working hours.

3.3 OPERATION AND MAINTENANCE MANUALS

A. Prepare Operation and Maintenance Manuals as directed for review by the Contractor, Owner, Architect, and Engineer.

B. Make corrections and resubmit as required.

3.4 VERIFICATION OF DIMENSIONS

A. Scaled and figured dimensions are approximate only. Before proceeding with work, carefully check and verify dimensions at site, and be responsible for properly fitting equipment and materials together and to the structure in spaces provided.

B. Drawings are essentially diagrammatic and many offsets, bends, special fittings and exact locations are not indicated. Carefully study drawings and premises in order to determine best methods, exact locations, routes, building obstructions, and install apparatus and equipment in available locations. Install apparatus and equipment in manner and in locations to avoid obstructions, preserve headroom, and keep openings and passageways clear.

3.5 CUTTING AND PATCHING

A. Cut work and patch per Division 01 as necessary to properly install the new work. As the work progresses, coordinate necessary openings, holes, chases, etc., in their correct location. If the required openings, holes and chases are not in their correct locations, make the necessary corrections at no cost to the Owner. Avoid excessive cutting and do not cut structural members without the consent of the Architect. Include as a part of the work all structural framing required by penetrations through the roof and necessary steel to support ducts and pipes between structural steel unless shown on the structural drawings.

3.6 CLOSING-IN OF UNFINISHED WORK

A. Cover no work until inspected, tested and approved. Where work is covered before inspection and test, uncover it, and when inspected, tested and approved, restore all work to original proper condition.

3.7 EXCAVATION AND BACKFILL

A. Perform all necessary excavation, shoring and backfilling required for the proper laying of all pipes inside the building and premises, and outside as may be necessary. Remove all excess excavated materials from the site or dispose of on site as directed by General Contractor.

B. Excavate all trenches open cut, keep trench banks as nearly vertical as practicable, and sheet and brace trenches where required for stability and safety. Excavate trenches true to line and make bottoms not less than 18" wide but no wider than necessary to provide ample work room. Grade trench bottoms accurately to provide uniform bearing and support for each section of pipe on undisturbed soil along its entire length. Dig "bell" holes after the trench bottom has been graded. Machine grade only to the top line of the pipes, doing the balance by hand. Do not cut any trench near or under footings without first consulting the Architect. Comply with OSHA requirements.

C. Provide not less than 4 inches of granular material as pipe bedding prior to laying pipe in trench to continuously support pipe and maintain required slope. Granular material shall be pea gravel or sand per MAG Standards.

D. Provide backfilling and compaction in accordance with provisions of these specifications and under the direction of the Architect to the required density.

E. Provide not less than 4 inches of granular material, same as piping bedding, all around pipe. Make the first 2 feet of fill in 6 inch layers, each thoroughly compacted as directed, and free from rocks, large clods of earth, leaves, branches, and debris. Compact the rest of the backfill as directed, using in the backfill no rocks larger than 4 inches in diameter, and using no rock in the top 12 inches.

3.8 ACCESSIBILITY

A. Install valves, thermometers, gauges, traps, cleanouts, control devices or other specialties requiring reading, adjustment, inspection, repairs, removal or replacement conveniently and accessibly throughout the finished building. Where any of these devices are shown on the contract drawings to be installed above any inaccessible ceiling or behind any inaccessible wall, the Plumbing Contractor shall furnish access doors or panels as required.

B. All access doors or panels in walls and ceilings required for access to control devices, traps, valves and similar devices are to be furnished and installed as part of the work under this section. Provide type as specified under Division 08.

C. Refer to architectural drawings for type of wall and ceiling in each area and for rated construction.

D. Coordinate work of various sections to locate valves, traps, etc. with others to avoid unnecessary duplication of access doors.

E. The Contractor, along with the Owner's representative, shall complete the Plumbing Accessibility/Clearance Checklist at the end of this section for all plumbing equipment. The chart shall be submitted to the Architect for approval prior to substantial completion. All conflicts shall be resolved to the Architect's and Owner's satisfaction prior to submission.

3.9 ROOF FLASHINGS

A. Flash and counterflash all piping penetrating roofing membrane with flashing per roofing manufacturer's recommendations. Refer to architectural drawings for detailing of pipe penetrations through roof.

3.10 PRODUCT AND EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. All equipment, valves, sensors, etc., shall be installed in strict conformance with the manufacturer's recommendations and all codes.

B. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.

C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

D. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations.

E. Install equipment to allow right-of-way for piping installed at required slope.

F. Do not install any equipment in an application not recommended by the manufacturer.

3.11 EQUIPMENT ROUGH-IN

A. Rough in all equipment and fixtures as designated on the drawings and in the specifications. The drawings indicate only the approximate location of rough-ins. The exact rough-in locations must be determined from large-scale certified drawings. The Contractor shall obtain all certified rough-in information before progressing with any work for rough-in final connections.

B. Be responsible for providing all outlets and services of proper size at the required locations.

C. Minor changes in the contract drawings shall be anticipated and provided for under this contract.

1. Rough-in only (unless otherwise designated on the drawings) shall include providing all services as indicated and required, including all piping and valves. Valve and cap all piping stub-outs.

3.12 OWNER-FURNISHED AND OTHER EQUIPMENT

A. Rough-in only for all Owner-furnished equipment see Division 01 and all equipment furnished under other sections of the specifications, except as otherwise specified and/or noted on the drawings.

B. Provide all services designated, valve and cap all piping, and leave in a clean and orderly manner.

3.13 EQUIPMENT FINAL CONNECTIONS

A. Provide all piping final connections for all equipment under Division 22 and as indicated on the drawings.

3.14 CLEANUP

A. In addition to cleanup specified under Division 01, thoroughly clean all parts of the equipment and fixtures. Where exposed parts are to be painted, thoroughly clean off any splattered construction materials and remove all oil and grease spots. Wipe the surface carefully and scrape out all cracks and corners.

B. Thoroughly flush and clean all water systems.

C. During the progress of the work, keep the premises clean and free of debris.

3.15 PAINTING

A. Except as otherwise specified or indicated in the architectural drawings and/or specifications, paint all exposed unfinished metal with one coat of rust-inhibiting primer. Factory painted equipment shall be considered as having primed surface.

B. Damage and Touch-Up: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

C. Finished painting is specified under Division 09.

3.16 CONNECTIONS TO SERVICES

A. Provide all connections to sanitary sewer lines, storm water lines, gas lines, and water lines, except as otherwise specifically designated. Provide all necessary tees, taps and connections required to properly connect to all building services. Verify all requirements with civil drawings before making any piping connections to sanitary sewer, storm sewer, water or gas piping and conform to them during installation.

3.17 OBJECTIONABLE NOISE AND VIBRATION

A. Construct and brace piping systems to prevent vibration or rattling when systems are in operation. Install connections to equipment so noise and vibration will not reach the conditioned area through piping, conduit, or the building structure.

- END OF SECTION -

PLUMBING ACCESSIBILITY / CLEARANCE CHECKLIST
(See Paragraph 3.8.E)

Bldg.	Location	Unit #	Acceptable Access		Conflict	Date	Action	Observer	
			Yes	No				Owner	Contractor

- SECTION 22 0501 -

DEMONSTRATION & TRAINING FOR PLUMBING SYSTEMS & COMPONENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for demonstration of proper operation of equipment and instructing Owner's personnel, including the following:
   1. Demonstration of operation of systems, subsystems, and equipment.
   2. Training in operation and maintenance of systems, subsystems, and equipment.

1.3 CLOSEOUT SUBMITTALS

A. At completion of training, submit complete training manual(s) for Owner's use.

1.4 QUALITY ASSURANCE

A. Instructor Qualifications: A factory-authorized service representative experienced in operation and maintenance procedures and training.

1.5 COORDINATION

A. Complete demonstrations prior to Substantial Completion.

B. Complete instruction prior to Final Completion.

C. Coordinate demonstration and instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.

D. Coordinate content of training modules with content of approved operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system. Include training for all plumbing systems and equipment such as water heaters, water softeners, booster pumps, mixing valves, flush valves, etc. and as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
   a. System, subsystem, and equipment descriptions.
   b. Operating standards.
   c. Regulatory requirements.
   d. Equipment function.
   e. Operating characteristics.
   f. Limiting conditions.
   g. Performance curves.
2. Documentation: Review the following items in detail:
   a. Emergency manuals.
   b. Operations and Maintenance manuals.
   c. Project record documents.
   d. Identification systems.
   e. Warranties and bonds.
   f. Maintenance service agreements and similar continuing commitments.
3. Emergencies: Include the following, as applicable:
   a. Instructions on meaning of warnings, trouble indications, and error messages.
   b. Instructions on stopping.
   c. Shutdown instructions for each type of emergency.
   d. Operating instructions for conditions outside of normal operating limits.
   e. Sequences for electric or electronic systems.
   f. Special operating instructions and procedures.
4. Operations: Include the following, as applicable:
   a. Startup procedures.
   b. Equipment or system break-in procedures.
   c. Routine and normal operating instructions.
   d. Regulation and control procedures.
   e. Control sequences.
   f. Safety procedures.
   g. Instructions on stopping.
   h. Normal shutdown instructions.

i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:
   a. Alignments.
   b. Checking adjustments.
   c. Noise and vibration adjustments.
   d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
   a. Diagnostic instructions.
   b. Test and inspection procedures.
7. Maintenance: Include the following:
   a. Inspection procedures.
   b. Types of cleaning agents to be used and methods of cleaning.
   c. List of cleaning agents and methods of cleaning detrimental to product.
   d. Procedures for routine cleaning
   e. Procedures for preventive maintenance.
   f. Procedures for routine maintenance.
   g. Instruction on use of special tools.
8. Repairs: Include the following:
   a. Diagnosis instructions.
   b. Repair instructions.
   c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   d. Instructions for identifying parts and components.
   e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

A. Inspect and test each system, subsystem and piece of equipment prior to demonstration. Confirm proper operation prior to scheduling demonstrations.
   1. Replace defective work or material.
   2. Repeat inspection and testing until defects are eliminated.

B. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements for "Operations and Maintenance Data."

3.2 DEMONSTRATION

A. Inspect and operate satisfactorily, in presence of Engineer and Owner, each system and item of equipment, including accessories.

3.3 INSTRUCTION

A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
   1. Owner will furnish Contractor with names and positions of participants.

B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
   1. Schedule training with Owner with at least seven days' advance notice.

C. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of an oral or a demonstration performance-based test.

- END OF SECTION -

- SECTION 22 0513 -

COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Basic Motor Requirements
   2. Polyphase Motors
   3. Single Phase Motors

B. Related Sections:
   1. Division 22 Sections for application of motors and reference to specific motor requirements for motor-driven equipment.

1.3 SUBMITTALS

A. Submit “Letter of Conformance” in accordance with Section 01 33 00 (01330) indicating specified items selected for use in Project with the following supporting data:
   1. Product Data: Show nameplate data and ratings; characteristics; mounting arrangements; size and location of winding termination lugs, conduit entry, and grounding lug; and coatings.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Listing and Labeling: Provide motors specified in this Section that are listed and labeled.
   1. Terms "Listed and Labeled": As defined in the National Electrical Code, Article 100.

PART 2 - PRODUCTS

2.1 BASIC MOTOR REQUIREMENTS

A. Basic requirements apply to mechanical equipment motors, unless otherwise indicated.

B. Motors 1/2 HP and Larger: Polyphase.

C. Motors smaller than 1/2 HP: Single phase.

D. Frequency Rating: 60 Hz.

E. Voltage Rating: Determined by voltage of circuit to which motor is connected.

F. Service Factor: According to NEMA MG 1, general purpose continuous duty, design type "B."

G. Capacity and Torque Characteristics: Rated for continuous duty and sufficient to start, accelerate, and operate connected loads at designated speeds, in indicated environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

H. Enclosure: Open drip proof, unless otherwise indicated.

I. Efficiency: Motors shall have a higher efficiency rating than industry standard average motor as delineated in IEEE Standard 112, Test Method 13.

2.2 POLYPHASE MOTORS

A. Description: NEMA MG 1, medium induction motor.
   1. Design Characteristics: NEMA MG 1, Design B, unless otherwise indicated.
   2. Energy-Efficient Design: Where indicated.
   3. Stator: Copper windings, unless otherwise indicated. Multispeed motors have separate winding for each speed.
   4. Rotor: Squirrel cage, unless otherwise indicated.
   5. Bearings: Double-shielded, prelubricated ball bearings suitable for radial and thrust loading.
   6. Temperature Rise: Match insulation rating, unless otherwise indicated.
   7. Insulation: Class F, unless otherwise indicated.

B. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for indicated controller, with required motor leads brought to motor terminal box to suit control method.

C. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
   1. Critical vibration frequencies are not within operating range of controller output.
   2. Temperature Rise: Match rating for Class B insulation.
   3. Insulation: Class H.

4. Thermal Protection: Where indicated, conform to NEMA MG 1 requirements for thermally protected motors.

D. Source Quality Control: Perform the following routine tests according to NEMA MG 1:
1. Measurement of winding resistance.
2. No-load readings of current and speed at rated voltage and frequency.
3. Locked rotor current at rated frequency.
4. High-potential test.
5. Alignment.

2.3 SINGLE-PHASE MOTORS

A. Type: As indicated or selected by manufacturer from one of the following, to suit starting torque and other requirements of specific motor application.
1. Permanent-split capacitor.
2. Split-phase start, capacitor run.
3. Capacitor start, capacitor run.

B. Shaded-Pole Motors: Do not use, unless motors are smaller than 1/20 hp.

C. Thermal Protection: Where indicated or required, internal protection automatically opens power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal protection device automatically resets when motor temperature returns to normal range, unless otherwise indicated.

D. Bearings: Ball-bearing type for belt-connected motors and other motors with high radial forces on motor shaft. Sealed, prelubricated sleeve bearings for other single-phase motors.

PART 3 - EXECUTION

3.1 ADJUSTING

A. Use adjustable motor mounting bases for belt-driven motors.

B. Align pulleys and install belts.

C. Tension according to manufacturer's written instructions.

- END OF SECTION -

- SECTION 22 0519 -

METERS & GAUGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Thermometers.
2. Pressure Gages.
3. Water Meters.

B. Related Sections:
1. Section 21 10 00 (13900) – Fire Suppression Systems: For fire-pump flow-measuring systems.
2. Section 22 11 23 (15194) - Natural Gas Piping: For gas meters.
3. Division 22 (15) Plumbing Equipment Sections that specify meters and gages as part of factory-fabricated equipment.
4. Section 33 00 00 (02500) - Utilities: For water meters outside the building.

1.3 SUBMITTALS

A. Submit “Letter of Conformance” in accordance with section 01 33 00 (01330) indicating specified items selected for use in Project with the following supporting data:
1. Product Data: Include scale range, ratings, and calibrated performance curves for each meter, gage, fitting, specialty and accessory specified.
a. Include scale range, ratings, and calibrated performance curves for each meter, gage, fitting, specialty, and accessory specified.
2. Shop Drawings: Include schedule indicating manufacturer's number, scale range, fittings, and location for each meter and gage.
3. Product Certificates: Signed by manufacturers of meters and gages certifying accuracies under specified operating conditions and compliance with specified requirements.

4. Maintenance Data: For meters and gages to include in maintenance manuals specified in Division 01. Include data for the following:
   a. Flow-measuring systems.
   b. Flow meters.
   c. Water meters.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved Manufacturers:
   1. Liquid-in-Glass Thermometers:
      a. Ashcroft, Inc.
      b. Marsh Bellofram (800-727-5646)
      c. Weiss Instruments, Inc. (631-207-1200)
   2. Pressure Gages:
      a. Ashcroft, Inc.
      b. Marsh Bellofram (800-727-5646)
      c. Weiss Instruments, Inc. (631-207-1200)
   3. Water Meters and Submeters:
      a. As required by the local authority having jurisdiction.

2.2 THERMOMETERS, GENERAL

A. Scale Range: Temperature ranges for services listed are as follows:
   1. Domestic Hot and Cold Water: 30 to 240 deg F, with 2-degree scale divisions.

B. Accuracy: Plus or minus 1 percent of range span or plus or minus one scale division to maximum of 1.5 percent of range span.

2.3 THERMOMETERS - LIQUID-IN-GLASS

A. Description: ASTM E1-03a.

B. Case: Die cast and aluminum finished in baked-epoxy enamel, glass front, spring secured, 9 inches long.

C. Adjustable Joint: Finish to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.

D. Tube: Red or blue reading, mercury filled with magnifying lens.

E. Scale: Satin-faced nonreflective aluminum with permanently etched markings.

F. Stem: Brass for separable socket; of length to suit installation.

2.4 PRESSURE GAGES

A. Description: ASME B40.100, phosphor-bronze bourdon-tube type with bottom connection; dry type, unless liquid-filled-case type is indicated.

B. Case: Drawn steel, brass, or aluminum with 4-1/2-inch- diameter, glass lens.

C. Connector: Brass, NPS 1/4 (DN8).

D. Scale: White-coated aluminum with permanently etched markings.

E. Accuracy: Grade A, plus or minus 1 percent of middle 50 percent of scale.

F. Range: Comply with the following:
   1. Fluids under Pressure: Two times the operating pressure (or 0 to 160 psi).

2.5 PRESSURE-GAGE FITTINGS

A. Valves: NPS 1/4 (DN8) brass needle type with round knurled handle.

B. Snubbers: ASME B40.5, NPS 1/4 (DN8) extended stem brass bushing with corrosion-resistant porous-metal disc of material suitable for system fluid and working pressure.

2.6 WATER METERS AND SUB-METERS

A. Water Meter shall be provided as required by the local authority having jurisdiction.

PART 3 - EXECUTION

3.1 INSTALLATION - METER AND GAGE, GENERAL

A. Install meters, gages, and accessories according to manufacturer's written instructions for applications where used.

3.2 INSTALLATION - THERMOMETER

A. Install thermometers and adjust vertical and tilted positions.

B. Install in the following locations:
   1. Domestic hot water supply main (downstream of storage tank).
   2. Domestic hot water return main.
   3. Domestic hot water storage tank.
   4. Domestic water heater discharge.
   5. Building domestic cold water service entrance.

3.3 INSTALLATION - PRESSURE-GAGE

A. Install pressure gages in piping tees with pressure-gage valve located on pipe at most readable position.

B. Install dry-type pressure gages in the following locations:
   1. Upstream and downstream of each pressure-reducing valve.
   2. Building water-service entrance.

C. Install liquid-filled-type pressure gages at suction and discharge of each pump.

D. Install pressure-gage needle valve and snubber in piping to pressure gages.

3.4 INSTALLATION - WATER METER

A. Install water meters, piping, and specialties according to AWWA M6 and utility's requirements.
   1. Install displacement-type water meters with shutoff valve on water meter inlet. Install valve on water meter outlet and valved bypass around meter, unless prohibited by authorities having jurisdiction.
   2. Install compound-type water meters with shutoff valves on water meter inlet and outlet and on valved bypass around meter. Support meters, valves, and piping on brick or concrete piers.
   3. Install detector-type water meters with shutoff valves on water meter inlet and outlet and on full-size valved bypass around meter. Support meter, valves, and piping on brick or concrete piers.

B. Rough-In
   1. Install roughing-in piping and specialties for domestic water and/or site irrigation water meter installation according to utility's instructions and requirements.
   2. See Section 22 11 16 for domestic water piping requirements.

3.5 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties. The following are specific connection requirements:
   1. Install meters and gages adjacent to equipment to allow service and maintenance.

B. Make electrical connections to power supply and electrically operated meters and devices.

C. Ground electrically operated meters.
   1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

D. Install electrical connections for power and devices.

E. Electrical power, wiring, and connections are specified in Division 26 Sections.

3.6 ADJUSTING AND CLEANING

A. Calibrate meters according to manufacturer's written instructions, after installation.

B. Adjust faces of meters and gages to proper angle for best visibility.

C. Clean windows of meters and gages and clean factory-finished surfaces. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer's touchup paint.

- END OF SECTION -

- SECTION 22 0523 -

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Valves.

B. Related Sections:
   1. Section 22 05 53 (15075) – Identification for Plumbing Piping and Equipment: For valve tags and charts.
   2. Division 22 Plumbing Piping System Sections: Special purpose valves

1.3 SUBMITTALS

A. Submit “Letter of Conformance” in accordance with section 01 33 00 (01330) indicating specified items selected for use in Project with the following supporting data:
   1. Product Data for each valve type. Include body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions. Include list indicating valve and its application.
   2. Maintenance data for valves to include in the operation and maintenance manual specified in Division 01. Include detailed manufacturer's instructions on adjusting, servicing, disassembling, and repairing.

1.4 QUALITY ASSURANCE

A. Single-Source Responsibility: Comply with the requirements specified in Division 01. Provide all valves of the same manufacturer where possible.
   1. ASME Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.

B. MSS Compliance: Comply with the various MSS Standard Practice documents referenced.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Set globe and gate valves closed to prevent rattling.
   4. Set ball and plug valves open to minimize exposure of functional surfaces.
   5. Block check valves in either closed or open position.

B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store indoors and maintain valve temperature higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use a sling to handle large valves. Rig to avoid damage to exposed parts. Do not use handwheels and stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved Manufacturers:
   1. Ball Valves and Gate Valves:
      a. Hammond Valve Corporation (800-348-6544)
      b. Milwaukee Valve Company, Inc. (262-432-2700)
      c. NIBCO Inc. (574-295-3000)
   2. Balancing Valves:
      a. Victaulic Company (800-742-5842)
      b. Hays Fluid Controls, A Romac Industries, Inc. Company (800-354-4297)
   3. Check Valves:
      a. Hammond Valve Corporation (800-348-6544)
      b. Milwaukee Valve Company, Inc. (262-432-2700)
      c. NIBCO Inc. (574-295-3000)

2.2 GENERAL

A. Design: Rising stem or rising outside screw and yoke stems, except as specified below.
   1. Nonrising stem valves may be used only where headroom prevents full extension of rising stems.

B. Pressure and Temperature Ratings: As indicated in the "Application Schedule" of Part 3 of this Section and as required to suit system pressures and temperatures.

C. Sizes: Same size as upstream pipe, unless otherwise indicated.

D. Operators: Use specified operators and handwheels, except provide the following special operator features:
   1. Handwheels: For valves other than quarter turn.
   2. Lever Handles: For quarter-turn valves 6 inches (DN150) and smaller, except for plug valves, which shall have square heads. Furnish Owner with 1 wrench for every 10 plug valves.

E. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.

F. Bypass and Drain Connections: Comply with MSS SP-45 bypass and drain connections.

G. Threads: ASME B1.20.1.

H. Flanges: ASME B16.1 for cast iron, ASME B16.5 for steel, and ASME B16.24 for bronze valves.

I. Solder Joint: ASME B16.18.
   1. Caution: Where soldered end connections are used, use solder having a melting point below 840 deg F for gate, globe, and check valves; below 421 deg F for ball valves.

2.3 BALL VALVES

A. Ball Valves, 4 Inches (DN100) and Smaller: MSS SP-110, Class 150, 600-psi CWP, ASTM B584 bronze body and bonnet, 2-piece construction; chrome-plated full-port brass ball; blowout proof; bronze or brass stem; Teflon seats and seals; threaded or soldered end connections:
   1. Operator: Vinyl-covered steel lever handle.
   2. Stem Extension: For valves installed in insulated piping.
   3. Memory Stop: For operator handles (balancing valves).

2.4 GATE VALVES

A. Gate Valves, 5 Inches (DN80) and Larger: MSS SP-70, Class 125, 250-psi CWP, ASTM A126 cast-iron body and bonnet, solid cast-iron wedge, brass-alloy stem, outside screw and yoke, Teflon-impregnated packing with 2-piece packing glad assembly, flanged end connections; and with cast-iron handwheel.

2.5 BALANCING VALVES

A. Calibrated Balancing Valves: Adjustable, with 2 readout ports and memory setting indicator. Include manufacturer's standard hoses, fittings, valves, differential pressure meter, and carrying case.
   1. 2-inch NPS (DN50) and Smaller: Bronze body with brass ball, adjustment knob, calibrated nameplate, and threaded or solder-joint ends.
   2. 2-inch NPS (DN50) and Smaller: Bronze, Y-pattern body with adjustment knob and threaded ends.

B. Memory-Stop Balancing Valves, 2-Inch NPS (DN50) and Smaller: MSS SP-110, ball valve, rated for 400-psig minimum CWP. Include 2-piece, ASTM B62 bronze body with standard port,

chrome-plated brass ball, replaceable seats and seals, blowout-proof stem, solder-joint ends, and vinyl-covered steel handle with memory-stop device.

C. Automatic Flow Control Valves (AFCV): Automatic flow control valves shall be factory set to rated flow, and shall automatically control the flow to within 10% of the rated value, over a 40 to 1 differential pressure, operating range, (2 to 80 PSID). Operational temperature shall be rated from fluid freezing, to 225 degree F.

1. "MESURFLO" by Hays Fluid Controls, or approved substitution by listed manufacturers.
    a. Automatic Flow Control valve body shall be constructed of hot forged brass UNS C37700 or C36000 per ASTM B283 latest revision, ductile iron per ASTM A395, valve grade cast iron per ASTM B209, or UNS C84400 Cast Semi-Red Brass with inch size pipe thread fittings per ASME B1.20.1, and B31.9. UNS C37700 and UNS C36000 valve bodies are suitable for 600 PSIG Iron, and Cast Brass valve bodies are suitable for 400 PSIG. Working Pressure rating per ASTM A53 threaded joint type. Valve body shall also be available with sweat fittings per ASME B16.22 requirements and are intended for use in Building Services Piping meeting the requirements of ASME B31.9. The Temperature/Pressure Rating of the Solder Joint is dependent upon the type of solder used. ASME Standard B16.22 Pressure Ratings should be reviewed prior to sweating.
2. "Y-BALL MESURFLO" by Hays Fluid Controls, or approved substitution by listed manufacturers:
    a. Ball Valve, combination Automatic Flow Control Valves, shall be made of hot forged brass UNS C37700 per ASTM B283 Latest Revision, using full flow design balls, blowout proof stems, and shall be rated for 600 PSIG WOG.
    b. Copper Sweat fittings 1/2, 3/4, 1 & 1 1/4, INCH shall be suitable for 522 PSIG. Working Pressure Rating per ASME B31.9 Building Services Piping.
    c. Threaded fittings 1/2, through 1 1/2 INCH shall be suitable for 600 PSIG. Working Pressure Rating per ASTM A53B for threaded joint type extra weight, of the pipe size indicated. (For most Building Services applications, ANSI Class 125 rating.) Flow rates from .5 to 24.0 GPM will have a differential pressure operating range of 2 to 80 PSID. Flow rates shall be field changeable without breaking the piping connections.
3. Valve internal control mechanism shall be of a quiet, clog resistant design and consist of one or more, precision sculptured brass or polyphenylsulfone with high temperature elastomeric diaphragm. Each automatic balancing valve will automatically control the flow rate within 10% of its rated flow, over a temperature range of 32 to 225 degree F, and a pressure differential range of 2-80 PSID. Flow increments shall be available in 0.125 to 0.5 GPM steps for 0.5 to 8.0 GPM, 1.0 to 2.0 GPM steps for 9.0 to 24 GPM, and 5.0 GPM steps for 25 to 200 GPM.
4. Dual pressure/temperature test ports for verifying the pressure differential and system temperature shall be standard.
5. Manufacturer shall provide certified independent laboratory tests verifying accuracy of performance.
6. All valves shall be marked per MMS-SP-25-78 (1983) and shall show as a minimum; controlled flow direction, flow rate, PSID control range, manufacturer and model number.

2.6 CHECK VALVES

A. Swing Check Valves, 2-1/2 Inches (DN65) and Smaller: MSS SP-80; Class 125, 250-psi CWP, or Class 150, 300-psi CWP; horizontal swing, Y-pattern, ASTM B62 cast-bronze body and cap,

rotating bronze disc with rubber seat or composition seat, threaded or soldered end connections:

B. Swing Check Valves, 3 Inches (DN80) and Larger: MSS SP-71, Class 125, 250-CWP, ASTM A126 cast-iron body and bolted cap, horizontal-swing bronze disc, flanged or grooved end connections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of valves. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

C. Operate valves from fully open to fully closed positions. Examine guides and seats made accessible by such operation.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.

F. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION

A. Install valves as indicated, according to manufacturer's written instructions.

B. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.

C. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.

D. Locate valves for easy access and provide separate support where necessary.

E. Install valves in horizontal piping with stem at or above the center of the pipe and in a position to allow full stem movement.

F. Installation of Check Valves: Install for proper direction of flow as follows:
   1. Swing Check Valves: Horizontal position with hinge pin level.

G. Sectional Valves: Install sectional gate or ball valves closest to main on each branch and riser serving plumbing fixtures or equipment, and where indicated.

H. Shutoff Valves: Install gate or ball shutoff valve on each water supply to equipment, on each supply to plumbing fixtures without supply stops, and where indicated.

I. Drain Valves: Install drain valves for equipment, at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
   1. Install hose-end drain valves with cap and chain at low points in water mains, risers, and branches.
   2. Install stop-and-waste drain valves where indicated.

J. Balancing Valves: Install in each hot-water circulation return branch, discharge side of each pump and circulator, and where indicated.

3.3 SOLDERED CONNECTIONS

A. Cut tube square and to exact lengths.

B. Clean end of tube to depth of valve socket with steel wool, sand cloth, or a steel wire brush to a bright finish. Clean valve socket.

C. Apply proper soldering flux in an even coat to inside of valve socket and outside of tube.

D. Open gate and globe valves to fully open position.

E. Remove the cap and disc holder of swing check valves having composition discs.

F. Insert tube into valve socket, making sure the end rests against the shoulder inside valve. Rotate tube or valve slightly to ensure even distribution of the flux.

G. Apply heat evenly to outside of valve around joint until solder melts on contact. Feed solder until it completely fills the joint around tube. Avoid hot spots or overheating valve. Once the solder starts cooling, remove excess amounts around the joint with a cloth or brush.

3.4 THREADED CONNECTIONS

A. Note the internal length of threads in valve ends and proximity of valve internal seat or wall to determine how far pipe should be threaded into valve.

B. Align threads at point of assembly.

C. Apply appropriate tape or thread compound to the external pipe threads, except where dry seal threading is specified.

D. Assemble joint, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

3.5 FLANGED CONNECTIONS

A. Align flange surfaces parallel.

B. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

C. For dead-end service, butterfly valves require flanges both upstream and downstream for proper shutoff and retention.

3.6 VALVE END SELECTION

A. Select valves with the following ends or types of pipe/tube connections:
   1. Copper Tube Size, 2-1/2 Inches and Smaller: Solder ends.
   2. Copper Tube Size 3 Inches to 4 Inches: Flanged ends.
   3. Steel Pipe Sizes, 2-1/2 Inches and Smaller: Threaded or grooved end.
   4. Steel Pipe Sizes, 3 Inches and Larger: Grooved end or flanged.

3.7 APPLICATION SCHEDULE

A. General Application: Use gate and ball, valves for shutoff duty; globe and ball for throttling duty. Refer to piping system Specification Sections for specific valve applications and arrangements.

B. Domestic Water Systems: Use the following valve types:
   1. Ball Valves: Class 150, 600-psi CWP, with stem extension.

C. Domestic Hot Water Recirculation Systems: Use the following valve types:
   1. Balancing Valves: Automatic or adjustable Ball valves with readout ports.

3.8 ADJUSTING

A. Adjust or replace packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves if leak persists.

- END OF SECTION -

- SECTION 22 0529 -

HANGERS & SUPPORTS FOR PLUMBING PIPING & EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Hangers and Supports for Plumbing System Piping and Equipment.

B. Related Sections:
   1. Section 05 50 00 (05500) - Metal Fabrications
   2. Section 09 90 00 (09900) - Painting
   3. Section 21 10 00 (13900) - Fire Suppression Systems
   4. Section 22 05 48 (15070) – Vibration and Seismic Control for Plumbing Piping and Equipment

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports.

1.4 SUBMITTALS

A. Submit “Letter of Conformance” in accordance with Section 01 33 00 (01330) with the following supporting data:
   1. Product Data:
      a. For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated.

1.5 QUALITY ASSURANCE

A. Engineering Responsibility: Where required by the local authority having jurisdiction design and preparation of Shop Drawings and calculations for each multiple pipe support, trapeze, and seismic restraint by a qualified professional engineer.

1. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of hangers and supports that are similar to those indicated for this Project in material, design, and extent.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved Manufacturers:

1. Pipe Hangers, Supports, and Components:
   a. Cooper B-Line, Inc. (618-654-2184)
   b. Grinnell Mechanical Products, A Tyco International Company (800-500-4768)
   c. National Pipe Hanger Corporation (609-261-5353)
2. Channel Support Systems:
   a. Cooper B-Line, Inc. (618-654-2184)
   b. Grinnell Mechanical Products, A Tyco International Company (800-500-4768)
   c. National Pipe Hanger Corporation (609-261-5353)
3. Thermal-Hanger Shield Inserts:
   a. Carpenter & Patterson, Inc. (301.333.4631)
   b. Erico (Michigan Hanger) (440-248-0100)
   c. PHS Industries, Inc. (800-626-2336)
4. Powder-Actuated and Mechanical Anchor Fastener Systems:
   a. Gunnebo Fastening Corp. (800-336-1640)
   b. Hilti, Inc.(800-879-8000)
   c. ITW Ramset/Red Head (800-899-7890)

2.2 HANGERS AND SUPPORTS

A. Pipe Hangers, Supports, and Components:

1. MSS SP-58, factory-fabricated components. Refer to "Hanger and Support Applications" Article in Part 3 for where to use specific hanger and support types.
   a. Galvanized, Metallic Coatings: For piping and equipment that will not have field-applied finish.
   b. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

B. Channel Support Systems:
   1. MFMA-2, factory-fabricated components for field assembly.
   2. Coatings: Manufacturer's standard finish.
   3. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

C. Thermal-Hanger Shield Inserts:
   1. 100-psi minimum compressive-strength insulation, encased in sheet metal shield.
   2. Material for Cold Piping: ASTM C552, Type I cellular glass.
   3. Material for Hot Piping: ASTM C552, Type I cellular glass.
   4. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
   5. For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.
   6. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.3 MISCELLANEOUS MATERIALS

A. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

C. Structural Steel: ASTM A36, steel plates, shapes, and bars, black and galvanized.

D. Grout: ASTM C1107, Grade B, factory-mixed and -packaged, non-shrink and nonmetallic, dry, hydraulic-cement grout.
   1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
   2. Properties: Nonstaining, noncorrosive, and nongaseous.
   3. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger requirements are specified in Sections specifying equipment and systems.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification Sections.

C. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
   1. Adjustable Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.

2. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24 if little or no insulation is required.
3. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4 to allow off-center closure for hanger installation before pipe erection.
4. Adjustable Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
5. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
6. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
7. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
8. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.

D. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20 (DN20 to DN500).

E. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.

F. Building Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
2. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
3. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
4. C-Clamps (MSS Type 23): For structural shapes.
5. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
   a. Light (MSS Type 31): 750 lb.
   b. Medium (MSS Type 32): 1500 lb.

G. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended by manufacturer to prevent crushing insulation.

3.2 HANGER AND SUPPORT INSTALLATION

A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.
   1. Field assemble and install according to manufacturer's written instructions.

C. Install building attachments to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, and at changes in direction of piping.

D. Install powder-actuated drive-pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.

E. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

H. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

I. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.

J. Insulated Piping: Comply with the following:
   1. Attach clamps and spacers to piping.
      a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
      b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
      c. Do not exceed pipe stress limits according to ASME B31.9.
   2. Install MSS SP-58, Type 39 protection saddles, if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
   3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span arc of 180 degrees.
   4. Shield Dimensions for Pipe: Not less than the following:
      a. NPS 1/4 to NPS 3-1/2 (DN8 to DN90): 12 inches long and 0.048 inch thick.
      b. NPS 4 (DN100): 12 inches long and 0.06 inch thick.
   5. Insert Material: Length at least as long as protective shield.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Prime and Paint Equipment Supports as specified in Section 09 90 00 “Painting”.

3.4 METAL FABRICATION

A. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.

B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments, to level equipment, and to achieve indicated slope of pipe.

3.6 PAINTING

A. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 09 90 00 “Painting”.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

- END OF SECTION -

- SECTION 22 0553 -

IDENTIFICATION FOR PLUMBING PIPING & EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Identifying Devices and Labels for Plumbing Piping and Equipment

B. Related Sections:
   1. Section 22 05 00 (15050) – Common Work Results for Plumbing

1.3 SUBMITTALS

A. Submit “Letter of Conformance” in accordance with section 01 33 00 (01330) indicating specified items selected for use in Project with the following supporting data:
   1. Product Data: For identification materials and devices.
   2. Samples: Of color, lettering style, and graphic representation required for each identification material and device.

1.4 QUALITY ASSURANCE

A. Comply with ASME A13.1, "Scheme for the Identification of Piping Systems" for lettering size, length of color field, colors, and viewing angles of identification devices.

1.5 SEQUENCING AND SCHEDULING

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 GENERAL

A. General: Products specified are for applications referenced in other Division 22 Sections. If more than single type is specified for listed applications, selection is Installer's option.

B. Pipes Including Insulation: Full-band pipe markers, extending 360 degrees around pipe at each location.

2.2 IDENTIFYING DEVICES AND LABELS

A. Lettering and Graphics:
   1. Utilize manufacturer's standard preprinted captions as selected by Owner's Representative.
   2. Coordinate names, abbreviations, and other designations used in plumbing identification with corresponding designations indicated. Use numbers, letters, and terms indicated for proper identification, operation, and maintenance of plumbing systems and equipment.
      a. Multiple Systems: Identify individual system number and service if multiple systems of same name are indicated.
   3. Use piping system terms indicated and abbreviate only as necessary for each application length.
      a. Arrows: Either integrally with piping system service lettering, to accommodate both directions, or as separate unit, on each pipe marker to indicate direction of flow.

B. Plastic Tape: Manufacturer's standard color-coded, pressure-sensitive, self-adhesive, vinyl tape, at least 3 mils thick.
   1. Width: 1-1/2 inches on pipes with OD, including insulation, less than 6 inches; 2-1/2 inches for larger pipes.
   2. Color: Comply with ASME A13.1, unless otherwise indicated.

C. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch sequenced numbers. Include 5/32-inch hole for fastener.
   1. Material: 0.032-inch thick, polished brass.
   2. Size: 1-1/2-inches diameter, unless otherwise indicated.

D. Valve Tag Fasteners: Brass, wire-link chain and S-hooks.

E. Access Panel and Equipment Markers: 1/16-inch thick, engraved plastic-laminate markers, with abbreviated terms and numbers corresponding to concealed valve and equipment identification corresponding to schedules on Drawings. Provide 1/8-inch center hole for attachment.

F. Valve Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include screws.
   1. Frame: Extruded aluminum.
   2. Glazing: ASTM C1036, Type I, Class 1, Glazing quality B, 2.5-mm, single-thickness glass.

PART 3 - EXECUTION

3.1 LABELING AND IDENTIFYING PIPING SYSTEMS

A. Install pipe markers on each system as indicated below. Include arrows showing normal direction of flow.
   1. Domestic Cold Water.
   2. Domestic Hot Water.
   3. Domestic Hot Water Return.
   4. Natural Gas.
   5. Sanitary Drain.
   6. Storm Drain.
   7. Vent.

B. Marker Type: Plastic markers, with application systems. Install on pipe insulation segment where required for hot, noninsulated pipes.

C. Fasten markers on pipes and insulated pipes by one of following methods:
   1. Snap-on application of pretensioned, semirigid plastic pipe marker.

D. Locate pipe markers where piping is exposed in machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations according to the following:
   1. Near each valve and control device.
   2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Mark each pipe at branch, where flow pattern is not obvious.
   3. Near penetrations through walls, floors, ceilings, or nonaccessible enclosures.
   4. At access doors, manholes, and similar access points that permit view of concealed piping.
   5. Near major equipment items and other points of origination and termination.
   6. Spaced at a maximum of 50-foot intervals along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
   7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

3.2 VALVE TAGS

A. Install on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, plumbing fixture supply stops, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in valve schedule.

B. Valve Tag Application Schedule: Tag valves according to size, shape, color scheme, and with captions similar to those indicated in the following:
   1. Domestic Cold Water
   2. Domestic Hot Water
   3. Domestic Hot Water Return

4. Gas

C. Tag Material: Brass.

D. Tag Size and Shape: According to the following:
1. Cold Water: 1-1/2 inches round.
2. Hot Water: 1-1/2 inches round.
3. Gas: 1-1/2 inches round.

E. Install framed valve schedule in each major mechanical equipment room.

F. Valve schedule and tag locations shall be shown on record drawings.

3.3 LABELING AND IDENTIFYING PLUMBING EQUIPMENT.

A. Label all plumbing equipment with designations as indicated in plumbing equipment schedules on Drawings.

3.4 ADJUSTING AND CLEANING

A. Relocate plumbing identification materials and devices that have become visually blocked by work of this or other Divisions.

B. Clean faces of identification devices and glass frames of valve charts.

- END OF SECTION -

- SECTION 22 0700 -

PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Insulation Materials
2. Jackets
3. Accessories and Attachments
4. Vapor Retarders

B. Related Sections:
1. Section 07 84 00 (07840) - Firestopping: Firestopping materials and requirements for penetrations through fire and smoke barriers.
2. Section 22 05 29 (15060) - Hangers and Supports for Plumbing Piping and Equipment: For pipe insulation shields and protection saddles.

1.3 REFERENCES

A. ASTM International (ASTM) Publications:
1. E84 "Standard Test Method for Surface Burning Characteristics of Building Materials"
2. C195 “Standard Specification for Mineral Fiber Thermal Insulating Cement”
3. C196 “Standard Specification for Expanded or Exfoliated Vermiculite Thermal Insulating Cement”
4. C449 “Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement”
5. C450 “Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging”
6. C547 “Standard Specification for Mineral Fiber Pipe Insulation”
7. C553 “Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications”
8. C921 “Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation”

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
   1. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
   2. Shop Drawings:
      a. Submit Manufactures data for each type of insulation used.
      b. Application of field-applied jackets.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or similar industry recognized craft training program.

B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.
   1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
   2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

1.6 STORAGE, AND HANDLING

A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Section 22 05 29 - "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for insulation application.

C. Coordinate installation and testing of electric heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after testing piping systems and, where required, after installing and testing heat-trace tape. Insulation application may begin on segments of piping that have satisfactory test results.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved Manufacturers:
   1. Mineral-Fiber Insulation:
      a. CertainTeed Corp. (610-647-3011)
      b. Knauf Insulation. (800-825-4434)
      c. Owens-Corning Fiberglas Corp. (800-447-3759)

2.2 INSULATION MATERIALS

A. Mineral-Fiber Insulation:
   1. Glass fibers bonded with a thermosetting resin complying with the following:
      a. Preformed Pipe Insulation: Comply with ASTM C547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket.
      b. Blanket Insulation: Comply with ASTM C553, Type II, without facing.
      c. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:
         1) Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.
         2) Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.
      d. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.
      e. Mineral-Fiber Insulating Cements: Comply with ASTM C195.
      f. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C196.
      g. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.

B. Prefabricated Thermal Insulating Fitting Covers:
   1. Comply with ASTM C450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

2.3 FIELD-APPLIED JACKETS

A. General: ASTM C921, Type 1, unless otherwise indicated.

B. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.

C. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils thick; roll stock ready for shop or field cutting and forming.
   1. Adhesive: As recommended by insulation material manufacturer.
   2. PVC Jacket Color: White or gray.

3. PVC Jacket Color: Color-code piping jackets based on materials contained within the piping system.

D. Standard PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil- thick, high-impact, ultraviolet-resistant PVC.
1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
2. Adhesive: As recommended by insulation material manufacturer.

2.4 ACCESSORIES

A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz./sq. yd.
1. Tape Width: 4 inches.

2.5 VAPOR RETARDERS

A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

3.3 GENERAL APPLICATION REQUIREMENTS

A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.

C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.

E. Apply multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.

H. Keep insulation materials dry during application and finishing.

I. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

J. Apply insulation with the least number of joints practical.

K. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.

L. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
   1. Apply insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
   3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.

M. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

N. Apply adhesives and mastics at the manufacturer's recommended coverage rate.

O. Apply insulation with integral jackets as follows:
   1. Pull jacket tight and smooth.
   2. Circumferential Joints: Cover with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches o.c.
   3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
      a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.
   4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.

5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.

P. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
1. Seal penetrations with vapor-retarder mastic.
2. Apply insulation for exterior applications tightly joined to interior insulation ends.
3. Extend metal jacket of exterior insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal metal jacket to roof flashing with vapor-retarder mastic.

Q. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.

R. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.

S. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.
1. Firestopping and fire-resistive joint sealers are specified in Section 07 84 00 "Firestopping."

T. Floor Penetrations: Apply insulation continuously through floor assembly.
1. For insulation with vapor retarders, seal insulation with vapor-retarder mastic where floor supports penetrate vapor retarder.

3.4 MINERAL-FIBER INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:
1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet to form a vapor retarder between pipe insulation segments.
3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.

B. Apply insulation to flanges as follows:
1. Apply preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch and seal joints with vapor-retarder mastic.

C. Apply insulation to fittings and elbows as follows:
   1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
   2. When premolded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.
   3. Cover fittings with standard PVC fitting covers.

D. Apply insulation to valves and specialties as follows:
   1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
   2. When premolded insulation sections are not available, apply glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to strainer basket without disturbing insulation.
   3. Apply insulation to flanges as specified for flange insulation application.
   4. Use preformed standard PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.

3.5 PLUMBING PIPING SYSTEM APPLICATIONS

A. Insulation materials and thicknesses are specified in schedules at the end of this Section.

B. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
   1. Flexible connectors.
   2. Vibration-control devices.
   3. Fire-suppression piping.
   4. Below-grade piping, unless otherwise indicated.
   5. Air chambers, unions, strainers, check valves, plug valves, and flow regulators.

3.6 FIELD QUALITY CONTROL

A. Insulation applications will be considered defective if sample inspection reveals noncompliance with requirements. Remove defective Work and replace with new materials according to these Specifications.

B. Reinstall insulation and covers on fittings and valves uncovered for inspection according to these Specifications.

3.7 INTERIOR INSULATION APPLICATION SCHEDULE

A. General:
   1. Refer to insulation application schedules for required insulation materials, vapor retarders, and field-applied jackets.

2. Application schedules identify piping system and indicate pipe size ranges and material, thickness, and jacket requirements.

Service	Material	Thickness	Field Applied Jacket	Vapor Retarder Required	Finish
Domestic cold and industrial cold water outside the building. Operating Temperature: 50 to 90 deg. F.	Mineral fiber with jacket	Copper piping ALL sizes: 1"	None	Yes	None
Domestic hot and recirculated hot water 1-1/2" and less. Operating Temperature: 90 to 160 deg. F.	Mineral fiber with jacket	Copper piping ALL sizes: 1"	None	Yes	None
Domestic hot and recirculated hot water 2" and larger. Operating Temperature: 90 to 140 deg. F.	Mineral fiber with jacket	Copper piping ALL sizes: 1-1/2"	None	Yes	None
Domestic hot and recirculated hot water 2" and larger. Operating Temperature: 145 to 160 deg. F.	Mineral fiber with jacket	Copper piping ALL sizes: 2"	None	Yes	None
Horizontal Rainwater Conductors between roof drain and first vertical drop.	Mineral fiber or Cellular glass, with jacket	Cast Iron Pipe, All sizes: 1"	Foil and Paper	Yes	None
Roof Drain Bodies	Mineral fiber or Cellular glass, with jacket	1"	None	Yes	None
Exposed Sanitary Drains and Domestic Water Supplies and Stops for Fixtures for the Disabled.	"Lav-Guard" as manufactured by Truebro		PVC P-trap and supply covers	No	White

- END OF SECTION -

- SECTION 22 0716 -

PLUMBING EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes insulating the following plumbing equipment:
   1. Domestic water heat exchangers.
   2. Domestic hot water storage tanks.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated, include manufacturer's technical data with proposed thickness and r-value indicated as well as proposed application.

B. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
   1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
   2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Products shall not contain asbestos, lead, mercury, or mercury compounds.

B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Manufacturers: Subject to compliance with requirements, provide product by one of the following manufacturers:
   a. Armstrong.
   b. Halstead-Nomalco.
   c. Imcoa.
   d. Nomaco.
   e. Rubatex, LLC.

F. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

1. Manufacturers: Subject to compliance with requirements, provide product by one of the following manufacturers:
   a. CertainTeed Corp.
   b. Johns Manville.
   c. Knauf Insulation.
   d. Owens Corning.

G. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.

1. Manufacturers: Subject to compliance with requirements, provide product by one of the following manufacturers:
   a. Armacell LLC.
   b. Imcoa.
   c. Nomaco.

2.2 INSULATING CEMENTS

A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
   1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
   1. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. ASJ Adhesive and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
   1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. PVC Jacket Adhesive: Compatible with PVC jacket.
   1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
   1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
   1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
   2. Service Temperature Range: Minus 20 to plus 180 deg F.
   3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
   4. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
   1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
   2. Service Temperature Range: Minus 20 to plus 180 deg F.
   3. Solids Content: 60 percent by volume and 66 percent by weight.
   4. Color: White.

2.5 SEALANTS

A. Joint Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.
4. Color: White or gray.
5. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. ASJ Flashing Sealants, and Vinyl, and PVC Jacket Flashing Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.
5. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for equipment.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Adhesive: As recommended by jacket material manufacturer.
2. Color: White.
3. Factory-fabricated tank heads and tank side panels.

2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Width: 3 inches.
2. Thickness: 11.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
   1. Width: 2 inches.
   2. Thickness: 6 mils.
   3. Adhesion: 64 ounces force/inch in width.
   4. Elongation: 500 percent.
   5. Tensile Strength: 18 lbf/inch in width.

2.9 SECUREMENTS

A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.

B. Insulation Pins and Hangers:
   1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
      a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
      b. Spindle: Stainless steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
      c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
   2. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
      a. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
      b. Spindle: Nylon, 0.106-inch-diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
      c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
   3. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
      a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
   4. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

2.10 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
   a. For below ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

O. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.3 INSTALLATION OF EQUIPMENT, TANK, AND VESSEL INSULATION

A. Mineral-Fiber, Pipe, and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.

4. Install adhesively attached insulation hangers and speed washers on sides of tanks and vessels as follows:
   a. Do not weld anchor pins to ASME-labeled pressure vessels.
   b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
   c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
   d. Do not overcompress insulation during installation.
   e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
   f. Impale insulation over anchor pins and attach speed washers.
   g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches.
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
   1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
   2. Seal longitudinal seams and end joints.

3.4 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.5 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
   1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.6 EQUIPMENT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

B. Insulate indoor and outdoor equipment that is not factory insulated.

C. Heat-Exchanger (Water-to-Water for Domestic Water Heating Service) Insulation:
   1. Mineral-Fiber Pipe and Tank: 2 inches thick.

D. Domestic water, domestic chilled-water (potable), and domestic hot-water hydropneumatic tank insulation shall be one of the following:
   1. Flexible Elastomeric: 1 inch thick.
   2. Mineral-Fiber Pipe and Tank: 1 inch thick.
   3. Polyolefin: 1 inch thick.

E. Domestic Hot-Water Storage Tank Insulation:
   1. Mineral-Fiber Pipe and Tank: Of thickness to provide an R-value of 24.

3.7 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Equipment, Concealed: None.

D. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
   1. PVC: 30 mils thick.

3.8 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. If more than one material is listed, selection from materials listed is Contractor's option.

B. Equipment, Concealed:
   1. PVC: 30 mils thick.

- END OF SECTION -

- SECTION 22 0800 -

COMMISSIONING OF PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. The purpose of this section is to specify Division 22 responsibilities in the commissioning process.
      a. The systems to be commissioned are listed in Section 01 91 13.
      b. Commissioning requires the participation of Division 22 to ensure that all systems are operating in a manner consistent with the Contract Documents. The general commissioning requirements and coordination are detailed in Division 01. Division 22 shall be familiar with all parts of Division 01 and the commissioning plan issued by the CxA and shall execute all commissioning responsibilities assigned to them in the Contract Documents.

B. Related Sections:
   1. Section 01 91 13 – General Commissioning Requirements.
   2. Section 22 08 00.01 – Plumbing Testing Requirements
   3. Section 22 08 00.02 – Plumbing Prefunctional Checklists
   4. Section 22 08 00.03 – Plumbing Sample Functional Test Procedures

C. Related Work:
   1. Refer to Section 01 91 13 for a listing of all Sections where commissioning requirements are found.
   2. Refer to Section 01 91 13 for systems to be commissioned and Sections 22 08 00 through 22 08 00.03 for functional testing requirements.

1.3 RESPONSIBILITIES

A. Plumbing Contractor. The commissioning responsibilities applicable to the Plumbing Contractor of Division 22 are as follows (all references apply to commissioned equipment only):
   1. Construction and Acceptance Phases
      a. Include and itemize the cost of commissioning in the contract price.

b. In each purchase order or subcontract written, include requirements for submittal data, commissioning documentation, O&M data and training.

c. Attend a commissioning scoping meeting and other meetings necessary to facilitate the Cx process.

d. Provide a copy of the O&M manuals of commissioned equipment, through normal channels, to the CxA for review and approval.

e. Develop a full start-up and initial checkout plan using manufacturer's start-up procedures and the prefunctional checklists from the CxA for all commissioned equipment. Submit to CxA for review and approval prior to startup. Refer to Section 01 91 13 for further details on start-up plan preparation.

f. During the startup and initial checkout process, execute the Fire Protection-related portions of the prefunctional checklists for all commissioned equipment.

g. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CxA.

h. Address current A/E punch list items before functional testing.

i. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.

j. Provide training of the Owner's operating staff using expert qualified personnel, as specified.

k. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

2. Warranty Period: Correct deficiencies and make necessary adjustments to O&M manuals and record drawings for applicable issues identified in any seasonal testing.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. Division 22 shall provide all test equipment necessary to fulfill the testing requirements of this Division.

B. Refer to Section 01 91 13 for additional Division 22 requirements.

PART 3 - EXECUTION

3.1 STARTUP

A. The plumbing contractor shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this Section and in Section 01 91 13. Division 22 has start-up responsibility and is required to complete systems and sub-systems so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the commissioning agent or Owner.

B. Functional testing is intended to begin upon completion of a system. Functional testing may proceed prior to the completion of systems or sub-systems at the discretion of the CxA and GC.

Beginning system testing before full completion does not relieve the Contractor from fully completing the system, including all prefunctional checklists as soon as possible.

3.2 FUNCTIONAL PERFORMANCE TESTS

A. Refer to Section 01 91 13 for a list of systems to be commissioned and to Section 01 91 13, Article 3.06 “Documentation, Non-Conformance and Approval Of Tests” for a description of the process and to Sections 22 08 00 through 22 08 00.03 for specific details on the required functional performance tests.

3.3 TESTING DOCUMENTATION, NON-CONFORMANCE AND APPROVALS

A. Refer to Section 01 91 13 for specific details on non-conformance issues relating to prefunctional checklists and tests.

B. Refer to Section 01 91 13 for issues relating to functional performance tests.

3.4 DEFERRED TESTING

A. Refer to Section 01 91 13 for requirements of deferred testing.

3.5 WRITTEN WORK PRODUCTS

A. Written work products of Contractors will consist of the start-up and initial checkout plan described in Section 01 91 13 and the filled out start-up, initial checkout and prefunctional checklists.

- END OF SECTION -

- SECTION 22 0800.01 -

PLUMBING TESTING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. This Section specifies the functional testing requirements for Division 22 systems and equipment.

B. Related Sections:
   1. Section 01 91 13 – General Commissioning Requirements.
   2. Section 22 08 00 – Commissioning of Plumbing
   3. Section 22 08 00.02 – Plumbing Prefunctional Checklists
   4. Section 22 08 00.03 – Plumbing Sample Functional Test Procedures

1.3 INCLUDED SYSTEMS AND EQUIPMENT

A. The following is a list of the equipment and system test requirements included in this section:
   1. Fuel Fired Domestic Water Heaters
   2. Domestic Water Pumps
   3. Plumbing Fixtures
   4. Sump Pumps

1.4 DESCRIPTION

A. This Section specifies the functional testing requirements for Division 22 systems and equipment. From these requirements, the Commissioning Authority (CxA) shall develop step-by-step procedures to be executed by the Subcontractors or the Commissioning Authority. The general functional testing process, requirements and test method definitions are described in Section 01 91 13. The test requirements for each piece of equipment or system contain the following:
   1. The contractors responsible to execute the tests, under the direction of the CxA.
   2. A list of the integral components being tested.
   3. Prefunctional checklists associated with the components.

4. Functions and modes to be tested.
5. Required conditions of the test for each mode.
6. Special procedures.
7. Required methods of testing.
8. Required monitoring.
9. Acceptance criteria.
10. Sampling strategies allowed.

1.5 PREREQUISITES

A. The following applicable generic prerequisite checklist items are listed on each written functional test form and shall be completed and checked off by CxA prior to functional testing:
   1. All related equipment has been started up and start-up reports and prefunctional checklists submitted and approved ready for functional testing:
   2. All control system functions for this and all interlocking systems are programmed and operable per contract documents, including final setpoints and schedules with debugging, loop tuning and sensor calibrations completed.
   3. Piping system flushing complete and required report approved.
   4. Water treatment system complete and operational.
   5. Vibration control report approved (if required).
   6. All A/E punchlist items for this equipment corrected.
   7. These functional test procedures reviewed and approved by installing contractor.
   8. Safeties and operating ranges reviewed by the CxA.
   9. Test requirements and sequences of operation attached.
   10. Schedules and setpoints attached.
   11. Sufficient clearance around equipment for servicing.
   12. Record of all values for pre-test setpoints changed to accommodate testing has been made and a check box provided to verify return to original values (control parameters, limits, delays, lockouts, schedules, etc.).
   13. Other miscellaneous checks of the prefunctional checklist and start-up reports completed successfully.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 DOMESTIC HOT WATER SYSTEM

A. Parties Responsible to Execute Functional Test:
   1. Plumbing contractor or vendor: Assist in testing sequences, correct deficiencies.
   2. CxA: Perform and document testing.

3. Owners Representative: Witness.

B. Integral Components or Related Equipment Being Tested (Prefunctional Checklist):
1. Hot water heaters (heaters, mixing valves, Domestic Hot Water System circulating pumps, recirculation pumps).

C. Prerequisites: The applicable prerequisite checklist items listed in the beginning of Section 22 08 00.01 shall be listed on each functional test form and checked off prior to functional testing. The commissioning agent will also spot-check misc. items and calibrations on the prefunctional checklists previously completed by the installer, before the beginning of functional testing.

D. Functions / Modes Required To Be Tested, Test Methods and Seasonal Test Requirements:
1. The following testing requirements are in addition to and do not replace any testing requirements elsewhere in this Division.

Function/Mode	Test Method (Manual, Monitoring, Either or Both)	Required Seasonal Test
General:		
1. Test each sequence in the sequence of operations, and other significant modes and sequences not mentioned; including startup, shutdown, unnoccupied & manual modes and power failure. Test functionality of this piece of equipment or system in all control strategies or interlocks that it is associated with.	Manual	
In addition to, or as part of (1) above, the following modes or tests are required:		
2. Verify schedules and setpoints to be reasonable and appropriate		
3. Pump operation	Either	
4. Mixing valve operation and temperature control	Either	
5. Sensor calibration checks on hot water temperature	Manual	

E. Special Procedures: None.

F. Required Monitoring: None.

G. Acceptance Criteria (referenced by function or mode ID):
1. 1 - 5. For the conditions, sequences and modes tested, the fan's integral components and related equipment respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice.

H. Sampling Strategy for Identical Units:
1. No sampling. Test all units.

- END OF SECTION -

- SECTION 22 0800.02 -

PLUMBING PREFUNCTIONAL CHECKLISTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Prefunctional Checklists (PC) in a form format. The Prefunctional Checklists consist of Instructions Sheets and Record Sheets.

B. Related Sections:
   1. Section 01 33 00 - Submittal and Substitution Procedures
   2. Section 01 91 13 – General Commissioning Requirements.
   3. Section 22 08 00 – Commissioning of Plumbing
   4. Section 22 08 00.01 – Plumbing Testing Requirements
   5. Section 22 08 00.03 – Plumbing Sample Functional Test Procedures

1.3 DESCRIPTION

A. The PC procedures displayed in a form format here are intended to provide the Contractor with an example of the format and an indication of the rigor of the required prefunctional checklists (Instruction Sheets and Record Sheets) and documentation for various equipment types. Though they were not developed specifically for this project, they are generally applicable.

B. The checklists contain items for both Division 22 and 26 contractors to perform.

C. Those executing the checklists are only responsible to perform items that apply to the specific application at hand. These checklists do not take the place of the manufacturer's recommended checkout and start-up procedures or report. Some checklist procedures may be redundant of some checkout procedures that will be documented on typical factory field checkout sheets. Double documenting is required in those cases.

D. Refer to Section 01 91 13 for additional requirements regarding prefunctional checklists, startup and initial checkout. Items that do not apply should be noted along with the reasons on the form. If supplied Prefunctional Checklist forms are not used for documenting, one of similar rigor and clarity shall be used. Contractors assigned responsibility for sections of the checklist

shall be responsible to see that checklist items by their subcontractors are completed and checked off.

E. The following is a list of the equipment and systems which will require Prefunctional Checklists (Instruction Sheets and Record Sheets) to be completed by the Contractors.
   1. Fuel Fired Domestic Water Heaters
   2. Domestic Water Pumps
   3. Plumbing Fixtures
   4. Sump Pumps

F. Refer to Section 01 33 00 - Submittal and Substitution Procedures for Prefunctional Checklists.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

- END OF SECTION -

- SECTION 22 0800.03 -

PLUMBING SAMPLE FUNCTIONAL TEST PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. This Section contains the Functional Testing Procedures for Plumbing Systems

B. Related Sections:
   1. Section 01 33 00 - Submittal and Substitution Procedures
   2. Section 01 91 13 – General Commissioning Requirements.
   3. Section 22 08 00 – Commissioning of Plumbing
   4. Section 22 08 00.01 – Plumbing Testing Requirements
   5. Section 22 08 00.02 – Plumbing Prefunctional Checklists

1.3 DESCRIPTION

A. The CxA will use the functional testing requirements in Sections 22 08 00 thru 22 08 00.03 and the testing protocols specified in Section 01 91 13 for developing site-specific functional test procedures and forms for this project. For illustrative purposes, sequences of operation associated with a few pieces of the equipment for which tests are included are also provided.

B. The following is a list of the equipment and systems which will require Prefunctional Checklists (Instruction Sheets and Record Sheets) to be completed by the Contractors.
   1. Domestic Water Pumps
   2. Plumbing Fixtures
   3. Sump Pumps

C. Refer to Section 01 33 00 - Submittal and Substitution Procedures for Prefunctional Checklists.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

- END OF SECTION -

- SECTION 22 1116 -

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Pipe and Tube Materials.
2. Fittings.
3. Joining Materials.
4. Polyethylene Encasement.

B. Related Sections:
1. Section 22 05 00 (15050) – Common Work Results for Plumbing
2. Section 22 05 29 (15060) - Hangers and Supports for Plumbing Piping and Equipment
3. Section 22 05 23 (15110) – General Duty Valves for Plumbing Piping
4. Section 22 05 19 (15122) - Meters and Gages for Plumbing Piping.
5. Section 22 10 03 (15430) - Plumbing Specialties
6. Section 31 20 00 (02300) - Earthwork
7. Section 33 00 00 (02500) - Utility Services: for exterior water service piping.

1.3 REFERENCES

A. The American Society of Mechanical Engineers (ASME) Publications:
1. B1.20.1 "Pipe Threads, General Purpose, Inch"
2. B16.18 “Cast Copper Alloy Solder Joint Pressure Fittings”
3. B16.22 “Wrought Copper and Copper Alloy Solder Joint Pressure Fittings”
4. B16.24 “Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 400, 600, 900, 1500 and 2500”
5. B31.9 “Building Services Piping”

B. ASTM International (ASTM) Publications:
1. A47 "Standard Specification for Ferritic Malleable Iron Castings"
2. A536 "Standard Specification for Ductile Iron Castings"
3. A674 “Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids”

4. B32 "Standard Specification for Solder Metal"
5. B75 “Standard Specification for Seamless Copper Tube”
6. B88 “Standard Specification for Seamless Copper Water Tube”
7. B584 “Standard Specification for Copper Alloy Sand Castings for General Applications”
8. F876 “Standard Specification for Cross-linked Polyethylene (PEX) Tubing”
9. F877 “Standard Specification for Cross-linked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems”
10. F1960 “Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-linked Polyethylene (PEX) Tubing”

C. American Water Works Association (AWWA) Publications:
1. C104/ANSI A21.4-03 “Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water”
2. C105/ANSI A21.5-99 “Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems”
3. C110/ANSI A21.10-03 “Standard for Ductile-Iron and Gray-Iron Fittings, 3 In.-48 In. (76 mm-1,219 mm), for Water”
4. C111/ANSI A21.11-00 “Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings”
5. C115/ANSI A21.15-99 “Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges”
6. C151/ANSI A21.51-02 “Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water”
7. C153/ANSI A21.53-00 “Standard for Ductile-Iron Compact Fittings for Water Service”
8. C550 “Protective Epoxy Interior Coatings for Valves and Hydrants”
9. C600 “Installation of Ductile-Iron Water Mains and Their Appurtenances”
10. C606 “Grooved and Shouldered Joints”
11. C651 “Disinfecting Water Mains”
12. C652 “Disinfection of Water-Storage Facilities”

D. American Welding Society (AWS) Publications:
1. A5.8 "Specification For Filler Metals For Brazing And Braze Welding"

1.4 DEFINITIONS

A. Water Service Piping: Water piping outside building that conveys water to building (by Site Subcontractor).

B. Service Entrance Piping: Water piping at entry into building between water service piping and water distribution piping (by Plumbing Subcontractor, beginning at 5’-0” outside of building).

C. Water Distribution Piping: Water piping inside building that conveys water to fixtures and equipment throughout the building.

1.5 SYSTEM PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:

1. Combined Fire-Protection and Domestic, Service Entrance Piping: 250 psig (provide only where permitted by the authority having jurisdiction).
2. Service Entrance Piping: 160 psig.
3. Water Distribution Piping: 125 psig and 210 psig as indicated.

1.6 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

B. Submit “Letter of Conformance” in accordance with Section 01 33 00 (01330) indicating specified items selected for use in project with the following supporting data.
1. Product Data: Water Samples, Test Results, and Reports: Specified in "Field Quality Control" and "Cleaning" articles.

1.7 QUALITY ASSURANCE

A. Provide listing/approval stamp, label, or other marking on piping made to specified standards.

B. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

C. Comply with NSF 61, "Drinking Water System Components--Health Effects," Sections 1 through 9 for potable-water piping and components.

PART 2 - PRODUCTS

2.1 PIPE AND TUBE MATERIALS

A. General: Applications of the following pipe and tube materials are indicated in Part 3 "Piping Applications" Article.

B. Soft Copper Tube: ASTM B88, Types K and L, water tube, annealed temper.

C. Hard Copper Tube: ASTM B88, Types L, water tube, drawn temper.

D. Ductile-Iron Pipe: AWWA C151, 250-psig minimum pressure rating with mechanical- or push-on-joint bell, plain spigot end, and AWWA C104 cement-mortar lining. Include AWWA C111 ductile-iron gland, rubber gasket, and steel bolts with mechanical-joint pipe. Include AWWA C111 rubber gasket with push-on-joint pipe.

E. Flanged, Ductile-Iron Pipe: AWWA C115 ductile-iron barrel with 250-psig pressure rating and AWWA C104 cement-mortar lining. Include Class 150 or 300, iron-alloy threaded flanges that match piping.

F. PEX-a TUBING: ATSM 876/877

2.2 PIPE AND TUBE FITTINGS

A. General: Applications of the following pipe and tube fitting materials are indicated in Part 3 "Piping Applications" Article.

B. Copper, Solder-Joint Pressure Fittings: ASME B16.18 cast-copper alloy or ASME B16.22 wrought copper.

C. Copper, Grooved-End Fittings: ASTM B75 copper tube or ASTM B584 bronze castings.

D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.

E. Copper Unions: ASME B16.18, cast-copper-alloy, hexagonal-stock body with ball-and-socket joint, metal-to-metal seating surfaces, and solder-joint, threaded, or solder-joint and threaded ends. Include threads conforming to ASME B1.20.1 on threaded ends.

F. Ductile-Iron, Mechanical- or Push-on-Joint Fittings: AWWA C110, ductile- or gray-iron standard pattern; or AWWA C153, ductile-iron compact pattern; with 250-psig minimum pressure rating and AWWA C104 cement-mortar lining. Include AWWA C111 ductile- or gray-iron glands, rubber gaskets, and steel bolts with mechanical-joint fittings. Include AWWA C111 rubber gaskets with push-on-joint fittings.

G. Ductile-Iron, Flexible Expansion Joints: Compound fitting with combination of flanged and mechanical-joint ends conforming to AWWA C110 or AWWA C153. Include 2 gasketed ball-joint sections, 1 or more gasketed sleeve sections, 250-psig minimum working-pressure rating, and AWWA C550 epoxy interior coating. Assemble components for offset and expansion indicated. Include AWWA C111 ductile-iron glands, rubber gaskets, and steel bolts.

H. Ductile-Iron, Grooved-End Fittings: ASTM A47 malleable-iron castings or ASTM A536 ductile-iron castings with cement-mortar lining or AWWA C550 interior coating and dimensions matching ductile-iron pipe.

I. Ductile-Iron Flanged Fittings: AWWA C110, ductile- or gray-iron standard pattern; with 250-psig minimum pressure rating and AWWA C104 cement-mortar lining.

J. Ferrous Expansion Joints: Compound, galvanized steel fitting with telescoping body and slip-pipe section. Include 150-psig minimum pressure rating, packing rings, packing, limit rods, chrome-plated finish on slip-pipe section, flanged ends, and AWWA C550 epoxy interior coating.

K. Ferrous, Double Expansion Joints: Compound, galvanized steel fitting with telescoping body and 2 slip-pipe sections. Include 150-psig minimum pressure rating, packing rings, packing, limit rods, chrome-plated finish on slip-pipe sections, flanged ends, and AWWA C550 epoxy interior coating.

L. PEX Fittings: ASTM F1960 cold expansion fittings.

2.3 JOINING MATERIALS

A. General: Applications of the following piping joining materials are indicated in Part 3 "Piping Applications" Article.

B. Refer to Section 22 05 00 - "Common Work Results for Plumbing" for commonly used joining materials.

C. Solder: ASTM B32, Alloy Sn95, Sn94, or E; lead free.

D. Brazing Filler Metal: AWS A5.8, BCuP, copper phosphorus or BAg, silver classification.

E. Copper, Keyed Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for hot water, and bolts and nuts.

F. Ductile-Iron, Keyed Couplings: AWWA C606 for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for hot water, and bolts and nuts.

G. Transition Couplings: Coupling or other manufactured fitting same size as, with pressure rating at least equal to, and with ends compatible with piping to be joined.

2.4 POLYETHYLENE ENCASEMENT

A. Polyethylene Encasement for Ductile-Iron Piping: ASTM A674 or AWWA C105 polyethylene film, 0.008-inch minimum thickness, tube or sheet.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Section 31 20 00 - "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below, unless otherwise indicated.

B. Flanges may be used on aboveground piping, unless otherwise indicated.

C. Fitting Option: Mechanically formed tee-branch outlets and brazed joints may be used on aboveground copper tubing.

D. Underground, Service Entrance Piping: Do not use flanges or valves underground. Use the following:

1. 2-Inch NPS (DN50) and Smaller: Soft copper tube, Type K (Type A); copper, solder-joint pressure fittings; and soldered joints.
2. 2-1/2- to 3-1/2-Inch NPS (DN65 to DN90): Soft copper tube, Type K (Type A); copper, solder-joint pressure fittings; and soldered joints.

3. 4- to 8-Inch NPS (DN100 to DN200): Ductile-iron pipe and fittings, and mechanical or push-on joints.

E. Aboveground, Water Distribution Piping within Guestrooms: Use one of the following:
1. 2-Inch NPS (DN90) and Smaller: PEX-a with ASTM F1960 cold expansion fittings.
2. 2-1/2-Inch NPS (DN90) and Smaller: Hard copper tube, Type L (Type B); copper, solder-joint fittings; and soldered joints.

F. Aboveground, Water Distribution Piping between Booster Pump Discharge and Pressure Reducing Valve Inlet and Downstream of Hot Water Return Pumps: Use the following:
1. 2-1/2-Inch NPS (DN90) and Smaller: Hard copper tube, Type L (Type B); copper, solder-joint fittings; and soldered joints.
2. 4- to 6-Inch NPS (DN100 to DN150): Hard copper tube, Type L (Type B) with grooved ends; copper, grooved-end fittings; and copper, keyed couplings rated for minimum 210 psig.

G. Aboveground, Water Distribution Piping in all other Areas: Use the following:
1. 2-1/2-Inch NPS (DN90) and Smaller: Hard copper tube, Type L (Type B); copper, solder-joint fittings; and soldered joints.
2. 4- to 6-Inch NPS (DN100 to DN150): Hard copper tube, Type L (Type B) with grooved ends; copper, grooved-end fittings; and copper, keyed couplings.

H. Underground, Water Distribution Piping: Do not use flanges or valves underground. Use the following:
1. 2-Inch NPS (DN50) and Smaller: Soft copper tube, Type L (Type B); wrought-copper, solder-joint pressure fittings; and soldered joints.
2. 2-1/2- to 4-Inch NPS (DN65 to DN100): Hard copper tube, Type L (Type B); wrought-copper, solder-joint pressure fittings; and soldered joints.

3.3 PIPING INSTALLATION, GENERAL

A. Refer to Section 22 05 00 - "Common Work Results for Plumbing" for basic piping installation.

3.4 SERVICE ENTRANCE PIPING INSTALLATION

A. Extend service entrance piping to exterior water service piping in sizes and locations indicated for service entrances into building. Refer to Section 33 00 00 - "Utilities" for water service piping.

B. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside building at each service entrance pipe per local Utility Code requirements.

C. Install water-pressure regulators downstream from shutoff valves. Refer to Section 22 10 13 - "Plumbing Specialties" for water-pressure regulators.

D. Ductile-Iron, Service Entrance Piping: Comply with AWWA C600. Install buried piping between shutoff valve and connection to water service piping with restrained joints. Anchor pipe to wall or floor at entrance. Include thrust-block supports at vertical and horizontal offsets.
1. Encase piping with polyethylene film according to ASTM A674 or AWWA C105 if required by the local authority having jurisdiction.

E. Install wall penetration system at each service entrance pipe penetration through foundation wall. Make installation watertight. Refer to Section 22 05 00 - "Common Work Results for Plumbing" for wall penetration systems.

3.5 JOINT CONSTRUCTION

A. Refer to Section 22 05 00 - "Common Work Results for Plumbing" for basic piping joint construction.

B. Grooved Joints: Assemble joints with coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

3.6 HANGER AND SUPPORT INSTALLATION

A. Refer to Section 22 05 29 - "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices. Install the following:
   1. Riser clamps, MSS Type 8 or Type 42, for vertical runs.
   2. Adjustable steel clevis hangers, MSS Type 1, for individual, straight, horizontal runs 100 feet and less.
   3. Adjustable roller hangers, MSS Type 43, for individual, straight, horizontal runs longer than 100 feet.
   4. Spring cushion rolls, MSS Type 49, if indicated, for individual, straight, horizontal runs longer than 100 feet.
   5. Pipe rolls, MSS Type 44, for multiple, straight, horizontal runs 100 feet or longer. Support pipe rolls on trapeze.
   6. Spring hangers, MSS Type 52, for supporting base of vertical runs.

B. Install supports according to Section 22 05 29 - "Hangers and Supports for Plumbing Piping and Equipment"

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for PEX tubing with the following maximum spacing and minimum rod diameters:
   1. 3/4-Inch NPS (DN20) and Smaller without PEX-a Pipe Support: Maximum horizontal spacing, 32 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 5 feet.
   2. 3/4-Inch NPS (DN20) and Smaller with PEX-a Pipe Support: Maximum horizontal spacing, 72 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 5 feet.
   3. 1-Inch NPS (DN25) without PEX-a Pipe Support: Maximum horizontal spacing, 32 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 5 feet.
   4. 1-1/4-Inch NPS (DN32) to 2-Inch (DN50) without PEX-a Pipe Support: Maximum horizontal spacing, 48 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 5 feet.
   5. 1-Inch to 2-Inch NPS (DN25 and DN50) with PEX-a Pipe Support: Maximum horizontal spacing, 96 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 5 feet.

F. Install hangers for copper tubing with the following maximum spacing and minimum rod diameters:
   1. 3/4-Inch NPS (DN20) and Smaller: Maximum horizontal spacing, 60 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 10 feet.
   2. 1-Inch NPS (DN25): Maximum horizontal spacing, 72 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 10 feet.
   3. 1-1/4-Inch NPS (DN32): Maximum horizontal spacing, 72 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 10 feet.
   4. 1-1/2 and 2-Inch NPS (DN40 and DN50): Maximum horizontal spacing, 96 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 10 feet.
   5. 2-1/2-Inch NPS (DN65): Maximum horizontal spacing, 108 inches with 1/2-inch minimum rod diameter; maximum vertical spacing, 10 feet.
   6. 3-Inch NPS (DN80): Maximum horizontal spacing, 10 feet with 1/2-inch minimum rod diameter; maximum vertical spacing, 10 feet.
   7. 3-1/2-Inch NPS (DN90): Maximum horizontal spacing, 10 feet with 1/2-inch minimum rod diameter; maximum vertical spacing, 10 feet.
   8. 4- and 5-Inch NPS (DN100 and DN125): Maximum horizontal spacing, 10 feet with 1/2-inch minimum rod diameter; maximum vertical spacing, 10 feet.

G. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Connect service entrance piping to exterior water service piping. Use transition fitting to join dissimilar piping materials.

B. Connect water distribution piping to service entrance piping at shutoff valve, and extend to and connect to the following:
   1. Water Heaters: Connect cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
   2. Plumbing Fixtures: Connect hot- and cold-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Section 22 40 00 - "Plumbing Fixtures."
   3. Equipment: Connect hot- and cold-water supply piping as indicated. Provide shutoff valve and union for each connection. Use flanges instead of unions for connections 2-1/2-inch NPS (DN65) and larger.
   4. Booster Systems (Where required): Connect cold-water suction and discharge piping.

3.8 FIELD QUALITY CONTROL

A. Inspect service entrance piping and water distribution piping as follows:
   1. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
   2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
      a. Roughing-In Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.

b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

B. Test service entrance piping and water distribution piping as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.

3. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for 4 hours. Leaks and loss in test pressure constitute defects that must be repaired.

4. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.

5. Prepare reports for tests and required corrective action.

3.9 CLEANING

A. Clean and disinfect service entrance piping and water distribution piping as follows:

1. Purge new piping and parts of existing water piping that have been altered, extended, or repaired before using.

2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed, procedure described in either AWWA C651 or AWWA C652 or as described below:

a. Flush piping system with clean, potable water until dirty water does not appear at outlets.

b. Fill and isolate system according to either of the following:

1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.

2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for 3 hours.

c. Flush system with clean, potable water until chlorine is no longer in water coming from system after the standing time.

d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows contamination.

B. Prepare and submit reports for purging and disinfecting activities.

C. Clean interior of piping system. Remove dirt and debris as work progresses.

3.10 COMMISSIONING

A. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.

B. Perform the following steps before putting into operation:
   1. Close drain valves, hydrants, and hose bibbs.
   2. Open shutoff valves to fully open position.
   3. Open throttling valves to proper setting.
   4. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
   5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
   6. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and that cartridges are clean and ready for use.

C. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.

D. Check plumbing specialties and verify proper settings, adjustments, and operation.
   1. Water-Pressure Regulators: Set outlet pressure at 80 psig maximum, unless otherwise indicated.

E. Energize pumps and verify proper operation.

- END OF SECTION -

- SECTION 22 1119 -

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following domestic water piping specialties:
   1. Vacuum breakers.
   2. Backflow preventers.
   3. Water pressure-reducing valves.
   4. Balancing valves.
   5. Temperature-actuated water mixing valves.
   6. Clothes washer drain and supply.
   7. Strainers.
   8. Hose bibbs.
   9. Wall hydrants.
   10. Roof hydrants.
   11. Drain valves.
   12. Water hammer arresters.
   13. Trap-seal primer valves.

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.4 SUBMITTALS

A. Product Data: For each type of water piping specialty proposed for this project. Include manufacturer, model number, materials of construction, options and accessories, etc.
   1. For thermostatic mixing valves include a copy of the piping diagram.

B. Field quality-control test reports.

C. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. NSF Compliance:
1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
1. Standard: ASSE 1001.
2. Size: NPS 1/4 to NPS 3, as required to match connected piping.
3. Body: Bronze.
4. Inlet and Outlet Connections: Threaded.
5. Finish: Chrome plated.

2.2 BACKFLOW PREVENTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Conbraco Industries, Inc.
2. FEBCO.
3. Watts Industries, Inc.; Water Products Div.
4. Wilkins.

B. Reduced-Pressure-Principle Backflow Preventers:
1. Standard: ASSE 1013.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
4. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved, steel with interior lining complying with AWWA C550 or that is FDA approved, or stainless steel for NPS 2-1/2 and larger.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
6. Configuration: Designed for horizontal, straight through flow.
7. Accessories:
   a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
   b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

2.3 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Conbraco Industries, Inc.
   b. Watts Industries, Inc.
   c. Wilkins.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Design Outlet Pressure Setting: As indicated on drawings.
5. Body: Bronze for NPS 2 and smaller; cast iron for NPS 2-1/2 and NPS 3.
6. Valves for Booster Heater Water Supply: Include integral bypass.
7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

2.4 BALANCING VALVES

A. Bronze, Calibrated-Orifice, Balancing Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Armstrong Pumps, Inc.
   b. Bell & Gossett Domestic Pump; a division of ITT Industries.
   c. Griswold Controls.
   d. NIBCO INC.
   e. Oventrop
   f. Taco.
2. Body: Brass resistant to dezincification (DZR) or stainless steel, ball, plug or globe type with calibrated orifice or venturi.
3. Ball: Brass resistant to dezincification (DZR) or stainless steel.
4. Seat: PTFE.
5. End Connections: Threaded or socket.
6. Pressure Gage Connections: Two, one on either side of valve with integral seals for portable differential pressure meter.
7. Handle Style: Lever or handwheel, with memory stop to retain set position.
8. CWP Rating: Minimum 125 psig.
9. Maximum Operating Temperature: 250 deg F.

2.5 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Point-of-Use, Water-Temperature Limiting Devices:
1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
   a. Bradley.
   b. Conbraco Industries, Inc.
   c. Lawler Manufacturing Company, Inc.

d. Powers.
e. Symmons Industries, Inc.
f. Watts Industries, Inc.
g. Wilkins.

2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded or union inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: 110° F.
9. Tempered-Water Design Flow Rate: .5gpm – 2.5gpm.
10. Valve Finish: Chrome plated where exposed, (0.3 L/S - .15 L/S) rough bronze where concealed.

B. Primary, Thermostatic, Water Mixing Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
   a. Bradley.
   b. Lawler Manufacturing Company, Inc.
   c. Powers.
   d. Symmons Industries, Inc.
   e. Wilkins.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Cabinet-type, thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded or union inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
9. Pressure Drop at Design Flow Rate: 25 psig.
10. Valve Finish: Rough bronze.
11. Piping Finish: Copper.
12. Cabinet: Factory-fabricated, stainless steel, for surface mounting and with hinged, stainless-steel door.

2.6 CLOTHES WASHER DRAIN & SUPPLY

A. General: Recessed-mounting outlet boxes with fittings complying with ASME A112.18.1. Include box with faceplate, services indicated for equipment connections, and wood-blocking reinforcement.

B. Clothes Washer Outlet Boxes: With hose connections, drain, and the following:
   1. Box and Faceplate: Plastic.
   2. Shutoff Fittings: 2 hose bibbs.
   3. Supply Fittings: Two 1/2-inch NPS (DN15) gate, globe, or ball valves and 1/2-inch NPS (DN15) copper, water tubing.
   4. Drain Fitting: 2-inch NPS (DN50) drainage piping P-trap with 2-inch NPS (DN50) standpipe extending from floor to outlet box and 2-inch NPS (DN50) waste.

2.7 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:
   1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
   2. Body: Bronze for NPS 2 and smaller; cast iron for NPS 2-1/2 and larger.
   3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
   4. Screen: Stainless steel with round perforations, unless otherwise indicated.
   5. Perforation Size:
      a. Strainers NPS 2 and Smaller: 0.020 inch.
      b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
      c. Strainers NPS 5 and Larger: 0.10 inch.
   6. Drain: Pipe plug.

2.8 HOSE BIBBS

A. Hose Bibbs:
   1. Standard: ASME A112.18.1 for sediment faucets.
   2. Body Material: Bronze.
   3. Seat: Bronze, replaceable.
   4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
   5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
   6. Pressure Rating: 125 psig.
   7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
   8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
   9. Finish for Service Areas: Rough bronze.
   10. Finish for Finished Rooms: Chrome or nickel plated.
   11. Operation for Equipment Rooms: Wheel handle or operating key.
   12. Operation for Service Areas: Operating key.
   13. Operation for Finished Rooms: Operating key.
   14. Include operating key with each operating-key hose bibb.
   15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.9 WALL HYDRANTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Chicago.
   2. MIFAB, Inc.
   3. Smith, Jay R. Mfg. Co.
   4. Watts Drainage Products Inc.
   5. Woodford Manufacturing Company.
   6. Zurn.

B. Moderate-Climate Wall Hydrants:
   1. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
   2. Pressure Rating: 125 psig.
   3. Operation: Loose key.
   4. Inlet: NPS 3/4 or NPS 1.
   5. Outlet: Concealed, with integral vacuum breaker or nonremovable hose-connection and garden-hose thread complying with ASME B1.20.7.
   6. Box: Deep, flush mounting with cover.
   7. Box and Cover Finish: Polished nickel bronze
   8. Operating Keys(s): One with each wall hydrant.

2.10 ROOF HYDRANTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Chicago.
   2. MIFAB, Inc.
   3. Smith, Jay R. Mfg. Co.
   4. Watts Drainage Products Inc.
   5. Woodford Manufacturing Company.
   6. Zurn.

B. Nonfreeze Roof Hydrants:
   1. Pressure Rating: 100 psig.
   2. Operation: Lift handle.
   3. Casing and Operating Rod: Galvanized casing approximately 50 inches long with bronze interior parts. Include coated, cast iron roof sleeve with anchoring flange and clamp collar.
   4. Inlet: NPS 3/4 or NPS 1.
   5. Head: Coated cast iron with bronze interior parts.
   6. Outlet: Vacuum breaker with garden-hose thread complying with ASME B1.20.7.

2.11 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:
1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.12 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. MIFAB, Inc.
   b. PPP Inc.
   c. Sioux Chief Manufacturing Company, Inc.
   d. Smith, Jay R. Mfg. Co.
   e. Watts Drainage Products Inc.
   f. Zurn.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows or Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.13 TRAP GUARD

A. Supply-Type, Trap-Seal Primer Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Provent
2. Standard: ASSE 1072-07, ICC-ES Listing (PMG-1091).
3. Conformance: Intended to serve as an alternate for trap primers in floor drains conforming with either ANSI/ASME A112.6.3 or CSA B79.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install backflow preventers at connection points of domestic water system to water-service piping. Comply with authorities having jurisdiction.

B. Install backflow preventers in each water supply to equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
   1. Locate backflow preventers in same room as connected equipment or system.
   2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
   3. Do not install bypass piping around backflow preventers.

C. Install water pressure regulators with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.

D. Install balancing valves in locations where they can easily be adjusted.

E. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
   1. Install thermometers and water regulators if specified.
   2. Install cabinet-type units recessed in or surface mounted on wall as specified.

F. Install Y-pattern strainers for water on supply side of each water pressure-reducing valve, solenoid valve, and pump.

G. Install roof hydrants where indicated on drawings. Secure hydrant to roof structure to prevent movement during operation and use. Coordinate flashing with roofing contractor. Route drain to location indicated on drawings, or to nearest mop sink, floor sink, or landscaping area exterior to the building. Terminate 1 inch above flood level of mop or floor sink, or 6 inches above grade for landscape areas.

H. Install water hammer arresters in water piping according to PDI-WH 201.

I. Install trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain or floor-sink body, trap, or inlet fitting. Adjust valve for proper flow.
   1. Install trap primer valves at all floor drains or floor sinks, except floor drains in commercial showers.
   2. Install supply-type valves where floor drains and floor sinks are in close proximity to flush valves.
   3. Install electronic valves where floor drains and floor sinks are not in close proximity to flush valves.

J. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
   1. Reduced-pressure-principle backflow preventers.
   2. Water pressure-reducing valves.
   3. Primary, thermostatic, water mixing valves.

K. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:
   1. Test each reduced-pressure-principle backflow preventer assembly according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.3 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

- END OF SECTION -

- SECTION 22 1123 -

DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Domestic Water Inline Pumps

B. Related Sections:
   1. Section 22 05 23 - General Duty Valves for Plumbing Piping
   2. Section 22 05 19 - Meters and Gages for Plumbing Piping
   3. Section 22 11 16 - "Domestic Water Piping
   4. Section 22 11 23.13 (15444) - Domestic Water Packaged Booster Pumps: for booster systems.
   5. Section 22 34 00 (15486) – Fuel-Fired Domestic Water Heaters.
   6. Division 26 Sections for power-supply wiring, field-installed disconnects, electrical devices, and motor controllers.

1.3 SUBMITTALS

A. Submit “Letter of Conformance” in accordance with Section 01 33 00 (01330) indicating items selected for use in Project with the following supporting data:
   1. Product Data:
      a. Include certified performance curves and rated capacities of selected models; shipping, installed, and operating weights; furnished specialties; and accessories for each type and size of pump specified. Indicate pumps' operating point on curves.
   2. Maintenance Data: For each pump specified to include in maintenance manuals specified in Division 01.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain same type of pumps through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved Manufacturers:
1. Domestic Water Inline Pumps:
   a. Armstrong Pumps, Inc. (716-693-8813)
   b. ITT Industries (201-760-9800)
   c. Taco, Inc. (401-942-2360)

2.2 GENERAL

A. Description: Factory-assembled and -tested, single-stage, centrifugal pump units; complying with UL 778; suitable for potable-water service; with all-bronze or stainless-steel construction and components in contact with water made of corrosion-resistant materials.

B. Motors: Comply with requirements in Section 22 05 13 "Common Motor Requirements for Plumbing Equipment" with built-in thermal-overload protection appropriate for motor size and duty.

C. End Connections for NPS 2 (DN50) and Smaller: Threaded. Pumps available only with flanged ends may be furnished with threaded companion flanges.

D. End Connections for NPS 2-1/2 (DN65) and Larger: Flanged.

E. Finish: Manufacturer's standard paint applied to factory-assembled and -tested units before shipping.

F. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles.

2.3 DOMESTIC WATER IN-LINE PUMPS

A. Description: Horizontal in-line circulator, rated for 125-psig minimum working pressure and minimum continuous water temperature of 225 deg F.
1. Construction: Radially split, all-bronze casing.
2. Impeller: ASTM B36, rolled brass; or ASTM B584, cast bronze or stainless steel; overhung, single suction, and keyed to shaft.

3. Seal: Mechanical.
4. Shaft and Sleeve: Steel shaft, with oil-lubricated copper sleeve.
5. Pump Bearings: Oil-lubricated, bronze-journal or thrust type.
6. Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
7. Motor: Single speed, with oil-lubricated bearings, unless otherwise indicated; and resiliently mounted to pump casing.
   a. Motor Size: For motors larger than 1/2 hp, select motor size that will not overload through full range of pump performance curve.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water distribution piping to verify actual locations of connections before pump installation.

3.2 INSTALLATION

A. Install pumps according to manufacturer's written instructions and with access for periodic maintenance, including removing motors, impellers, couplings, and accessories.

B. Support pumps and piping so weight of each is not supported by the other.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties. The following are specific connection requirements:
   1. Connect water distribution piping to pumps. Install suction and discharge pipe equal to or greater than size of pump nozzles. Refer to Section 22 11 16 - "Domestic Water Piping."
   2. Install shutoff valve and strainer on suction side of pumps, and check valve and throttling valve on discharge side of pumps. Install valves same size as connected piping. Refer to Section 22 05 23 - "General Duty Valves for Plumbing Piping" for general-duty valves.
   3. Install pressure gages at suction and discharge of pumps. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Refer to Section 22 05 19 - "Meters and Gages for Plumbing Piping" for pressure gages and gage connectors.

B. Electrical wiring and connections are specified in Division 26 Sections.

C. Ground equipment.
   1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 COMMISSIONING

A. Check suction piping connections for tightness.

B. Final Checks before Starting: Perform the following preventive maintenance operations:
   1. Lubricate oil-lubricated-type bearings.
   2. Verify that pump is free to rotate by hand and that pump for handling hot liquids is free to rotate with pump hot and cold. Do not operate pump if it is bound or drags, until cause of trouble is determined and corrected.
   3. Verify that pump controls are correct for required application.

C. Starting procedure for pumps is as follows:
   1. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
   2. Open circulating line valve if pump should not be operated against dead shutoff.
   3. Open discharge valve slowly.
   4. Check general mechanical operation of pump and motor.
   5. Close circulating line valve once there is sufficient flow through pump to prevent overheating.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain pumps as specified below:
   1. Conduct training as specified in Division 01 Sections.
   2. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining pumps.

- END OF SECTION -

- SECTION 22 1123.13 -

DOMESTIC WATER PACKAGED BOOSTER PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Multiplex, variable-speed booster pumps.

1.3 SUBMITTALS

A. Product Data: Provide manufacturer's product data for each unit indicated on the drawings. Data to be specific to the equipment proposed for the project with all options and accessories indicated. Include the following as a minimum:
   1. Manufacturer and model number.
   2. Rated capacity based on scheduled conditions and project elevation.
   3. Equipment dimensions.
   4. Required clearances.
   5. Electrical data.
   6. Motor horsepower
      a. Voltage/Phase/Hz
      b. Full load ampacity, minimum circuit ampacity and maximum overcurrent protection device requirements.
      c. Electrical service point(s) of connection.
      d. AIC rating of the equipment.
   7. Materials of construction.
   8. Accessories and options.
   9. Controls.

B. Warranty information.

C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASME Compliance: Comply with ASME B31.9 for piping.

C. UL Compliance for Packaged Pumping Systems:
   1. UL 508, "Industrial Control Equipment."
   2. UL 508A, "Industrial Control Panels."
   3. UL 778, "Motor-Operated Water Pumps."
   4. UL 1995, "Heating and Cooling Equipment."

PART 2 - PRODUCTS

2.1 MULTIPLEX, VARIABLE-SPEED BOOSTER PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Armstrong Pumps, Inc.
   2. Bell & Gossett; a Xylem brand.
   3. Canariis Corporation.
   4. Goulds Water Technology; a Xylem brand.
   5. Grundfos Pumps Corporation U.S.A.
   6. PACO Pumps; Grundfos Pumps Corporation, USA.
   7. Patterson Pump Company; a Gorman-Rupp company.
   8. SyncroFlo, Inc.
   9. TIGERFLOW Systems, Inc.

B. Description: Factory-assembled and -tested, fluid-handling system for domestic water, with pumps, piping, valves, specialties, and controls, and mounted on base.

C. Pumps:
   1. Type: Vertical, multistage as defined in HI 1.1-1.2 and HI 1.3 for in-line, multistage, separately coupled, overhung-impeller, centrifugal pump.
   2. Casing: Cast-iron or steel base and stainless-steel chamber.
   3. Impeller: Closed, stainless steel; statically and dynamically balanced and keyed to shaft.
   4. Shaft: Stainless steel.
   5. Seal: Mechanical.
   6. Bearing: Water-lubricated sleeve type.

D. Motors: Single speed, with grease-lubricated or pre-greased, permanently shielded, ball-type bearings. Select motors that will not overload through full range of pump performance curve.

E. Piping: Copper tube and copper fittings or stainless-steel pipe and fittings.

F. Valves:
   1. Shutoff Valves NPS 2 and smaller: Two-piece, full-port ball valve, in each pump's suction and discharge piping.
   2. Shutoff Valves NPS 2-1/2 and Larger: Lug-type butterfly valve, in each pump's suction and discharge piping and in inlet and outlet headers.
   3. Check Valves NPS 2 and smaller: Silent or swing type in each pump's discharge piping.
   4. Check Valves NPS 2-1/2 and Larger: Silent type in each pump's discharge piping.
   5. Thermal-Relief Valve: Temperature-and-pressure relief type in pump's discharge header piping.

G. Dielectric Fittings: With insulating material isolating joined dissimilar metals.

H. Control Panel: Factory installed and connected as an integral part of booster pump; automatic for multiple-pump, constant-speed operation, with load control and protection functions.
   1. Control Logic: Solid-state system with transducers, programmable microprocessor, variable frequency motor drives, and other devices in the controller.
   2. Motor Controller: NEMA ICS 7, NEMA ICS 61800-2, UL 508C solid-state, variable frequency motor drive.
   3. Enclosure: NEMA 250, Type 1 or better.
   4. Interface: Touch screen and/or plain language display with push buttons.
   5. Motor Overload Protection: Overload relay in each phase.
   6. Starting Devices: Hand-off-automatic selector switch for each pump in cover of control panel, plus pilot device for automatic control as required below:
      a. Duplex, Automatic, Alternating Starter: Switches lead pump to lag main pump and to two-pump operation.
      b. Triplex, Sequence (Lead-Lag-Lag) Starter: Switches lead pump to one lag main pump and to three-pump operation.
   7. Pump Operation and Sequencing: Pressure-sensing method that modulates pump(s) speed to maintain discharge pressure setpoint at varying flow conditions.
      a. Time Delay: Controls pump on-off operation; adjustable from 1 to 300 seconds.
   8. Instrumentation: Suction and discharge pressure gages.
   9. Lights: Running light for each pump.
   10. Alarm Signal Device: Sounds alarm when backup pumps are operating.
      a. Time Delay: Controls alarm operation; adjustable from 1 to 300 seconds, with automatic reset.
   11. Thermal-bleed cutoff.
   12. Low-suction-pressure or water-storage-tank, low-level cutout as required for project.
   13. High-suction-pressure cutout.
   14. Low-discharge-pressure cutout.
   15. High-discharge-pressure cutout.
   16. Building Automation System Interface: Provide auxiliary contacts for interface to BACnet building automation system. Building automation systems are specified in Section 230900 "Instrumentation and Control for HVAC." Include the following:
      a. On-off status of each pump.
      b. Alarm status.

I. Base: Structural steel designed to support pumps, piping, and controls.

2.2 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors.
   1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
   2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in NFPA 70.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment Mounting:
   1. Install booster pumps on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Division 03.
   2. Comply with requirements for vibration isolation and seismic control devices specified in Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Support connected domestic-water piping so weight of piping is not supported by booster pumps.

C. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect domestic-water piping to booster pumps. Install suction and discharge pipe equal to or greater than size of system suction and discharge headers.
   1. Install shutoff valves on piping connections to booster-pump suction and discharge headers. Install ball or butterfly valves same size as suction and discharge headers. Comply with requirements for general-duty valves specified in Section "General Duty Valves for Plumbing Piping."
   2. Install union, flanged, or grooved-joint connections on suction and discharge headers at connection to domestic-water piping. Comply with requirements for unions and flanges specified in Section "Domestic Water Piping."
   3. Install valved bypass, same size as and between piping, at connections to booster-pump suction and discharge headers. Comply with requirements for domestic-water piping specified in Section "Domestic Water Piping."
   4. Install flexible connectors, same size as piping, on piping connections to booster-pump suction and discharge headers. Comply with requirements for flexible connectors specified in Section "Domestic Water Piping."
   5. Install piping adjacent to booster pumps to allow service and maintenance.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:
   1. Perform visual and mechanical inspection.
   2. Leak Test: After installation, charge booster pump and test for leaks. Repair leaks and retest until no leaks exist.
   3. Operational Test: After electrical circuitry has been energized, start booster pumps to confirm proper motor rotation and booster-pump operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Pumps and controls will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust booster pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust pressure set points.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting booster pump to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain booster pumps.

- END OF SECTION -

- SECTION 22 1316 -

SANITARY WASTE & VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Pipe Materials.
2. Fittings.
3. Joining Materials.

B. Related Sections:
1. Section 07 84 00 (07840) - Firestopping: for fire-barrier sealers.
2. Section 08 31 00 (08310) - Access Doors: for access panels to concealed components.
3. Section 09 90 00 (09900) - Painting: for field-applied finishes for piping.
4. Section 11 31 00 (11450) -Residential Appliances: for drainage and vent services for clothes washers.
5. Section 11 40 00 (11400) - Food Service Equipment: for drainage and vent services for food service equipment.
6. Section 22 05 00 (15050) – Common Work Results for Plumbing
7. Section 22 05 29 (15060) - Hangers and Supports for Plumbing Piping and Equipment
8. Section 22 05 53 (15075) – Identification for Plumbing Piping and Equipment.
9. Section 22 07 00 (15083) - Plumbing Insulation.
10. Section 22 30 00 (15430) - Plumbing Equipment.
11. Section 22 40 00 (15410) - Plumbing Fixtures.
12. Section 31 20 00 (02300) – Earth Moving: for excavating, trenching, and backfilling.
13. Section 33 00 00 (02500) - Utilities
14. Section 33 46 00 (02620) - Subdrainage

1.3 DEFINITIONS

A. Sewerage Piping: Building sewer piping outside building that conveys sanitary sewage from building (by Site Contractor).

B. Drainage Piping: Building sewer piping outside building that conveys storm drainage from building (by Plumbing Contractor, beginning at 5'-0" outside of building.)

C. Service Entrance Piping: Drainage piping at entry into building between outside building sewer piping and inside drainage piping (by Site Contractor).

D. Drainage and Vent Piping: Piping inside building that conveys waste water and vapors from fixtures and equipment throughout the building.

E. Force-Main Piping: Drainage piping, under pressure (where required due to local conditions).

1.4 SYSTEM PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
   1. Soil, Waste, and Vent Systems: 10-foot head of water.
   2. Storm Drainage Systems: 10-foot head of water.
   3. Sewage, Force-Main Piping Systems: 100 psig (only where required due to local conditions).

1.5 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
   1. Product Data:
   2. Test Results and Reports: Specified in "Field Quality Control" Article.

1.6 QUALITY ASSURANCE

A. Provide listing/approval stamp, label, or other marking on piping made to specified standards.

B. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS

A. General: Applications of the following pipe and tube materials are indicated in Part 3 "Piping Applications" Article.

B. Hub-and-Spigot, Cast-Iron Soil Pipe: ASTM A74, Service weight ASTM C564 rubber gasket.

C. Steel Pipe: ASTM A53.

D. Copper Tubing: ASTM B306.

2.2 JOINING MATERIALS

A. General: Applications of the following piping joining materials are indicated in Part 3 "Piping Applications" Article.

B. Refer to Section 22 95 00 - "Common Work Results for Plumbing" for commonly used joining materials.

C. Hubless, Cast-Iron, Soil-Piping Couplings: ASTM C1277 assembly of metal housing, corrosion-resistant fasteners, and ASTM C564 rubber sleeve or gasket with integral, center pipe stop. Include the following:

1. Heavy-Duty, Stainless-Steel couplings: ASTM A666, Type 304, stainless-steel housing or shield; and stainless-steel clamps. Include gasket.
   a. Clamp Width: 3 inches wide with 4 clamps, for piping 1-1/2- to 4-inch NPS.
   b. Clamp Width: 4 inches wide with 6 clamps, for piping 5- to 10-inch NPS.

D. Transition Couplings: Coupling or other manufactured fitting same size as, with pressure rating at least equal to, and with ends compatible with piping to be joined.

E. Flexible, Transition Couplings for Underground, Nonpressure Piping: ASTM C1173 with elastomeric sleeve. Include ends same sizes as piping to be joined and include corrosion-resistant metal band on each end.

1. Sleeve Type for Plain-End Piping: Rubber or elastomeric sleeve and stainless-steel band assembly, fabricated to match outside diameters of piping to be joined. Include the following:
   a. Sleeves for Cast-Iron Soil Piping: ASTM C564 rubber.
   b. Sleeves for Plastic Piping: ASTM F477 elastomeric seal.
   c. Sleeves for Dissimilar Piping: Compatible with piping materials to be joined.
   d. Bands: Stainless steel, one at each pipe insert.
2. Gasket Type for Dissimilar-End Piping: Rubber or elastomeric compression gasket, made to match inside diameter of pipe or hub, and outside diameter of adjoining pipe. Include the following:
   a. Gaskets for Cast-Iron Soil Piping: ASTM C564 rubber.
   b. Gaskets for Plastic Piping: ASTM F477 elastomeric seal.
   c. Gaskets for Dissimilar Piping: Compatible with piping materials to be joined.

2.3 PIPE AND TUBE FITTINGS

A. General: Applications of the following pipe and tube fitting materials are indicated in Part 3 "Piping Applications" Article.

B. Hub-and-Spigot, Cast-Iron, Soil-Pipe Fittings: ASTM A74, Service weight hub and spigot. Include ASTM C564 rubber gasket for each hub.

C. Hubless, Cast-Iron, Soil-Pipe Fittings: CISPI 301.

D. Ferrous Expansion Joints: Compound, galvanized steel fitting with telescoping body and slip-pipe section. Include packing rings, packing, limit rods, chrome-plated finish on slip-pipe section, and flanged ends.

E. Ferrous, Double Expansion Joints: Compound, galvanized steel fitting with telescoping body and 2 slip-pipe sections. Include packing rings, packing, limit rods, chrome-plated finish on slip-pipe sections, and flanged ends.

F. Steel Pipe Fittings:
1. Cast-Iron, Threaded, Drainage Fittings: ASME B16.12, galvanized.
2. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, galvanized, standard pattern.
3. Cast-Iron Flanges: ASME B16.1, Class 125.
4. Cast-Iron, Flanged Fittings: ASME B 16.1, Class 125, galvanized.

G. Copper Tube Fittings: ASME B16.23, cast copper or ASME B16.29 wrought copper, solder-joint fittings.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Section 31 20 00 - "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below, unless otherwise indicated.

B. Flanges may be used on aboveground piping, unless otherwise indicated.

C. Aboveground, Soil, Waste, and Vent Piping: Use the following:
1. 1-1/2-Inch NPS: Hubless, cast-iron soil pipe; hubless, cast-iron, soil-pipe fittings; and the following hubless, cast-iron, soil-piping couplings:
a. Couplings: Heavy-duty, Type 304, stainless steel.
2. 2- to 4-Inch NPS: Hubless, cast-iron soil pipe; hubless, cast-iron, soil-pipe fittings; and f the following hubless, cast-iron, soil-piping couplings:
a. Couplings: Heavy-duty, Type 304, stainless steel.
3. 5- and 6-Inch NPS (DN125 and DN150): Hubless, cast-iron soil pipe; hubless, cast-iron, soil-pipe fittings; and the following hubless, cast-iron, soil-piping couplings:
a. Couplings: Heavy-duty, Type 304, stainless steel.

D. Underground, Soil, Waste, and Vent Piping: Use the following:
1. 1-1/2-Inch NPS: Hubless, cast-iron soil pipe; hubless, cast-iron, soil-pipe fittings; and the following hubless, cast-iron, soil-piping couplings:
a. Couplings: Heavy-duty, Type 304, stainless steel.
2. 2- to 4-Inch NPS: Hubless, cast-iron soil pipe; hubless, cast-iron, soil-pipe fittings; and the following hubless, cast-iron, soil-piping couplings:
a. Couplings: Heavy-duty, Type 304, stainless steel.

3. 5- and 6-Inch NPS (DN125 and DN150): Hubless, cast-iron soil pipe; hubless, cast-iron, soil-pipe fittings; and the following hubless, cast-iron, soil-piping couplings:
   a. Couplings: Heavy-duty, Type 304, stainless steel.
4. 8-Inch NPS (DN200): Hubless, cast-iron soil pipe; hubless, cast-iron, soil-pipe fittings; and the following hubless, cast-iron, soil-piping couplings:
   a. Couplings: Heavy-duty, Type 304, stainless steel.

E. Aboveground, Sewage Force Mains: Use the following:
1. 2- to 4-Inch NPS (DN50 and DN100): Hard copper water tube, Type L (Type B); copper, solder-joint pressure fittings; and soldered joints.
2. 2- to 4-Inch NPS (DN50 and DN100): Hard copper water tube, Type L (Type B); copper, grooved-end fittings; and copper, keyed couplings.
3. 2- to 4-Inch NPS (DN50 to DN100): Galvanized steel pipe and cast-iron, threaded fittings.
4. 2- to 4-Inch NPS (DN50 to DN100): Galvanized steel pipe; steel, grooved-end fittings; and steel, keyed couplings.
5. 5- and 6-Inch NPS (DN125 and DN150): Hard copper water tube, Type L (Type B); copper, grooved-end fittings; and copper, keyed couplings.
6. 5- and 6-Inch NPS (DN125 and DN150): Galvanized steel pipe and cast-iron, threaded fittings.
7. 5- and 6-Inch NPS (DN125 and DN150): Galvanized steel pipe; steel, grooved-end fittings; and steel, keyed couplings.
8. 5- and 6-Inch NPS (DN125 and DN150): Ductile-iron, grooved-end pipe; ductile-iron, grooved-end fittings; and ductile-iron, keyed couplings.

3.3 PIPING INSTALLATION, GENERAL

A. Refer to Section 22 95 00 - "Common Work Results for Plumbing" for basic piping installation.

3.4 SERVICE ENTRANCE PIPING INSTALLATION

A. Refer to Section 33 00 00 - "Utilities" for sanitary piping and refer to Section 33 46 00 “Subdrainage” for storm piping.

B. Extend building sanitary drain piping and connect to sanitary sewer piping in sizes and locations indicated for service entrances into building. Install cleanout and extension to grade at connections of building sanitary drains with building sanitary sewers.

C. Install wall penetration system at each service entrance pipe penetration through foundation wall. Make installation watertight. Refer to Section 22 95 00 - "Common Work Results for Plumbing" for wall penetration systems.

3.5 DRAINAGE AND VENT PIPING INSTALLATION

A. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

B. Make changes in direction for drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not make change in direction of flow greater than 90 degrees. Use proper size of standard increasers and reducers if different sizes of piping are connected. Reducing size of drainage piping in direction of flow is prohibited.

C. Lay buried building drain piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

D. Install drainage and vent piping at the following minimum slopes, unless otherwise indicated:
   1. Sanitary Building Drain: 2 percent downward in direction of flow for piping 3-inch NPS (DN80) and smaller; 1 percent downward in direction of flow for piping 4-inch NPS (DN100) and larger.
   2. Horizontal, Sanitary Drainage Piping: 2 percent downward in direction of flow.
   3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

E. Install force mains at elevations indicated if required due to local conditions.

F. Install engineered, sanitary drainage and vent systems in locations indicated and as follows:
   1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
   2. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

G. Install engineered, controlled-flow, storm drainage systems in locations indicated. Comply with standards of authorities having jurisdiction.

H. Sleeves are not required for cast-iron soil piping passing through concrete slab on grade if slab is without membrane waterproofing.

3.6 JOINT CONSTRUCTION

A. Refer to Section 22 95 00 - "Common Work Results for Plumbing" for basic piping joint construction.

B. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
   1. Compression Joints: Make with rubber gasket matching class of pipe and fittings.
   2. Hubless Joints: Make with rubber gasket and sleeve or clamp.

C. Grooved Joints: Assemble joints with coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

3.7 HANGER AND SUPPORT INSTALLATION

A. Refer to Section 22 05 29 - "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices. Install the following:
   1. Riser clamps, MSS Type 8 or Type 42, for vertical runs.
   2. Adjustable steel clevis hangers, MSS Type 1, for individual, straight, horizontal runs 100 feet and less.
   3. Adjustable roller hangers, MSS Type 43, for individual, straight, horizontal runs longer than 100 feet.
   4. Spring cushion rolls, MSS Type 49, if indicated, for individual, straight, horizontal runs longer than 100 feet.
   5. Pipe rolls, MSS Type 44, for multiple, straight, horizontal runs 100 feet or longer. Support pipe rolls on trapeze.
   6. Spring hangers, MSS Type 52, for supporting base of vertical runs.

B. Install supports according to 22 05 29 - "Hangers and Supports for Plumbing Piping and Equipment"

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum spacing and minimum rod diameters:
   1. 1-1/2- and 2-Inch NPS (DN40 and DN50): Maximum horizontal spacing, 60 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 15 feet.
   2. 3-Inch NPS (DN80): Maximum horizontal spacing, 60 inches with 1/2-inch minimum rod diameter; maximum vertical spacing, 15 feet.
   3. 4- and 5-Inch NPS (DN100 and DN125): Maximum horizontal spacing, 60 inches with 5/8-inch minimum rod diameter; maximum vertical spacing, 15 feet.
   4. 6-Inch NPS (DN150): Maximum horizontal spacing, 60 inches with 3/4-inch minimum rod diameter; maximum vertical spacing, 15 feet.
   5. 8- through 12-Inch NPS (DN200 through DN300): Maximum horizontal spacing, 60 inches with 7/8-inch minimum rod diameter; maximum vertical spacing, 15 feet.
   6. Spacing for horizontal pipe in 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

F. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.8 CONNECTIONS

A. Connect service entrance piping to exterior sewerage and drainage piping. Use transition fitting to join dissimilar piping materials.

B. Connect drainage piping to service entrance piping, and extend to and connect to the following:
   1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code. Refer to Section 22 40 00 "Plumbing Fixtures."

2. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code. Refer to Section 22 10 13 - "Plumbing Specialties."
3. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections 2-1/2-inch NPS (DN65) and larger.

C. Connect force-main piping to drainage piping, and extend to and connect to the following:
1. Sump Pumps: Connect force-main piping to sump-pump discharge.
2. Sewage Pumps: Connect force-main piping to sewage-pump discharge.

3.9 FIELD QUALITY CONTROL

A. Inspect drainage and vent piping as follows:
1. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
a. Roughing-In Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

B. Test drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedure, as follows:
1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
3. Roughing-In Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10 feet of head. Water level must not drop from 15 minutes before inspection starts through completion of inspection. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.

5. Repair leaks and defects using new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

C. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedure, as follows:
1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for 4 hours. Leaks and loss in test pressure constitute defects that must be repaired.
3. Repair leaks and defects using new materials and retest piping or portion thereof until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

3.10 CLEANING AND PROTECTING

A. Clean interior of piping system. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

- END OF SECTION -

- SECTION 22 1319 -

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:
   1. Cleanouts.
   2. Floor drains.
   3. Floor sinks.
   4. Trench drains.
   5. Roof flashing assemblies.
   6. Miscellaneous sanitary drainage piping specialties.
   7. Flashing materials.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated, include manufacturer, model number, materials of construction, and options and accessories.

1.4 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Josam Company; Josam Div.
   2. Smith, Jay R. Mfr. Co.

3. Watts Drainage Products Inc.
4. Zurn Plumbing Products Group.

2.2 CLEANOUTS

A. Exposed Cast-Iron Cleanouts:
1. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
2. Size: Same as connected drainage piping
3. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or hubless, cast-iron soil pipe test tee as required to match connected piping.
4. Closure: Countersunk, plastic plug, except provide brass plug in return air plenums.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Floor Cleanouts:
1. Standard: ASME A112.36.2M for adjustable housing cleanout.
2. Size: Same as connected branch.
3. Type: Adjustable housing.
4. Body or Ferrule: Cast iron.
5. Clamping Device: Not required.
6. Outlet Connection: Spigot.
7. Closure: Plastic plug.
8. Adjustable Housing Material: Cast iron with threads.
9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy
10. Frame and Cover Shape: Round in concrete floors, square in tiled floors.
11. Top Loading Classification: Heavy Duty.
12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:
1. Standard: ASME A112.36.2M. Include wall access.
2. Size: Same as connected drainage piping.
3. Body: Hub-and-spigot, cast-iron soil pipe T-branch or hubless, cast-iron soil pipe test tee as required to match connected piping.
4. Closure: Countersunk, brass plug.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
6. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

2.3 FLOOR DRAINS

A. Cast-Iron Floor Drains:
1. Standard: ASME A112.6.3.
2. Pattern: Floor drain.
3. Body Material: Gray iron.
4. Seepage Flange: Required for slabs above grade.
5. Anchor Flange: Required for slabs on grade.

6. Clamping Device: Required, where floor has waterproofing membrane.
7. Outlet: Bottom or Side as required.
8. Backwater Valve: Not required.
9. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel when located in equipment rooms.
10. Sediment Bucket: Slotted type when located in equipment rooms.
11. Top or Strainer Material: Gray iron in unfinished floors, Nickel bronze in finished floors.
12. Top of Body and Strainer Finish: Nickel bronze in unfinished floors, polished bronze in finished floors.
13. Top Shape: Round in concrete floors, Square in tiled floors.
14. Top Loading Classification: Extra heavy-duty in areas with vehicle traffic, heavy duty in equipment rooms, light duty in finished areas.
15. Funnel: Required, where indicated on drawings.
16. Trap Material: Cast iron or copper to match adjacent piping.
17. Trap Pattern: Standard P-trap unless noted otherwise.
18. Trap Features: Trap-seal primer valve drain connection, and cleanout where indicated.

B. Stainless Steel Floor Drains For Use With Stainless Steel Waste Piping:
1. Pattern: Floor drain.
2. Body Material: Type 304 stainless steel.
3. Seepage Flange: Required for slabs above grade.
4. Anchor Flange: Required for slabs on grade.
5. Clamping Device: Required, where floor has waterproofing membrane.
6. Outlet: Bottom or Side as required.
7. Backwater Valve: Not required.
8. Top or Strainer Material: Type 304 stainless steel.
9. Top of Body and Strainer Finish: Type 304 stainless steel.
10. Top Shape: Round in concrete floors, Square in tiled floors.
11. Top Loading Classification: Extra heavy-duty in areas with vehicle traffic, heavy duty in equipment rooms, light duty in finished areas.
12. Funnel: Required, where indicated on drawings.
13. Trap Material: Type 304 stainless steel to match adjacent piping.
14. Trap Pattern: Standard P-trap unless noted otherwise.
15. Trap Features: Trap-seal primer valve drain connection and cleanout where indicated.

2.4 FLOOR SINKS

A. Cast-Iron Floor Sinks:
1. Standard: ASME A48-83.
2. Pattern: Floor sink.
3. Body Material: Gray iron.
4. Seepage Flange: Required for slabs above grade.
5. Anchor Flange: Required for slabs on grade.
6. Clamping Device: Required, where floor has waterproofing membrane.

7. Outlet: Bottom.
8. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel.
9. Sediment Bucket: Aluminum slotted type when located in kitchen area
10. Dome Strainer: Anti-splash with acid-resistant enamel coating for non-kitchen areas.
11. Top or Grate Material: Acid-resistant enamel.
12. Grate: Full, 3/4, or half as required for application.
13. Top Shape and Size: Square, 12 inches x 12 inches.
14. Basin Depth: 8 inches unless noted otherwise.
15. Funnel: Required, where indicated on drawings.
16. Trap Material: Cast iron or copper to match adjacent piping.
17. Trap Pattern: Standard P-trap unless noted otherwise.
18. Trap Features: Trap-seal primer valve drain connection.

B. Stainless Steel Floor Sinks For Use With Stainless Steel Waste Piping:
1. Pattern: Floor sink.
2. Body Material: Stainless steel.
3. Seepage Flange: Required for slabs above grade.
4. Anchor Flange: Required for slabs on grade.
5. Clamping Device: Required, where floor has waterproofing membrane.
6. Outlet: Bottom.
7. Sediment Bucket: Stainless steel slotted type when located in kitchen area
8. Dome Strainer: Anti-splash for non-kitchen areas.
9. Top or Grate Material: Type 304 stainless steel.
10. Grate: Full, 3/4, or half as required for application.
11. Top Shape and Size: Square, 12 inches x 12 inches.
12. Basin Depth: Minimum of 8 inches unless noted otherwise.
13. Funnel: Required, where indicated on drawings.
14. Trap Material: Type 304 stainless steel to match adjacent piping.
15. Trap Pattern: Standard P-trap unless noted otherwise.
16. Trap Features: Trap-seal primer valve drain connection.

2.5 TRENCH DRAINS

A. Shower Entry Trench Drains:
1. Standard: ADA Compliance.
2. Body Material: Polypropylene.
3. Flange: Not required.
4. Clamping Device: Molded clips to accommodate vertical rebar for positioning.
5. Outlet: Bottom.
6. Grate Material: Stainless steel, slotted.
7. Dimensions of Frame and Grate: 36” to 42” long x 6” wide or as noted on drawings.
8. Top-Loading Classification: Light Duty.

B. Area Trench Drains:
   1. Body Material: High density polypropylene with interlocking ends, radius bottom and .75% built-in slope.
   2. Clamping Device: Molded clips to accommodate vertical rebar for positioning and anchoring.
   3. Outlet: Bottom.
   4. Grate Material: Cast iron, slotted.
   5. Dimension: Modular, 80 inch long x 6 inch wide sections.
   6. Top Loading Classification: H-20 load rating with anchor studs.

2.6 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

B. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch- thick, lead flashing collar and skirt extending at least 6 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
   1. Open-Top Vent Cap: Without cap.

2.7 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:
   1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
   2. Size: Same as connected waste piping.

B. Deep-Seal Traps:
   1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
   2. Size: Same as connected waste piping.
      a. NPS 2: 4-inch minimum water seal.
      b. NPS 2-1/2 and Larger: 5-inch minimum water seal.

C. Floor-Drain, Trap-Seal Primer Fittings:
   1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
   2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

D. Air-Gap Fittings:
   1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
   2. Body: Bronze or cast iron.
   3. Inlet: Opening in top of body.
   4. Outlet: Larger than inlet.

5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

E. Sleeve Flashing Device:
1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

F. Stack Flashing Fittings:
1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

2.8 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

B. Fasteners: Metal compatible with material and substrate being fastened.

C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

D. Solder: ASTM B 32, lead-free alloy.

E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

D. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
   a. Radius, 30 Inches or Less: Equivalent to 2 percent slope, but not less than 1/4-inch total depression. 24 -inch radius at public space bathrooms
   b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
   c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

E. Install floor sinks where indicated on drawings. Set grates of sinks flush with finished floor, unless otherwise indicated.

1. Position floor sinks for easy access and maintenance.
2. Install floor-sink flashing collar or flange so no leakage occurs between sink and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
3. Install individual traps for floor sinks connected to sanitary building drain, unless otherwise indicated.

F. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface unless otherwise indicated.

G. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

H. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

I. Assemble open drain fittings and install with top of hub 2 inches above floor.

J. Install deep-seal traps on floor drains and other waste outlets where indicated.

K. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
2. Size: Same as floor drain inlet.

L. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

M. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

N. Install vent caps on each vent pipe passing through roof.

O. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
   1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
   1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
   2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
   3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07.

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

- END OF SECTION -

- SECTION 22 1323 -

SANITARY WASTE INTERCEPTORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Grease interceptors.

1.3 SUBMITTALS

A. Product Data: For each type of metal interceptor indicated.

B. Shop Drawings: For each type and size of precast-concrete interceptor indicated.

PART 2 - PRODUCTS

2.1 GREASE INTERCEPTORS

A. Grease Interceptors: Precast concrete complying with ASTM C 913.
   1. Manufacturers: Subject to compliance with requirements. Provide products by one of the following:
      a. Smith Precast
      b. Utility Vault
      c. Jensen Precast
   2. Interior Lining: Two-part, 100 percent solids, flake filled novolac epoxy coating with minimum 25 mil dry-film thickness. Similar to Carboline Plasite 4550 S.
   3. Include rubber-gasketed joints, vent connections, manholes, compartments or baffles, and piping or openings to retain grease and to permit wastewater flow.
   4. Structural Design Loads:
      a. Heavy-Traffic Load: Comply with ASTM C 890, A-16 (ASSHTO HS20-44).
   5. Resilient Pipe Connectors: ASTM C 923, cast or fitted into interceptor walls, for each pipe connection.

6. Steps: Individual FRP steps or FRP ladder, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of interceptor to finished grade is less than 72 inches.
7. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
8. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange and 26-inch-diameter cover.
   a. Ductile Iron: ASTM A 536, Grade 60-40-18, unless otherwise indicated.
   b. Gray Iron: ASTM A 48, Class 35, unless otherwise indicated.
   c. Include indented top design with lettering cast into cover, using wording equivalent to "**GREASE INTERCEPTOR**."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install precast-concrete interceptors according to ASTM C 891. Set level and plumb.

B. Install manhole risers from top of underground concrete interceptors to manholes and gratings at finished grade.

C. Set tops of manhole frames and covers flush with finished surface in pavements. Set tops 3 inches above finish surface elsewhere, unless otherwise indicated.

D. Set metal interceptors level and plumb.

E. Set tops of metal interceptor covers flush with finished surface in pavements. Set tops 3 inches above finish surface elsewhere, unless otherwise indicated.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Make piping connections between interceptors and piping systems.

3.3 IDENTIFICATION

A. Identification materials and installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tapes directly over piping and at outside edges of underground interceptors.
   1. Use warning tapes or detectable warning tape over ferrous piping.
   2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

- END OF SECTION -

- SECTION 22 1329 -

SANITARY SEWAGE PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Submersible sewage pumps.
   2. Sewage-pump basins and basin covers.

1.3 SUBMITTALS

A. Product Data: Provide manufacturer's product data for each unit indicated on the drawings. Data to be specific to the equipment proposed for the project with all options and accessories indicated. Include the following as a minimum:
   1. Manufacturer and model number.
   2. Rated capacity based on scheduled conditions.
   3. Equipment dimensions.
   4. Required clearances.
   5. Electrical data.
      a. Motor horsepower
      b. Voltage/Phase/Hz
      c. Full load ampacity, minimum circuit ampacity and maximum overcurrent protection device requirements.
      d. Electrical service point(s) of connection.
      e. AIC rating of the equipment.
   6. Materials of construction.
   7. Accessories and options.
   8. Controls.

B. Warranty information.

C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ABS.
   2. Gorman-Rupp.
   3. Hydromatic.
   4. Peabody-Barnes.
   5. Swaby.
   6. Weil Pump Company, Inc.
   7. Weinman Division.

2.2 SUBMERSIBLE SEWAGE PUMPS

A. Submersible, Quick-Disconnect, Double-Seal Sewage Pumps:
   1. Description: Factory-assembled and -tested sewage-pump unit with guide-rail supports.
   2. Pump type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, duplex configuration as indicated on the drawings, centrifugal sewage pump as defined in HI 1.1-1.2 and HI 1.3.
   3. Pump Casing: Cast iron, with open inlet, and discharge fittings for connection to guide-rail support.
   4. Impeller: Statically and dynamically balanced, ASTM A 48/A 48M, Class No. 25 A cast iron or ASTM A 532/A 532M, abrasion-resistant cast iron or ASTM B 584, cast bronze or stainless steel, non-clog, open, or semi-open design for solids handling, and keyed and secured to shaft.
   5. Pump and Motor Shaft: Stainless steel, with factory-sealed, grease-lubricated ball bearings.
   6. Seals: Mechanical.
   7. Moisture-Sensing Probe: Internal moisture sensor and moisture alarm.
   8. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
   9. Controls:
      a. Enclosure: NEMA 250, Type 1; pedestal or wall-mounted.
      b. Switch Type: Mechanical-float or Pressure type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.

c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.

d. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with mechanical-float or pressure switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.

10. Control-Interface Features:

a. Remote Alarm Contacts: For remote alarm interface.

b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:

1) On-off status of each pump.

2) Alarm status.

11. Guide-Rail Supports:

a. Standard: SWPA's "Submersible Sewage Pumping Systems (SWPA) Handbook."

b. Guide Rails: Vertical pipes or structural members, made of galvanized steel or other corrosion-resistant metal, attached to baseplate and basin sidewall or cover.

c. Baseplate: Corrosion-resistant metal plate, attached to basin floor, supporting guide rails and stationary elbow.

d. Pump Yoke: Motor-mounted or casing-mounted yokes or other attachments for aligning pump during connection of flanges.

e. Movable Elbow: Pump discharge-elbow fitting with flange, seal, and positioning device.

f. Stationary Elbow: Fixed discharge-elbow fitting with flange that mates to movable-elbow flange and support attached to baseplate.

g. Lifting Cable: Stainless steel; attached to pump and cover at manhole.

2.3 SEWAGE-PUMP BASINS AND BASIN COVERS

A. Basins: Factory-fabricated, watertight, cylindrical, basin sump with top flange and sidewall openings for pipe connections.

1. Material: Cast iron or Fiberglass.

2. Reinforcement: Mounting plates for pumps, fittings, guide-rail supports if used, and accessories.

3. Anchor Flange: Same material as or compatible with basin sump, cast in or attached to sump, in location and of size required to anchor basin in concrete slab.

B. Basin Covers: Fabricate metal cover with openings having gaskets, seals, and bushings; for access to pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.

1. Reinforcement: Steel or cast iron, capable of supporting foot traffic for basins installed in foot-traffic areas.

2.4 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 22 Section "Common Motor Requirements for Plumbing Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

B. Motors for submersible pumps shall be hermetically sealed.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation and filling are specified in Division 31 Section "Earth Moving."

3.2 INSTALLATION

A. Pump Installation Standard: Comply with HI 1.4 for installation of centrifugal pumps.

- END OF SECTION -

- SECTION 22 1413 -

STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Pipe, tube, and fittings.
   2. Specialty pipe fittings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of pipe and joining material, and for method for joining piping intended for the project.

1.4 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888.

B. Heavy-Duty, Hubless-Piping Couplings:
   1. Product: Subject to compliance with requirements, provide one of the following products:
      a. ANACO-Husky, SD 4000.
      b. Mission, HeavyWeight Coupling.

2. Standards: ASTM C 1277 and ASTM C 1540.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.3 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

B. Copper Drainage Fittings: ASME B16.23, cast-copper fittings or ASME B16.29, wrought-copper, solder-joint fittings.

C. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

D. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.4 SPECIALTY PIPE FITTINGS

A. Transition Couplings:
1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.
3. Shielded, Nonpressure Transition Couplings:
   a. Standard: ASTM C 1460.
   b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations from layout are approved.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Do not install piping within electrical rooms, elevator equipment rooms, MDF or IDF rooms, or stairwells. Exception: Pipe supplying equipment serving the room. Maintain all required clearances to other equipment.

E. Do not install piping above electrical equipment such as transformers, panels, motor control centers, etc. in other rooms.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees.

J. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Do not use bushings. Reducing size of drainage piping in direction of flow is prohibited.

K. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

L. Install storm drainage piping at the following minimum slopes unless otherwise indicated:
   1. Building Storm Drain: One-fourth inch per foot, 2 percent, downward in direction of flow.
   2. Horizontal Storm-Drainage Piping: One-fourth inch per foot, 2 percent downward in direction of flow.

M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

N. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

O. Plumbing Specialties:
   1. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping. Comply with requirements for cleanouts specified in Section 221423 "Storm Drainage Piping Specialties."
   2. Install drains in storm drainage gravity-flow piping. Comply with requirements for drains specified in Section 221423 "Storm Drainage Piping Specialties."

P. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.2 JOINT CONSTRUCTION

A. Join hub-and-spigot, cast-iron soil piping with gasketed joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

C. Join copper tube and fittings with soldered joints according to ASTM B 828 procedure. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

D. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

3.3 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:
   1. Install transition couplings at joints of piping with small differences in OD's.
   2. In Drainage Piping: Shielded, nonpressure transition couplings.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
   1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
   2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
   3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
   4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
   5. Vertical Piping: MSS Type 8 or Type 42, clamps.
   6. Individual, Straight, Horizontal Piping Runs:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
   7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   8. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support each section of horizontal piping and tubing within 12 inches of each fitting and coupling.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
   2. NPS 3: 60 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
   4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
   5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
   6. Spacing for 10-foot pipe lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/4: 72 inches with 3/8-inch rod.
   2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
   3. NPS 2-1/2: 108 inches with 1/2-inch rod.
   4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
   5. NPS 6: 10 feet with 5/8-inch rod.
   6. NPS 8: 10 feet with 3/4-inch rod.

H. Install supports for vertical copper tubing every 10 feet.

I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.
   1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
   2. Comply with requirements for cleanouts and drains specified in Section 221423 "Storm Drainage Piping Specialties."

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

3.6 IDENTIFICATION

A. Identify exposed storm drainage piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.7 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
   2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   3. Test Procedure: Test storm drainage piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. Water level must not drop for 4 hours. Inspect joints for leaks.
   4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
   5. Prepare reports for tests and required corrective action.

3.8 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.9 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground storm drainage piping shall be any of the following:
   1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
   2. Hubless, cast-iron soil pipe and fittings; heavy-duty, hubless-piping couplings; and coupled joints.
   3. Copper DWV tube, copper drainage fittings, and soldered joints.
   4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

C. Underground storm drainage piping shall be any of the following:
   1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
   2. Hubless, cast-iron soil pipe and fittings; heavy-duty, hubless-piping couplings; and coupled joints.
   3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

- END OF SECTION -

- SECTION 22 1423 -

STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Roof drains.
2. Miscellaneous storm drainage piping specialties.
3. Cleanouts.
4. Trench drains.
5. Flashing materials.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated, include manufacturer, model number, accessories and options.

1.4 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 METAL ROOF AND OVERFLOW DRAINS

A. Manufacturers: Subject to compliance with requirements. Provide products by one of the following:
1. Jay R. Smith Manufacturing Co.
2. Josam Company; Josam Division.
3. Wade.
4. Watts Drainage Products Inc.

5. Zurn Plumbing Products Group.

B. Cast-Iron, Large-Sump, General-Purpose Roof Drains:
1. Standard: ASME A112.6.4, for general-purpose roof drains.
2. Body Material: Cast iron.
3. Dimension of Body: Nominal 14-inch diameter.
4. Combination Flashing Ring and Gravel Stop: Required.
5. Outlet: Bottom or Side.
6. Extension Collars: Adjustable.
7. Underdeck Clamp: Required.
8. Sump Receiver Plate: Required.
9. Dome Material: Cast iron.
10. Vandal-Proof Dome: Required.
11. Water Dam: 2 inches high, required on overflow drains.

C. Metal, Parapet Roof Drains:
1. Standard: ASME A112.6.4, for parapet roof drains.
2. Body Material: Cast iron or bronze.
3. Outlet: Back or Angle as required.
4. Grate Material: Bronze or Cast iron.
5. Vandal-Proof Grate: Required.

D. Metal, Large-Sump, Area Drains:
1. Standard: ASME A112.6.4, for area drains.
2. Body Material: Cast iron.
3. Dimension of Body: Nominal 14-inch diameter.
4. Dimension of Frame and Grate: Nominal 14 inches square.
5. Outlet: Bottom.
6. Grate Material: Nickel-bronze alloy.
7. Vandal-Proof Grate: Required.
8. Extension Collars: As required.
9. Sump Receiver: Required.
10. Sediment Bucket: Required.

2.2 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Conductor Nozzles:
1. Description: Nickel bronze body with threaded or hub-less inlet and bronze wall flange with mounting holes. Designed to discharge water away from building and to prevent wall staining.
2. Size: Same as connected conductor.

2.3 CLEANOUTS

A. Floor Cleanouts:
1. Standard: ASME A112.36.2M, for adjustable housing cleanouts.
2. Size: Same as connected branch.
3. Type: Adjustable housing.
4. Body or Ferrule Material: Cast iron.
5. Clamping Device: As required.
6. Outlet Connection: Spigot.
7. Closure: Plastic.
8. Adjustable Housing Material: Cast iron with threads.
9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
10. Frame and Cover Shape: Round or Square
11. Top-Loading Classification: Medium Duty.
12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

B. Test Tees:
1. Standard: ASME A112.36.2M and ASTM A 74, ASTM A 888, or CISPI 301, for cleanout test tees.
2. Size: Same as connected drainage piping.
3. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or hubless, cast-iron soil-pipe test tee as required to match connected piping.
4. Closure Plug: Countersunk, brass.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

C. Wall Cleanouts:
1. Standard: ASME A112.36.2M, for cleanouts. Include wall access.
2. Size: Same as connected drainage piping.
3. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or Hubless, cast-iron soil-pipe test tee as required to match connected piping.
4. Closure: Countersunk brass plug.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
6. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

2.4 TRENCH DRAINS

A. Area Trench Drains:
1. Body Material: High density polypropylene with interlocking ends, radius bottom and .75% built-in slope.
2. Clamping Device: Molded clips to accommodate vertical rebar for positioning and anchoring.
3. Outlet: Bottom.
4. Grate Material: Cast iron, slotted.
5. Dimension: Modular, 80 inch long x 6 inch wide sections.

6. Top Loading Classification: H-20 load rating with anchor studs.

2.5 FLASHING MATERIALS

A. Copper Sheet: ASTM B 152/B 152M, 12 oz./sq. ft..

B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

D. Fasteners: Metal compatible with material and substrate being fastened.

E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

F. Solder: ASTM B 32, lead-free alloy.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roofing materials are specified in Division 07.
   1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
   2. Install expansion joints, if indicated, in roof drain outlets.
   3. Position roof drains for easy access and maintenance.

B. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.

C. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:
   1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
   2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
   3. Locate cleanouts at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
   4. Locate cleanouts at base of each vertical soil and waste stack.

D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

F. Install test tees in vertical conductors and near floor.

G. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

H. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface unless otherwise indicated.

I. Install sleeve flashing device with each conductor passing through floors with waterproof membrane.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
   1. Lead Sheets: Burn joints of 6.0-lb/sq. ft. lead sheets, 0.0938-inch thickness or thicker. Solder joints of 4.0-lb/sq. ft. lead sheets, 0.0625-inch thickness or thinner.
   2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
   1. Pipe Flashing: Sleeve type, matching the pipe size, with a minimum length of 10 inches and with skirt or flange extending at least 8 inches around pipe.
   2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
   3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

- END OF SECTION -

- SECTION 22 1429 -

SUMP PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Submersible sump pumps.

1.3 SUBMITTALS

A. Product Data: Provide manufacturer's product data for each unit indicated on the drawings. Data to be specific to the equipment proposed for the project with all options and accessories indicated. Include the following as a minimum:
   1. Manufacturer and model number.
   2. Rated capacity based on scheduled conditions.
   3. Equipment dimensions.
   4. Required clearances.
   5. Electrical data.
      a. Motor horsepower
      b. Voltage/Phase/Hz
      c. Full load ampacity, minimum circuit ampacity and maximum overcurrent protection device requirements.
      d. Electrical service point(s) of connection.
      e. AIC rating of the equipment.
   6. Materials of construction.
   7. Accessories and options.
   8. Controls.

B. Warranty information.

C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE SUMP PUMPS

A. Submersible, Fixed-Position, Single-Seal Sump Pumps:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Bell & Gossett Domestic Pump.
      b. Grundfos Pumps Corp.
      c. Little Giant Pump Co.
      d. Weil Pump Company, Inc.
      e. Weinman Division.
      f. Zoeller Company.
   2. Description: Factory-assembled and -tested sump-pump unit.
   3. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sump pump as defined in HI 1.1-1.2 and HI 1.3.
   4. Pump Casing: Cast iron, with strainer inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
   5. Impeller: Statically and dynamically balanced, ASTM A 48/A 48M, Class No. 25 A cast iron or ASTM A 532/A 532M, abrasion-resistant cast iron or ASTM B 584, cast bronze, design for clear wastewater handling, and keyed and secured to shaft.
   6. Pump and Motor Shaft: Stainless steel, with factory-sealed, grease-lubricated ball bearings.
   7. Seal: Mechanical.
   8. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
   9. Controls:
      a. Switch Type: Unit mounted Mechanical-float or pressure type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
      b. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with mechanical-float or pressure switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.

2.2 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 22 Section "Common Motor Requirements for Plumbing Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

B. Motors for submersible pumps shall be hermetically sealed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Pump Installation Standard: Comply with HI 1.4 for installation of sump pumps.

- END OF SECTION -

- SECTION 22 1623 -

FACILITY NATURAL GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Valves.
5. Pressure regulators.

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.
2. Service Regulators: 100 psig minimum unless otherwise indicated.

B. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 0.5 psig but not more than 5 psig, and is reduced to secondary pressure of 0.5 psig or less.

1.4 SUBMITTALS

A. Product Data: Include manufacturer's product literature indicating materials of construction, ratings, options and accessories for each type of the following:
1. Pipe and fittings.
2. Piping specialties.
3. Valves.
4. Pressure Regulators.

B. Welding certificates.

C. Field quality-control reports.

D. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
   1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
   2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
   3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
   4. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
      a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

2.2 PIPING SPECIALTIES

A. Appliance Flexible Connectors:
   1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
   2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
   3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
   4. Corrugated stainless-steel tubing with polymer coating.
   5. Operating-Pressure Rating: 0.5 psig.
   6. End Fittings: Zinc-coated steel.
   7. Threaded Ends: Comply with ASME B1.20.1.
   8. Maximum Length: 72 inches.

B. Quick-Disconnect Devices: Comply with ANSI Z21.41.
   1. Copper-alloy convenience outlet and matching plug connector.
   2. Nitrile seals.
   3. Hand operated with automatic shutoff when disconnected.

4. For indoor or outdoor applications.
5. Adjustable, retractable restraining cable.

C. Y-Pattern Strainers:
1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller.
3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

D. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.3 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 MANUAL GAS SHUTOFF VALVES

A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
1. CWP Rating: 125 psig.
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

C. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. BrassCraft Manufacturing Company; a Masco company.
b. Conbraco Industries, Inc.; Apollo Div.
c. Jomar.
d. McDonald, A. Y. Mfg. Co.
e. Perfection Corporation; a subsidiary of American Meter Company.

f. Watts.

2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

D. Bronze Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. ResLee Brass Company.
   b. McDonald, A. Y. Mfg. Co.
2. Body: Bronze, complying with ASTM B 584.
3. Plug: Bronze.
4. Ends: Threaded, socket, as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig.
7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Iron Plug Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. R&M Energy Systems; a Unit of Robbins & Myers, Inc.
   b. Flowserve Corp.; Nordstrom Valves.
2. Body: Cast gray iron, complying with ASTM A 126 Class B.
3. Plug: Cast gray iron, complying with ASTM A 126 Class B.
4. Ends: Threaded, flanged, as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig.
7. Listing: Valves NPS 4 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
9. Lubricant: Suitable for anticipated temperatures and service. Provide initial application and supplies for one year and application gun.

2.5 MOTORIZED GAS VALVES

A. Electrically Operated Valves: Comply with UL 429.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. ASCO Power Technologies, LP; Division of Emerson.
   b. Dungs, Karl, Inc.
   c. Eclipse Combustion, Inc.
   d. Goyen Valve Corp.; Tyco Environmental Systems.
   e. Magnatrol Valve Corporation.
   f. Parker Hannifin Corporation; Climate & Industrial Controls Group; Skinner Valve Div.
   g. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
2. Pilot operated.
3. Body: Brass or aluminum.
4. Seats and Disc: Nitrile rubber.
5. Springs and Valve Trim: Stainless steel.
6. 120-V ac, 60 Hz, Class F or H, continuous-duty molded coil, and replaceable. Maximum 21 watts power consumption.
7. NEMA ICS 6, Type 4, coil enclosure.
8. Normally closed.
9. Visual position indicator.

2.6 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller.

B. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Actaris.
   b. American Meter Company.
   c. Eclipse Combustion, Inc.
   d. Fisher Control Valves and Regulators.
   e. Invensys.
   f. Maxitrol Company.
2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.

5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 5 psig.

C. Appliance Pressure Regulators: Comply with ANSI Z21.18.
1. Body and Diaphragm Case: Die-cast aluminum.
2. Springs: Zinc-plated steel; interchangeable.
3. Diaphragm Plate: Zinc-plated steel.
4. Seat Disc: Nitrile rubber.
5. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
6. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
7. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
8. Maximum Inlet Pressure: 5 psig.

2.7 DIELECTRIC UNIONS

A. Minimum Operating-Pressure Rating: 150 psig.

B. Combination fitting of copper alloy and ferrous materials.

C. Insulating materials suitable for natural gas.

D. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

PART 3 - EXECUTION

3.1 OUTDOOR PIPING INSTALLATION

A. Comply with NFPA 54 and local code installation and purging of natural-gas piping.

B. Install fittings for changes in direction and branch connections.

C. Install pressure gage downstream from each service regulator. Pressure gages are specified in Division 22 Section "Meters and Gages for Plumbing Piping."

3.2 INDOOR PIPING INSTALLATION

A. Comply with NFPA 54 and local code for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Verify final equipment locations for roughing-in.

K. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

L. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

M. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

N. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

O. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

P. Connect branch piping from top or side of horizontal piping.

Q. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment.

R. Do not use natural-gas piping as grounding electrode.

S. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

T. Install pressure gage downstream from each line regulator. Pressure gages are specified in Division 22 Section "Meters and Gages for Plumbing Piping."

U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.3 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing or copper connector.

B. Install underground valves with valve boxes.

C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

3.4 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:
   1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
   2. Cut threads full and clean using sharp dies.
   3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
   4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
   5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:
   1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
   2. Bevel plain ends of steel pipe.

3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hangers and supports specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.

3.6 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.

B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

C. Install piping adjacent to appliances to allow service and maintenance of appliances.

D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.7 LABELING AND IDENTIFYING

A. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for piping and valve identification.

3.8 FIELD QUALITY CONTROL

A. Test, inspect, and purge natural gas according to NFPA 54 and local code and authorities having jurisdiction.

B. Natural-gas piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.9 OUTDOOR PIPING SCHEDULE

A. Aboveground natural-gas piping shall be one of the following:
   1. Steel pipe with malleable-iron fittings and threaded joints.
   2. Steel pipe with wrought-steel fittings and welded joints.

B. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

3.10 INDOOR PIPING SCHEDULE

A. Aboveground, branch piping NPS 1 and smaller shall be the following:
   1. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping shall be one of the following:
   1. Steel pipe with malleable-iron fittings and threaded joints.
   2. Steel pipe with wrought-steel fittings and welded joints.

3.11 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves for pipe sizes NPS 2 and smaller at service meter shall be one of the following:
   1. Two-piece, full port, bronze ball valves with bronze trim.
   2. Bronze plug valve.
   3. Iron plug valve.

B. Valves for pipe sizes NPS 3 and larger at service meter shall be the following: Iron plug valve.

C. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:
   1. One-piece, bronze ball valve with bronze trim.
   2. Two-piece, full-port, bronze ball valves with bronze trim.
   3. Bronze plug valve.

D. Distribution piping valves for pipe sizes NPS 3 and larger shall be the following: Iron plug valve.

E. Valves in branch piping for single appliance shall be one of the following:
   1. One-piece, bronze ball valve with bronze trim.
   2. Two-piece, full-port, bronze ball valves with bronze trim.
   3. Bronze plug valve.

- END OF SECTION -

- SECTION 22 3100 -

DOMESTIC WATER SOFTENERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Commercial Water Softeners
   2. Chemicals
   3. Water Testing Sets

B. Related Sections:
   1. Section 22 07 00 (15083) - Pipe Insulation: for softener-piping insulation.

1.3 SUBMITTALS

A. Submit “Letter of Conformance” in accordance with Section 01 33 00 (01330) indicating specified items selected for use in Project with the following supporting data:
   1. Product Data: Include rated capacities; shipping, installed, and operating weights; ion-exchange resins; salt purity and form; furnished specialties; and accessories.
   2. Shop Drawings: Detail equipment layouts and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
      a. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.
   3. Certificates of Shop Inspection and Data Reports: For softener tanks, as required by ASME Boiler and Pressure Vessel Code.
   4. Manufacturer's Field Service Reports: As specified in this Section.
   5. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
   6. Maintenance Agreement: As specified in this Section.
   7. Maintenance Data: For water softeners to include in maintenance manuals specified in Division 01.
   8. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of water softeners and are based on the specific system indicated.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of water softeners that fail in materials or workmanship within specified warranty period. Include coverage for the following:
   1. Attrition loss of resin not to exceed 3 percent per year.
   2. Resin not to be washed out of system during service run or backwashing period.
   3. Effluent turbidity not to be greater and color not to be darker than incoming water.
   4. Underdrain system, gravel, and resin not to become fouled, with turbidity or by dirt, rust, or scale from softener equipment or soft water, while operating according to manufacturer's written operating instructions.
   5. Response time shall be less than 24 from time of contact, seven (7) days per week.

C. Warranty Period: Not less than three years from date of Substantial Completion.

1.6 MAINTENANCE SERVICE

A. Maintenance: Submit four copies of manufacturer's "Agreement for Continued Service and Maintenance," before Substantial Completion, for Owner's acceptance. Offer terms and conditions for furnishing chemicals and providing continued testing and servicing to include replacing materials and equipment. Include one-year term of agreement with option for one-year renewal.

PART 2 - PRODUCTS

A. Approved Manufacturers:
   1. Commercial Water Softeners:
      a. Culligan International Co. (847-205-6000).
      b. Aquion Partners, L. P.; RainSoft Water Treatment Systems Div. (800-642-3426).
      c. Columbia Water Conditioning Systems, Inc. (888-404-7888).
      d. Custom Care Water Technologies.

2.2 COMMERCIAL WATER SOFTENERS

A. Description: Factory-assembled, pressure-type, commercial water softener.

B. Configuration:
   1. Triple unit with three softener tanks and one brine tank, on skids.

C. NSF Compliance:
   1. NSF 44, "Cation Exchange Water Softeners."
   2. NSF 44, "Cation Exchange Water Softeners," and NSF 61, "Drinking Water System Components--Health Effects."

D. Softener Tank: FRP, pressure-vessel quality. Include hydrostatic test at minimum of one and one-half times pressure rating and the following:
   1. Construction: Non-ASME code.
   2. Pressure Rating: 100 psig minimum.
   3. Wetted Components: Suitable for water temperatures from 40 to at least 100 deg.
   4. Freeboard: 50 percent minimum for backwash expansion above normal resin bed level.
   5. Support Legs or Skirt: Constructed of structural steel, attached to tank bottom.
   6. Upper Distribution System: Single, point type, fabricated from galvanized-steel pipe and fittings.
   7. Lower Distribution System: Hub and radial-arm or header-lateral type; fabricated from nonmetallic pipe and fittings with individual, fine-slotted, non-clogging plastic strainers; arranged for even flow distribution through resin bed.
   8. Liner: PE, ABS, or other material suitable for potable water.

E. Softener Tank: Steel, electric-welded, pressure-vessel quality. Include hydrostatic test at minimum of one and one-half times pressure rating and the following:
   1. Construction: Non-ASME code.
   2. Pressure Rating: 100 psig minimum.
   3. Wetted Components: Suitable for water temperatures from 40 to at least 100 deg.
   4. Freeboard: 50 percent minimum for backwash expansion above normal resin bed level.
   5. Handholes: 4 inches round or 4 by 6 inches elliptical, in top head and lower sidewall of tanks 30 inches and smaller in diameter.
   6. Manhole: 11 by 15 inches in top head of tanks larger than 30 inches in diameter.
   7. Support Legs or Skirt: Constructed of structural steel, welded to tank bottom.
   8. Finish: Hot-dip galvanized on exterior and interior of tank after fabrication.
   9. Finish: Exterior of tank spray painted with rust-resistant prime coat, 2- to 3-mil dry film thickness. Interior sandblasted and lined with epoxy-polyamide coating, 8- to 10-mil dry film thickness.
   10. Upper Distribution System: Single, point type, fabricated from galvanized-steel pipe and fittings.
   11. Lower Distribution System: Hub and radial-arm or header-lateral type; fabricated from PVC pipe and fittings with individual, fine-slotted, non-clogging PE strainers; arranged for even flow distribution through resin bed.
   12. Liner: PE, ABS, or other material suitable for potable water.

F. Controls: Fully automatic; factory mounted on units and factory-wired cycle controls. Include the following:

1. Adjustable duration of various regeneration steps.
2. Push-button start and complete manual operation.
3. Electric time clock and switch for fully automatic operation, adjustable to initiate regeneration at any hour of day and any day of week or at fixed intervals.
4. Sequence of Operation: Program multi-port pilot-control valve to automatically pressure actuate main operating valve through steps of regeneration and return to service. Include the following:
   a. Pointer on pilot-control valve to indicate cycle of operation.
   b. Means of manual operation of pilot-control valve if power fails.
5. Main Operating Valves: Industrial, automatic, multi-port, diaphragm type with the following features:
   a. Slow opening and closing, non-slam operation.
   b. Diaphragm guiding on full perimeter from fully open to fully closed.
   c. Isolated dissimilar metals within valve.
   d. Self-adjusting, internal, automatic brine injector that will draw brine and rinse at constant rate independent of pressure.
   e. Valve for single unit with internal automatic bypass of raw water during regeneration.
   f. Sampling cocks for soft water.
   g. Special tools are not required for service.
6. Flow Control: Automatic, to control backwash and flush rates over wide variations in operating pressures, and that does not require field adjustments.
   a. Meter Control: Equip each softener tank with signal-register-head water meter that will produce electrical signal indicating need for regeneration on reaching hand-set total in gallons. Design so signal will continue until reset.
   b. Demand-Initiated Control: Equip single softener-tank units with automatic-reset-head water meter that will electrically activate cycle controller to initiate regeneration at preset total in gallons. Design so head will automatically reset to preset total in gallons (liters) for next service run.
   c. Demand-Initiated Control: Equip each softener tank of twin units with automatic-reset-head water meters that will electrically activate cycle controllers to initiate regeneration at preset total in gallons. Design so heads will automatically reset to preset total in gallons for next service run. Include electrical lockout to prevent simultaneous regeneration of both tanks.
   d. Demand-Initiated Control: Equip twin softener-tank units with automatic-reset-head water meter in common outlet header that will electrically activate cycle controller to automatically regenerate one softener tank at preset total in gallons (liters) and divert flow to other tank. Set to repeat with other tank. Include electrical lockout to prevent simultaneous regeneration of both tanks.
   e. Demand-Initiated Control: Equip each softener tank of multiple tank units with automatic-reset-head water meters that will electrically activate cycle controllers to automatically regenerate at preset total in gallon. Design so heads will automatically reset to preset total in gallons for next service run. Include electrical lockouts to prevent simultaneous regeneration of more than one tank.
   f. Demand-Initiated Control: Equip multiple softener-tank units with automatic-reset-head water meter in common outlet header that will electrically activate cycle

controller to automatically regenerate one softener tank at preset total in gallons and divert flow to other tanks. Set to repeat with other tanks. Include electrical lockouts to prevent simultaneous regeneration of more than one tank.

G. Brine Tank: Combination brine and brine measuring. Include single wet-salt storage section.
   1. Construction: Fabricated from 3/16-inch-thick fiberglass or 3/8-inch-thick molded PE. Include plastic cover.
   2. Brine Valve: Float operated and plastic fitted for automatic control of brine withdrawn and freshwater refill. Include brine tubing and fittings.
   3. Size: Sufficient for at least four regenerations at full salting.

H. Include the following factory-installed accessories:
   1. Piping, valves, drains, and pressure gages.
   2. Sampling cocks.
   3. Main-operating-valve position indicators.
   4. Water meters.

2.3 CHEMICALS

A. Ion-Exchange Resin: High-capacity, sulfonated polystyrene that is stable over entire pH range with good resistance to bead fracture from attrition or shock. Include capacity to 30,000 grains of calcium carbonate hardness/cu. ft. of resin when regenerated with 15 lbs. of salt.

B. Salt for Brine-Tank Applications: High-purity, sodium chloride that is free of dirt and foreign material. Rock and granulated forms are unacceptable.
   1. Form: Salt pellets.

2.4 WATER TESTING SETS

A. Water-Hardness Testing Set: Manufacturer's standard testing apparatus and chemicals with testing procedure instructions and metal container suitable for wall mounting.

PART 3 - EXECUTION

3.1 CONCRETE BASES

A. Install concrete bases of dimensions indicated for equipment. Refer to Section 03 30 00 (03300) - "Cast-in-Place Concrete" and Section 21/22/23 95 00 (15050) "Basic Mechanical Materials and Methods."

3.2 WATER SOFTENER INSTALLATION

A. Install water softener equipment on concrete bases, level and plumb, according to manufacturer's written instructions, layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing servicing are accessible.

B. Anchor tanks and floor-mounting accessories to substrate.

C. Install pressure gages on raw-water inlet and soft-water outlet piping of each water softener tank. Refer to Division 22 Section "Meters and Gages" for pressure gages.

D. Install water testing sets near each water softener and mount on wall where indicated.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Make piping connections to dissimilar-metal water piping with dielectric fittings. Refer to Section 22 95 00 "Basic Materials and Methods" for dielectric fittings.

D. Install drains as indirect wastes to spill into open drains or over floor drains.

E. Install brine lines and fittings furnished by manufacturer but not specified to be factory mounted.

F. Install electrical connections for power, controls, and devices. Electrical power wiring, devices, and connections are specified in Division 16 Sections.

G. Ground Equipment: Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field assembly of components and installation of water softeners, including piping and electrical connections. Report results in writing.
   1. Leak Tests: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
   3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Sample water softener effluent after startup and at three consecutive seven-day intervals (total of four samples), and prepare certified test reports for required water performance characteristics. Comply with the following:
   1. ASTM D859, "Test Method for Silica in Water."
   2. ASTM D1067, "Test Methods for Acidity or Alkalinity of Water."
   3. ASTM D1068, "Test Methods for Iron in Water."
   4. ASTM D1126, "Test Method for Hardness in Water."
   5. ASTM D1129, "Terminology Relating to Water."
   6. ASTM D3370, "Practices for Sampling Water from Closed Conduits."

3.5 COMMISSIONING

A. Engage a factory-authorized service representative to perform startup service.

B. Perform the following final checks before startup:
   1. Water Piping Systems: Verify that tests have been completed.
   2. Load Softener Tank: Install gravel to cover lower distribution system and add water; smooth gravel surface and add softening resin.
   3. Load Brine Tank: Add water and fill tank with pellet-form salt.

C. Energize circuits.

D. Adjust operating controls.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.
   1. Conduct training as specified in Section 01 79 00 (01820) - "Training”.
   2. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining units.

- END OF SECTION -

- SECTION 22 3544 -

DOMESTIC HOT WATER STORAGE TANKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Unjacketed domestic hot water storage tanks.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Domestic-hot-water storage tanks shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.4 SUBMITTALS

A. Product Data: Provide manufacturer's product data for each unit indicated on the drawings. Data to be specific to the equipment proposed for the project with all options and accessories indicated. Include the following as a minimum:
   1. Manufacturer and model number.
   2. Rated capacity based on scheduled conditions.
   3. Equipment dimensions.
   4. Required clearances.
   5. Materials of construction.
   6. Accessories and options.

B. Operation and maintenance data.

C. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

A. ASME Compliance:
   1. Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
   2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube, domestic-water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.

B. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of domestic hot water storage tanks that fail in materials or workmanship within specified warranty period.
   1. Warranty Periods: From date of Substantial Completion.
      a. Storage Tank: Five years.

PART 2 - PRODUCTS

2.1 UNJACKETED DOMESTIC HOT WATER STORAGE TANKS

A. Manufacturers: Subject to compliance with requirements:
   1. Bock Water Heaters, Inc.
   2. Bradford White Corporation.
   3. Lochinvar Corporation.
   4. PVI Industries, LLC.
   5. Rheem Manufacturing Company.

B. Unjacketed, Lined, Domestic Hot Water Storage Tanks:
   1. Storage-Tank Construction: ASME-code steel with 125-psig pressure rating.
      a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
         1) Threaded ends according to ASME B1.20.1.
         2) Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
      b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
      c. Lining: Glass, nickel plate, or phenolic coating complying with NSF 61 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.

2. Factory-Installed Storage-Tank Appurtenances:
   a. Anode Rod: Replaceable magnesium.
   b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
   c. Exterior Finish: Primed and or painted.
   d. Cleanout: Handhole for inspection and cleaning.
   e. Temperature Sensor Tapping: 3/4 inch fitting in lower part or tank for aquastat mounting.
   f. Saddles: Provide steel support saddles for horizontal tanks design to support weight of tank and contents.
   g. Support: Provide steel support legs or skirt for vertical tanks designed to support weight of tank and contents.

2.2 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect assembled domestic-water heaters and storage tanks specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

PART 3 - EXECUTION

3.1 DOMESTIC HOT WATER STORAGE TANK INSTALLATION

A. Domestic Hot Water Storage Tank: Install domestic hot water storage tanks heaters on strut stands to support bottom of heater 6 inches above finished floor. Comply with requirements for supports specified in Hangers and Supports for Plumbing Piping and Equipment.
   1. Exception: Omit strut stands for storage tanks if installation on concrete pad or directly on floor is indicated.
   2. Maintain manufacturer's recommended clearances.
   3. Arrange units so controls and devices that require servicing are accessible.
   4. For supported equipment, install epoxy-coated anchor bolts that anchor stand to structural concrete floor.
   5. Anchor storage tanks to substrate.

B. Install storage tanks level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
   1. Install shutoff valves on water piping connected to water storage tanks. Comply with requirements for shutoff valves specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

C. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Division 22 Section "Domestic Water Piping Specialties."

D. Install thermometer on outlet piping of storage tanks. Comply with requirements for thermometers specified in Division 22 Section "Meters and Gages for Plumbing Piping."

E. Fill water storage tanks with water.

3.2 CONNECTIONS

A. Comply with requirements for domestic-water piping specified in Division 22 Section "Domestic Water Piping."

B. Drawings indicate general arrangement of piping, fittings, and specialties.

C. Where installing piping adjacent to water storage tanks, allow space for service and maintenance of water heaters. Arrange piping for easy removal of water storage tanks.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
   2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

B. Domestic hot water storage tanks will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 01 Section "Quality Requirements" for retesting and reinspecting requirements and Division 01 Section "Execution" for requirements for correcting the Work.

C. Prepare test and inspection reports.

- END OF SECTION -

- SECTION 22 4000 -

PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Plumbing Fixture Standards
2. Miscellaneous Fixture Standards
3. Miscellaneous Component Standards

B. Related Sections:
1. Section 07 92 00 (07920) - Joint Sealant: For sealing between fixtures and walls, floors, and counters.
2. Section 22 05 00 (15050) – Common Work Results for Plumbing
3. Section 22 05 23 (15110) – General Duty Valves for Plumbing Piping
4. Section 22 30 00 (15430) - Plumbing Equipment

1.3 REFERENCES

A. American National Standards Institute (ANSI) Publications:
1. A117.1 “Accessible and Useable Buildings and Facilities”
2. Z124.1 “Plastic Bathtub Units”
3. Z124.1a, and Z124.1b
4. Z124.5 “Plastic Toilet (Water Closet) Seats”
5. Z124.6 “Plastic Sinks”
6. Z358.1 “Emergency Eyewash and Shower Equipment”

B. Air-Conditioning and Refrigeration Institute (ARI) Publications:
1. 1010 “Self-Contained, Mechanically Refrigerated Drinking-Water Coolers”

C. The American Society of Mechanical Engineers (ASME) Publications:
1. A112.6.1.M “Floor Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use”
2. A112.18.1 “Plumbing Fixture Fittings”

3. A112.19.2 “Vitreous China Plumbing Fixtures and Hydraulic Requirements for Water Closets and Urinals”
4. A112.19.3 “Stainless Steel Fixtures (Designed for Residential Use)”
5. A112.19.4M “Porcelain Enameled Formed Steel Plumbing Fixtures”
6. A112.19.5 “Trim for Water-Closet Bowls, Tanks and Urinals”
7. A112.19.7M “Whirlpool Bathtub Appliances”
8. A112.19.8M “Suction Fittings for Swimming & Wading Pools Spas Hot Tubs & Whirlpool Bathtub Appliances”
9. A112.21.1M “Floor Drains”
10. B1.20.1 "Pipe Threads, General Purpose, Inch"
11. B1.20.7 “Hose Coupling Screw Threads, Inch”

D. American Society of Sanitary Engineering (ASSE) Publications:
1. 1001 “Performance Requirements for Atmospheric Type Vacuum Breakers”
2. 1008 “Performance Requirements for Household Food Waste Disposer Units”
3. 1011 “Performance Requirements for Hose Connection Vacuum Breakers”
4. 1014 “Performance Requirements for Backflow Prevention Devices for Hand-Held Showers”
5. 1016 “Performance Requirements for Automatic Compensating Valves for Individual Showers and Tub/Shower Combinations”
6. 1025 “Performance Requirements for Diverters for Plumbing Faucets with Hose Spray, Anti-Siphon Type, Residential Applications”
7. 1037 “Performance Requirements for Pressurized Flushing Devices (Flushometers) for Plumbing Fixtures”

E. ASTM International (ASTM) Publications:
1. F444 “Standard Consumer Safety Specification for Scald-Preventing Devices and Systems in Bathing Areas”
2. F445 “Consumer Safety Specification for Thermal-Shock-Preventing Devices and Systems in Showering Areas”
3. F462 “Consumer Safety Specification for Slip-Resistant Bathing Facilities”

F. National Sanitation Foundation Construction (NSF) Publications:
1. 2 “Food Equipment”
2. 61 “Drinking Water System Components - Health Effects”

G. Underwriter's Laboratories, Inc. (UL) Publications:
1. 399 “Drinking Water Coolers”
2. 430 “Waste Disposers”
3. 486A “Standard For Wire Connectors and Soldering Lugs for Use With Copper Conductors”
4. 486B “Standard for Wire Connectors for Use With Aluminum Conductors”
5. 1795 “Hydromassage Bathtubs”

1.4 DEFINITIONS

A. Accessible: Plumbing fixture, building, facility, or portion thereof that can be approached, entered, and used by physically handicapped, disabled, and elderly people.

B. Fitting: Device that controls flow of water into or out of plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, traps and waste pipes. Pipe fittings, tube fittings, and general-duty valves are included where indicated.

1.5 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

1. Product Data for each plumbing fixture category and type specified. Include selected fixture, trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
2. Maintenance data for plumbing fixtures and components to include in the operation and maintenance manuals specified in Division 01.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category from one source and by a single manufacturer.

1. Exception: Where fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for this category.

B. Regulatory Requirements: Comply with requirements of ANSI A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; regarding plumbing fixtures for physically handicapped people.

C. Provide Plumbing Fixtures with listed maximum water flush (gpf) and flow rates (gpm). For plumbing fixtures not listed, comply with Comply with requirements of Public Law 102-486, "Energy Policy Act."

D. Listing and labeling: Provide electrically operated fixtures and components specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.

E. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver plumbing fixtures in manufacturer's protective packing, crating, and covering.

B. Store plumbing fixtures on elevated platforms in dry location.

1.8 PROJECT CONDITIONS

A. Field Measurements: Coordinate roughing-in and final fixture locations and verify that plumbing fixtures can be installed to comply with original design and referenced standards.

1.9 EXTRA MATERIALS

A. Deliver extra materials to Owner. Furnish extra materials described in Section 01 78 43 - "Spare Parts and Maintenance" that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved Manufacturers:
1. American Standard, Inc. (732-980-3234)
    a. Bathtubs
    b. Bathtub Drains
    c. Bath/Shower Diverters, Valves & Trim
    d. Faucets
    e. Service Sinks
    f. Sinks
    g. Sink Strainers
    h. Toilet Seats
    i. Urinals
    j. Water Closets
    k. Flush Valve
2. Church Seats, A Division of Bemis Manufacturing Company (800-233-7328)
    a. Toilet Seats
3. Danze, a brand of Globe Union Branded Products (630-754-0253)
    a. Corner Sinks
    b. Water Closets
4. Delta Faucet Company (800-345-3358)
    a. Bath/Shower Diverters, Valves & Trim
    b. Faucets
    c. Mop Hangers/Hose Holders/
    d. Sink Strainers
    e. Flush Valve

5. Elkay Manufacturing Co. (630-574-8484)
   a. Sinks
   b. Water Coolers
6. Fiat
   a. Mop Sink, Hose Holder, Wall Guard
   b. Laundry Sink
7. Gerber Plumbing Fixtures, a brand of Globe Union Branded Products (630-754-0253)
   a. Bathtub Drains
   b. Water Closets
8. Halsey Taylor (630-574-3500)
   a. Water Coolers
9. Haws Corp. (510-525-5801)
   a. Eye Wash
   b. Water Coolers
10. Introsul, Inc. (478-987-3185 x 223)
    a. Shower Base
11. Kohler Co. (800-456-4537)
    a. Bathtubs
    b. Bathtub Drains
    c. Bath/Shower Diverters, Valves & Trim
    d. Faucets
    e. Laundry Sinks
    f. Service Sinks
    g. Shower Heads
    h. Sinks
    i. Sink Strainers/Grid Strainers
    j. Toilet Seats
    k. Urinals
    l. Water Closets
    m. Flush Valve
12. McGuire Manufacturing Company, Inc. (203-699-1801)
    a. Bathtub Drains
    b. Traps, Trap Arms
    c. Riser and Trap Insulation to meet ADA requirements
    d. Water Supply 1/4 Turn Stops and Risers
13. Mincey Marble Manufacturing Co. (800-533-1806)
    a. Shower Base
14. Moen Incorporated (800-321-8809)
    a. Bath/Shower Diverters, Valves & Trim
    b. Faucets
    c. Mop Hangers/Hose Holders/
    d. Sink Strainers

15. MPL Corporation (317-835-9000)
    a. Shower Base
16. E. L. Mustee & Sons, Inc. (800-321-3128)
    a. Mop Sink
    b. Mop Hanger/Hose Holder/Wall Guard
    c. Laundry Sink / Faucet
17. Oasis Industries Inc. (800-323-2748)
    a. Water Coolers
18. Speakman Company (800-537-2107)
    a. Shower Heads
19. Sunroc Corp (800-4SUNROC)
    a. Water Coolers
20. Toto USA, Inc. (800-350-8686)
    a. Toilet Seats
    b. Water Closets
21. Vitra USA (770-904-6830)
    a. Corner Sinks

2.2 PLUMBING FIXTURE STANDARDS

A. Comply with applicable standards below and other requirements specified.
1. Electric Water Coolers: ARI 1010 and UL 399.
2. Emergency Equipment: ANSI Z358.1.
3. National Sanitation Foundation Construction: NSF 2 and NSF 61.
4. Bathtubs: ANSI Z124.1
5. Plastic Laundry Trays: ANSI Z124.6.
6. Plastic Mop-Service Basins: ANSI Z124.6.
7. Shower Enclosures: ANSI Z124.2.
8. Whirlpool Bathtubs: ANSI Z124.1; and ASME A112.19.7M.
9. Porcelain-Enameled Fixtures: ASME A112.19.4M.
10. Slip-Resistant Bathing Surfaces: ASTM F 462.
11. Stainless-Steel Fixtures Other than Service Sinks: ASME A112.19.3.
12. Vitreous-China Fixtures: ASME A112.19.2.
13. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
14. Water-Closet, Flushometer Tank Trim: ASSE 1037.
15. Whirlpool Bathtub Fittings: ASME A112.19.8M.

2.3 PLUMBING FIXTURE MAXIMUM FLOW RATES

A. The flow rates of plumbing fixtures shall not exceed the maximum values stated below:
1. Employee / Public Restrooms:
    a. Lavatories: 1.00 GPM
    b. Water Closets: 1.28 GPF

c. Urinals: 0.50 GPF

2. Boardroom / Meeting Room / Bar:
   a. Sink: 1.50 GPM
3. Guestrooms:
   a. Lavatories: 1.50 GPM
   b. Wet Bar: 1.50 GPM
   c. Water Closets: 1.28 GPF
   d. Showerheads: 2.00 GPM
   e. Kitchen Sink: 2.00 GPM
4. Back-of-House:
   a. Employee Breakroom: 2.00 GPM

2.4 LAVATORY/SINK FAUCET STANDARDS

A. Comply with ASME A112.18.1, NSF 61 and other requirements specified for lavatory, sink, and similar-type-fixture faucet fittings. Include hot- and cold-water indicators; 2.5-gpm-maximum flow rate; and finish as shown on Plumbing Fixture Schedule on metal body. Coordinate faucet inlets with supplies and fixture holes and outlet with spout and fixture receptor.

1. Faucet:
   a. Valve shall be ceramic discs in cartridge assembly.
   b. Handles as indicated.
   c. Pop-up or grid drain as indicated.
2. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
3. Faucet Hose: ASTM D3901.
4. Hose-Connection Vacuum Breakers: ASSE 1011.
5. Hose-Coupling Threads: ASME B1.20.7.
6. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
7. Pipe Threads: ASME B1.20.1.
8. Sink Spray Hoses: ASTM D3573.

2.5 BATHTUB/SHOWER FAUCET STANDARDS

A. Comply with ASME A112.18.1 and other requirements specified for bathtub and shower faucet fittings. Include hot- and cold-water indicators; maximum flow rate and finish as shown on Plumbing Fixture Matrix. Coordinate faucet inlets with supplies and outlet with diverter valve; tub spout; and shower head, arm, and flange.

1. All Trim to be metallic.
2. Valving shall be ceramic discs in cartridge assemblies.
3. Cast brass valve-body with integral cast-in service stops.
4. Pressure balancing faucets shall utilize a diaphragm-balancing cartridge with integral check valves.
5. Combination, Pressure-Equalizing- and Thermostatic-Control, Antiscald Faucets: ASSE 1016.
6. Pressure balancing faucets shall utilize a diaphragm-balancing cartridge with integral check valves.

7. Hand-Held Showers: ASSE 1014.
8. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F445.
9. Hose-Coupling Threads: ASME B1.20.1 or ASME B1.20.7.
10. Manual-Control Antiscald Faucets: ASTM F444.
11. Pipe Threads: ASME B1.20.1.
12. Pressure-Equalizing-Control Antiscald Faucets: ASTM F444 and ASSE 1016.
13. Thermostatic-Control Antiscald Faucets: ASTM F444 and ASSE 1016.

2.6 MISCELLANEOUS FITTING STANDARDS

A. Comply with ASME A112.18.1 and other requirements specified for fittings, other than faucets. Include finish to coordinate with finishes shown on Plumbing Fixture Schedule. Coordinate fittings with other components and connectors.
1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Automatic Flow Restrictors: ASSE 1028.
3. Brass and Copper, Supplies and Tubular Brass: ASME A112.18.1.
4. Fixed Flow Restrictors: ASSE 1034.
5. Manual-Operation Flushometers: ASSE 1037.

2.7 MISCELLANEOUS COMPONENT STANDARDS

A. Comply with applicable standards below and other requirements specified for components for plumbing fixtures, equipment, and appliances.
1. Disposers: ASSE 1008 and UL 430.
2. Floor Drains: ASME A112.21.1M.
3. Hose-Coupling Threads: ASME B1.20.7.
4. Pipe Threads: ASME B1.20.1.
5. Plastic Shower Receptors: ANSI Z124.2 and ANSI Z124.2a.
6. Plastic Toilet Seats: ANSI Z124.5.
7. Supply and Drain Insulation Kits: ANSI A117.1.
8. Supports: ASME A112.6.1M.
9. Whirlpool Bathtub Equipment: UL 1795.

2.8 FITTINGS

A. Fittings for Plumbing Fixtures: Refer to plumbing fixture schedules in the Appendix for materials for supplies, supply stops, supply risers, traps, and other fittings.

B. Fittings for Equipment Specified in Other Sections: Fittings include the following:
1. Supply Inlets: Brass pipe or copper tube, size required for final connection.
2. Supply Stops: Chrome-plated brass, 1/4 turn, angle or straight; compression, loose-key type; same size as supply inlet and with outlet matching supply riser.
3. Supply Risers: 3/8-inch NPS (DN10) rigid brass tube with 1/4-inch NPS (DN8) offset, knob-end tailpiece. Use chrome-plated tube for exposed applications.

4. Traps: Tubular brass with 0.045-inch wall thickness, slip-joint inlet, cleanout, wall flange, escutcheons, and size to match equipment. Use chrome-plated tube for exposed applications.
5. Continuous Waste: Tubular brass, 0.045-inch wall thickness, with slip-joint inlet, and size to match equipment.
6. Indirect Waste: Tubular brass, 0.045-inch wall thickness, and size to match equipment.

2.9 FINISHES

A. Refer to Plumbing Fixture Matrix on Drawings for Finishes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for potable, hot- and cold-water supply piping systems; soil, waste, and vent piping systems; and supports. Verify that locations and sizes of piping and locations and types of supports match those indicated, before installing and connecting fixtures. Use manufacturer's roughing-in data when roughing-in data are not indicated.

B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.

C. Do not proceed until unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Include supports for plumbing fixtures according to the following:
1. Carriers: For wall-hanging water closets and fixtures supported from wall construction.
2. Chair Carriers: For wall-hanging urinals, lavatories, sinks, drinking fountains, and electric water coolers.
3. Heavy-Duty Chair Carriers: For accessible urinals, lavatories, and other fixtures where indicated.
4. Reinforcement: For floor-mounted lavatories and sinks that require securing to wall and recessed, box-mounted, electric water coolers.
5. Fabricate reinforcement from 2-by-4-inch or 2-by-6-inch fire-retardant-treated-wood blocking between studs or 1/4-by-6-inch steel plates attached to studs, in wall construction, to secure fixtures to wall. Include length that will extend beyond ends of fixture mounting bracket and attach to at least 2 studs.

B. Include fitting insulation kits for accessible fixtures according to the following:
1. Lavatories: Cover hot- and cold-water supplies, stops and handles, drain, trap, and waste to wall.
2. Sinks: Cover hot- and cold-water supplies, stops and handles, drain, trap, and waste to wall.
3. Fixtures with Offset Drain: Cover hot- and cold-water supplies, offset drain, trap, and waste to wall.
4. Other Fixtures: Cover exposed fittings below fixture.

3.3 PLUMBING FIXTURE INSTALLATION

A. Assemble plumbing fixtures and trim, fittings, faucets, and other components according to manufacturers' written instructions.

B. Install fixtures level and plumb according to manufacturers' written instructions, roughing-in drawings, and referenced standards.

C. General:
   1. Fasten wall-hanging plumbing fixtures securely to supports attached to building substrate when supports are specified, and to building wall construction where no support is indicated.
   2. Fasten floor-mounted fixtures to substrate. Fasten fixtures having holes for securing fixture to wall construction, to reinforcement built into walls.
   3. Fasten recessed, wall-mounted fittings to reinforcement built into walls.
   4. Fasten wall-mounted fittings to reinforcement built into walls.
      a. Secure supplies to supports or substrate within pipe space behind fixture.
   5. Fasten counter-mounting plumbing fixtures to casework.
   6. Install shower arm elbow fitting secure to backing to prevent movement.
   7. Set shower receptors and mop basins in leveling bed of cement grout.
   8. Install shower, flow-control fittings with specified maximum flow rates in shower arms.
   9. Install individual stop valve in each water supply to fixture. Use gate or globe valve where specific stop valve is not specified.
      a. Exception: Omit stop valves on supplies to emergency equipment, except when permitted by authorities having jurisdiction. When permitted, install valve chained and locked in OPEN position.
      b. Install water-supply stop valves in accessible locations.
   10. Install faucet, laminar-flow fittings with specified flow rates and patterns in faucet spouts when faucets are not available with required rates and patterns. Include adapters when required.
   11. Install supply, flow-control fittings with specified flow rates in fixture supplies at stop valves.
   12. Install faucet, flow-control fittings with specified flow rates and patterns in faucet spouts when faucets are not available with required rates and patterns. Include adapters when required.
   13. Install traps on fixture outlets. Omit traps on fixtures having integral traps. Omit traps on indirect wastes, except where otherwise indicated.
   14. Install escutcheons at wall, floor, and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons where required to conceal protruding pipe fittings.
   15. Seal joints between fixtures and walls, floors, and counters using sanitary-type sealant according to sealing requirements specified in Section 07 92 00 (07920) - "Joint Sealants." Match sealant color to fixture color.

D. Water Closets and Urinals:
   1. Install floor-mounted, floor-outlet water closets with closet flanges and gasket seals.
   2. Install floor-mounted, back-outlet water closets with fittings and gasket seals.

3. Install wall-hanging, back-outlet water closets with support manufacturer's tiling frame or setting gage.
4. Install toilet seats on water closets.
5. Install wall-hanging, back-outlet urinals with gasket seals.
6. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for handicapped people to reach.
7. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.

E. Disposers:
1. Install disposers in sink outlets. Install switch where indicated, or in wall adjacent to sink if location is not indicated.

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
1. Install piping connections between plumbing fixtures and piping systems and plumbing equipment specified in other Division 22 Sections.

B. Supply and Waste Connections to Plumbing Fixtures: Refer to plumbing fixture schedules on the Drawings for fitting sizes and connection requirements for each plumbing fixture.

C. Supply and Waste Connections to Equipment Specified in Other Sections: Connect equipment with supply inlets, supply stops, supply risers, and traps specified in this Section. Use fitting sizes required to match connected equipment. Connect fittings to plumbing piping.

D. Ground Equipment: Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

E. Arrange for electric-power connections to fixtures and devices that require power. Electric power is specified in Division 16 Sections.

3.5 FIELD QUALITY CONTROL

A. Verify that installed fixtures are categories and types specified for locations where installed.

B. Check that fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized and demonstrate proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.6 ADJUSTING AND CLEANING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Operate and adjust disposers, hot-water dispensers, and controls. Replace damaged and malfunctioning units and controls.

C. Adjust water pressure at drinking fountains, electric water coolers, faucets, shower valves, and flushometer valves having controls, to produce proper flow and stream.

D. Replace washers and seals of leaking and dripping faucets and stops.

E. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Include the following:
   1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
   2. Remove sediment and debris from drains.

3.7 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of fixtures for temporary facilities, except when approved in writing by Owner.

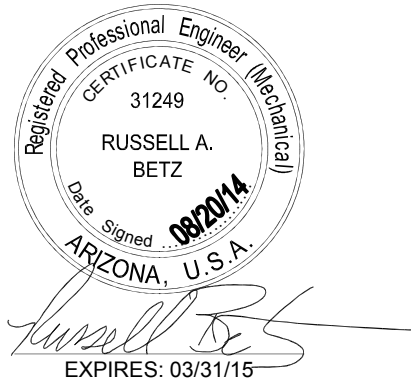
3.8 SCHEDULES

A. See Plumbing Fixture Matrix on Drawings.

- END OF SECTION -

DIVISION 23 – HEATING, VENTILATION & AIR CONDITIONING

TABLE OF CONTENTS



EXPIRES: 03/31/15

- SECTION 23 0500 -

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. HVAC Pipe and Pipe Fittings
2. Joining Materials
3. HVAC Piping System Installation
4. HVAC Equipment Installation
5. Concrete Bases.
6. Erection of Metal Supports
7. Erection of Wood Supports
8. Cutting and Patching

B. Related Sections:
1. Section 01 31 00 - Project Management and Coordination
2. Section 01 73 29 - Cutting and Patching
3. Section 01 78 43 - Spare Parts and Materials
4. Section 01 79 00 - Training
5. Section 01 78 23 - Operating and Maintenance Data
6. Section 03 30 00 - Cast-in-Place Concrete
7. Section 06 10 00 - Rough Carpentry
8. Section 07 62 00 - Sheet Metal Flashing and Trim
9. Section 07 84 00 - Firestopping
10. Section 08 31 00 - Access Doors
11. Section 09 90 00 - Painting
12. Section 23 05 53 – Identification for HVAC Piping and Equipment: Labeling and identifying HVAC systems and equipment.
13. Section 31 20 00 – Earth Moving

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

1. Product Data: For dielectric fittings, flexible connectors, plumbing sleeve seals, and identification materials and devices.
2. Coordination Drawings: Detail major elements, components, and systems of plumbing equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:
    a. Planned piping layout, including valve and specialty locations and valve-stem movement.
    b. Clearances for installing and maintaining insulation.
    c. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
    d. Equipment and accessory service connections and support details.
    e. Exterior wall and foundation penetrations.
    f. Fire-rated wall and floor penetrations.
    g. Sizes and location of required concrete pads and bases.
    h. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.
    i. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

1.5 QUALITY ASSURANCE

A. Equipment Selection: Equipment of higher electrical characteristics, physical dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting plumbing and electrical services, circuit breakers, conduit, motors,

bases, and equipment spaces are increased. Additional costs shall be approved in advance by appropriate Contract Modification for these increases.

1. If minimum energy ratings or efficiencies of equipment are specified, equipment must meet design requirements. See drawings for equipment schedules and requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and prevent entrance of dirt, debris, and moisture.

B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.

C. Protect flanges, fittings, and piping specialties from moisture and dirt.

D. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 SEQUENCING AND SCHEDULING

A. Coordinate HVAC equipment installation with other building components.

B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.

C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.

D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.

E. Coordinate connection of HVAC systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

F. Coordinate requirements for access panels and doors if mechanical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Section 08 31 13 - "Access Doors and Frames."

G. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

H. Posted Operating Instructions

I. Provide and post operating instructions for all HVAC systems.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved Manufacturers:
   1. HVAC Sleeve Seals:
      a. Metraflex Inc. (800-621-4347)
      b. PSI-Thunderline/Link-Seal (800-423-2410)

2.2 JOINING MATERIALS

A. Solder Filler Metals: ASTM B32.
   1. Alloy Sn95 or Alloy Sn94: Approximately 95 percent tin and 5 percent silver, with 0.10 percent lead content.
   2. Alloy E: Approximately 95 percent tin and 5 percent copper, with 0.10 percent maximum lead content.
   3. Alloy HA: Tin-antimony-silver-copper zinc, with 0.10 percent maximum lead content.
   4. Alloy HB: Tin-antimony-silver-copper nickel, with 0.10 percent maximum lead content.
   5. Alloy Sb5: 95 percent tin and 5 percent antimony, with 0.20 percent maximum lead content.

B. Brazing Filler Metals: AWS A5.8.
   1. BCuP Series: Copper-phosphorus alloys.
   2. BAg1: Silver alloy.
   3. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

PART 3 - EXECUTION

3.1 HVAC PIPING SYSTEMS - COMMON REQUIREMENTS

A. General: Install HVAC piping as described below, unless piping Sections specifies otherwise. Individual Division 23 Piping Sections specifies unique piping installation requirements.

B. General Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated, unless deviations to layout are approved on Coordination Drawings as required by Division 01 Sections and as outlined in Part 1 of this section.

C. Install components with pressure rating equal to or greater than system operating pressure.

D. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.

E. Install piping free of sags and bends.

F. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.

G. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.

H. Install piping to allow application of insulation plus 1-inch clearance around insulation.

I. Install sleeves for pipes passing through concrete and masonry walls, and concrete floor and roof slabs.
   1. Cut sleeves to length for mounting flush with both surfaces.

J. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping rings where required.
   1. Build sleeves into walls and slabs as work progresses.
   2. Install sleeves large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
   3. Use Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant.

K. Aboveground, Exterior-Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   1. Install steel pipe for sleeves smaller than 6 inches in diameter.
   2. Install cast-iron "wall pipes" for sleeves 6 inches in diameter and larger.
   3. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.

L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire stopping materials. Refer to Section 07 84 00 - "Firestopping" for materials.

M. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

N. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping specification Sections:
   1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
   2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
   3. Soldered Joints: Construct joints according to CDA's "Copper Tube Handbook."
   4. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

3.2 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to provide maximum possible headroom, if mounting heights is not indicated.

B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Owner's Representative.

C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

D. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

E. Clearance from Electrical Equipment: Piping and ductwork are prohibited in electric rooms and closets, elevator machine rooms and installation over transformers, switchboards and motor control centers.

3.3 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

B. Field Welding: Comply with AWS D1.1, "Structural Welding Code--Steel."

C. Prime and paint all metal supports per Section 09 90 00 requirements similar to "Pipes and Mechanical Equipment".

3.4 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage to support and anchor HVAC materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.5 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of trades involved.

B. Repair cut surfaces to match adjacent surfaces.

C. Refer to Division 01 Sections for additional requirements.

3.6 GROUTING

A. Install nonmetallic, non-shrink, grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's written instructions.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placing of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases to provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout according to manufacturer's written instructions.

- END OF SECTION -

- SECTION 23 0500.01 -

GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SCOPE

A. Provisions of this section apply to all work specified in all sections under Division 23.

B. In addition, work in Division 23 is governed by the provisions of the Bidding Requirements, Contract Forms, General Conditions, and all sections under Division 01.

1.3 MECHANICAL CONTRACTOR

A. The Mechanical Contractor shall be licensed and hold a current contracting license that has been valid for a minimum of two years in the State of Arizona as a mechanical contractor.

1.4 REGULATIONS, PERMITS, FEES, CHARGES, INSPECTIONS

A. Regulations: Comply with all applicable codes, rules and regulations.

B. Fees and Permits: Pay all connection, installation, use, development, etc., fees and/or charges. Obtain and pay for all required permits and licenses. Refer to Division 01.

C. Inspections: All work must be inspected and approved by local authorities. Prior to final approval, furnish the Architect with certificates of inspections and approvals by the local authorities in accordance with Division 01.

1.5 DRAWINGS AND SPECIFICATIONS

A. If a conflict exists on the drawings or between the drawings and specifications, promptly notify the Architect.

1.6 SUBMITTALS

A. Submittals are for information and coordination only. The Engineer will diligently review the submittals and attempt to verify compliance with the project requirements. Such review, however, does not constitute approval or disapproval of obligation to comply with all project

requirements. The submittals are not to be construed to be contract documents. Any failure by the Engineer to note a point of non-compliance shall not be construed to be acceptance or approval of the discrepancy.

B. Product Information Sheets: Provide manufacturer's literature which includes the information required by the Product Data paragraph of the applicable Specification Section. Where Product Information Sheets show multiple models or options, clearly mark the model and options to be provided.

C. Assembly: Assemble all required submittal information for each specification section and submit in PDF format.
   1. Assemble PDF submittals in one PDF file for each Division. Separate and order sections within each file by corresponding specification number. Provide bookmarks at the first page of each section and label each bookmark with the specification number and name to allow for easy navigation of the submittal.
   2. Partial submittals will be returned without review. Submittals for Building Automation System may be submitted separately.

D. Identification and Information:
   1. Name the PDF file with the Project name, Division number and sequential submittal number. (I.E. The first submittal shall be No. 1; the second submittal shall be No. 2.)
   2. Provide a cover sheet at the front of each submittal with the following information:
      a. Project name.
      b. Date.
      c. Name of Engineer.
      d. Name of Contractor.
      e. Name of subcontractor.
   3. Provide a cover sheet at the front of each submittal section with the following information:
      a. Name of supplier.
      b. Name of manufacturer.
      c. Number and title of appropriate Specification Section.
      d. Drawing number and detail references, as appropriate.
      e. Other necessary identification.

E. Options:
   1. Identify options requiring selection by the Engineer.
   2. Identify options included with submittal item.

F. Deviations: Identify deviations from the Contract Documents on submittals.

1.7 MATERIAL SAFETY DATA SHEETS

A. Provide current, Material Safety Data Sheets (MSDS), for all hazardous chemicals that are proposed for use at the project site.
   1. Provide one complete set to the Owner for review and approval a minimum of one week prior to the delivery of any hazardous chemicals to the site.
   2. Maintain a second complete set at the project location, readily accessible by both the Owner's personnel and the contractor's personnel.

1.8 REQUEST FOR INFORMATION

A. Request for Information:
   1. A document submitted by the Contractor requesting clarification of a portion of the Contract Documents, hereinafter referred to as RFI.
   2. A properly prepared request for information shall include a detailed written statement of the clarification, apparent conflict, or information requested that indicates the specific drawings or specification in need of clarification and the nature of the clarification requested.
      a. Drawings shall be identified by drawing number and location on the drawing sheet.
      b. Specifications shall be identified by section number, page, and paragraph.
   3. Include a proposed solution, where appropriate, based upon the field conditions and best knowledge of the Contractor.

B. Improper or Frivolous RFIs: RFIs which are not properly prepared or that request information which is clearly shown in the contract documents will be returned unanswered. Processing time for multiple submissions of improper or frivolous RFIs will be billed at the Engineer's standard hourly rate to the Owner who may deduct an equal amount from the monies due the Contractor.

1.9 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings, Submittals and Shop Drawings.
   1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Include underground and overhead piping. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
      a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
      b. Include dimensions both horizontally and vertically to permanent points of reference accurate within 6 inches. Include descriptors such as "below slab", "above ceiling", etc.
      c. Record data daily or as soon as possible after obtaining it.
      d. Record and check the markup before enclosing concealed installations.
   2. Mark the Contract Drawings, Submittals and Shop Drawings completely and accurately. Utilize personnel proficient at recording graphic information in production of marked-up record prints.
   3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
   4. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
   1. Record Prints: Organize record prints and newly prepared Record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.

2. Identification: As follows:
   a. Project name.
   b. Date.
   c. Designation "PROJECT RECORD DRAWINGS."
   d. Name of Engineer.
   e. Name of Contractor.
3. Remove or obscure Engineer's seal from Record Drawings.

1.10 OPERATION AND MAINTENANCE MANUAL

A. Prior to completion of the project, compile a complete equipment, operation and maintenance manual for all equipment supplied under Division 23.

B. Schedule:
   1. Submit a preliminary copy of the manual not less than 30 days prior to substantial completion for review and comment.
   2. Submit the final version the manual not more than four weeks after substantial completion of the project.

C. Format: Submit manuals in both of the following formats:
   1. PDF electronic file. Assemble each manual into a composite electronically-indexed file. Submit on digital media acceptable to Engineer.
      a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically-linked operation and maintenance directory.
      b. Enable inserted reviewer comments on draft submittals.
      c. Provide one final copy to Engineer and two copies to Owner.
   2. Three paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Engineer will return three copies.

D. Provide operating and maintenance manuals for all systems, subsystems, and equipment that requires operation and regular maintenance, or has replaceable parts.

E. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, product data, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below. In addition to requirements in this Section, include operation and maintenance data required in individual Specification Sections.

F. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

G. Product Data: Include the following information:
   1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.

2. Approved submittals.
3. Include the following if not shown on approved submittals:
   a. Product name and model number. Use designations for products indicated on Contract Documents.
   b. Manufacturer's name.
   c. Equipment identification with serial number of each component.
   d. Equipment function.
   e. Operating characteristics.
   f. Limiting conditions.
   g. Performance curves.
   h. Engineering data and tests.

H. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures. Including precautions against improper use.
10. Operating logs.

I. Wiring Diagrams: Diagram of factory installed wiring including any options as well as any field modifications.

J. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

K. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification. Include valve locations and designations.

L. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins.
2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

M. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.

4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

N. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

O. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

P. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

Q. Licenses: Include copies of any licenses with requirements including inspection and renewal dates.

R. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

S. Test and Balance Report: Include a final, approved copy of the Test and Balance Report.

1.11 WORK AND MATERIALS

A. Unless otherwise specified, all materials must be new and of the quality specified. The workmanship shall be of a quality that is acceptable to the Architect, Engineer, and Owner, and is equal to the standards of the trades. Contractor must staff the project with sufficient skilled workmen, including a fully qualified construction superintendent, to complete the work in the time allotted. The superintendent must be qualified to supervise all of the work in his work category.

B. Uniformity: Unless otherwise specified, provide all equipment and products of same type or classification by the same manufacturer.

1.12 APPROVALS OF MATERIALS AND EQUIPMENT

A. Refer to Division 01 for description of material and equipment for prior approvals and substitutions.

1.13 COOPERATIVE WORK

A. Correct without charge any work requiring alteration due to lack of proper supervision or failure to make proper provision in time. Correct without charge any damage to adjacent work caused by the alteration. See Division 01 for additional requirements.

B. Cooperative Work Includes:
1. General supervision and responsibility for proper location, rough-in and size of work related to Division 23 but provided under other divisions of these specifications.
2. Installation of sleeves, inserts and anchors bolts for work under sections in Division 23.

3. Sealing of penetrations through fire and smoke barriers caused by work installed as part of Division 23.

1.14 CONSTRUCTION FACILITIES

A. General: Under this division of the specifications, execute all work in a manner to provide safe and lawful ingress and egress to the Owner's establishment and such facilities shall be kept clear of materials or equipment. Refer to Division 01 for additional requirements.

B. Furnish and maintain from the beginning to the completion of all work all lawful and necessary guards, railings, fences, canopies, lights, and warning signs. Take all necessary precautions required by city and state laws to avoid injury or damage to any and all persons and property.

1.15 GUARANTEE

A. Guarantee all material, equipment, installation and workmanship for all sections under Division 23 in writing to be free from defects of material and workmanship for one year from date of final acceptance as outlined in Division 01. Equipment warranties shall be a minimum of one year from date of substantial completion or as specified elsewhere. Replace without charge any material or equipment proving defective during this period. The guarantee shall include performance of the equipment under all conditions of load, installing any additional items of control and/or protective devices as required and the replacing of any refrigerant lost.

1.16 MECHANICAL WIRING

A. Provide all temperature control wiring, interlock wiring, and equipment control wiring for the equipment that is to be provided under Division 23 unless wiring is specifically shown on electrical drawings.

B. The following schedule is intended to summarize the division of work material responsibilities between the Mechanical Contractor, Controls Contractor and the Electrical Contractor.

Item	Furn. By	Set By	Power Wiring	Control Wiring
Equipment Motors	MC	MC	EC	--
Motor Control Center	EC	EC	EC	CC
Motor Starters, Controllers, Contactors and Overload Heaters	MC*	EC**	EC	CC
Fused and Non-Fused Disconnect Switches	EC	EC	EC	--
Manual Operating Switches, Multispeed Switches, Pushbutton Stations and Pilot Lights	CC	CC	CC	CC
Control Relays and Transformers	CC	CC	CC	CC
Line Voltage Thermostats and Time Switches***	MC	MC	EC	EC
Low Voltage Thermostats	MC	MC	-	MC

Item	Furn. By	Set By	Power Wiring	Control Wiring
Temperature Control Panels	MC	MC	EC	CC
Smoke Detectors (Duct Mounted)	EC	MC	EC	MC or CC
Motor and Solenoid Valves, Damper Motors, PE and EP Switches	CC	MC	CC	CC
Water Treatment Equipment	MC	MC	EC	CC

MC = Mechanical Contractor
CC = Controls Contractor
EC = Electrical Contractor

*Except where such devices are located in MCC's.

**Unless required by these specifications to be provided as part of a factory furnished assembly (i.e. fan coils, air handlers, chillers, etc.).

***Motor-drive units which are controlled from line voltage automatic controls such as line voltage thermostats, float switches or time switches which conduct full load current of the motor shall be wired for both power and control circuit under the electrical contract.

PART 2 - PRODUCTS

2.1 MACHINERY DRIVES

A. Unless otherwise specified in Division 23 equipment sections, use V-belts designed for 150% of capacity for all belt drives. For multiple belt drives, use matched sets, so marked at the factory.

B. On drives with not more than two belts, provide adjustable pitch motor sheaves with the midpoint of the adjustment range equal to that required to achieve the specified fan capacity.

C. On motors with drives with more than two belts, furnish non-adjustable sheaves, providing the specified fan capacity.

2.2 MACHINERY ACCESSORIES

A. Guards: Provide totally-enclosed OSHA type belt guards for all rotating equipment. Design guards to be readily removable for access to belt drives.

2.3 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
   1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
   2. Design Mix: 5000-psi, 28-day compressive strength.

B. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SUBMITTALS

A. Prepare submittals as directed for review by the Contractor, Owner, Architect, and Engineer.

B. Submit one copy of PDF submittals via email, project website or other electronic media.

3.2 REFRIGERANT HANDLING AND DOCUMENTATION

A. Refrigerant Handling: Handle, contain and dispose of refrigerant in compliance with local, federal, and EPA regulations and requirements.

B. Documentation: Maintain documentation for all refrigerant brought onto or removed from project location in compliance with local, federal, and EPA regulations and requirements. Submit documentation to Owner and Architect.

3.3 RECORD DRAWINGS

A. Recording: Post changes and modifications to project record documents as they occur; do not wait until the end of Project.

B. Maintenance of Record Documents and Samples: Store record documents in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Engineer's reference during normal working hours.

3.4 OPERATION AND MAINTENANCE MANUALS

A. Prepare Operation and Maintenance Manuals as directed for review by the Contractor, Owner, Architect, and Engineer.

B. Make corrections and resubmit as required.

3.5 VERIFICATION OF DIMENSIONS

A. Scaled and figured dimensions are approximate only. Before proceeding with work, carefully check and verify dimensions at site, and be responsible for properly fitting equipment and materials together and to the structure in spaces provided.

B. Drawings are diagrammatic and many offsets, bends, special fittings and exact locations are not indicated. Carefully study drawings and premises in order to determine best methods, exact locations, routes, building obstructions, and install apparatus and equipment in available locations. Install apparatus and equipment in manner and in locations to avoid obstructions, preserve headroom, and keep openings and passageways clear.

3.6 CUTTING AND PATCHING

A. Cut work and patch per Division 01 as necessary to properly install the new work. As the work progresses, coordinate necessary openings, holes, chases, etc., in their correct location. If the required openings, holes and chases are not in their correct locations, make the necessary corrections at no cost to the Owner. Avoid excessive cutting and do not cut structural members without the consent of the Architect. Include as a part of the work all structural framing required by penetrations through the roof and necessary steel to support ducts and pipes between structural steel unless shown on the structural drawings.

3.7 CLOSING-IN OF UNFINISHED WORK

A. Cover no work until inspected, tested and approved. Where work is covered before inspection and test, uncover it, and when inspected, tested and approved, restore all work to original proper condition.

3.8 EXCAVATION AND BACKFILL

A. Perform all necessary excavation, shoring and backfilling required for the proper laying of all pipes, ducts, and conduits inside the building and premises, and outside as may be necessary. Remove all excess excavated materials from the site or dispose of on site as directed by General Contractor.

B. Excavate all trenches open cut, keep trench banks as nearly vertical as practicable, and sheet and brace trenches where required for stability and safety. Excavate trenches true to line and make bottoms not less than 18" wide but no wider than necessary to provide ample work room. Grade trench bottoms accurately to provide uniform bearing and support for each section of pipe on undisturbed soil along its entire length. Dig "bell" holes after the trench bottom has been graded. Machine grade only to the top line of the pipes, doing the balance by hand. Do not cut any trench near or under footings without first consulting the Architect. Comply with OSHA requirements.

C. Provide not less than 4 inches of granular material as pipe bedding prior to laying pipe in trench to continuously support pipe and maintain required slope. Granular material shall be pea gravel or sand per MAG Standards.

D. Provide backfilling and compaction in accordance with provisions of these specifications and under the direction of the Architect to the required density.

E. Provide not less than 4 inches of granular material, same as piping bedding, all around pipe. Make the first 2 feet of fill in 6 inch layers, each thoroughly compacted as directed, and free from rocks, large clods of earth, leaves, branches, and debris. Compact the rest of the backfill as directed, using in the backfill no rocks larger than 4 inches in diameter, and using no rock in the top 12 inches.

3.9 ACCESSIBILITY

A. Install valves, dampers, thermometers, gauges, traps, cleanouts, control devices or other specialties requiring reading, adjustment, inspection, repairs, removal or replacement conveniently and accessibly throughout the finished building. Where any of these devices are shown on the contract drawings to be installed above any inaccessible ceiling or behind any inaccessible wall, the Mechanical Contractor shall furnish access doors or panels as required.

B. All access doors or panels in walls and ceilings required for access to control devices, traps, valves and similar devices are to be furnished and installed as part of the work under this section. Provide type as specified under Division 08.

C. Refer to architectural drawings for type of wall and ceiling in each area and for rated construction.

D. Coordinate work of various sections to locate valves, traps, and dampers with others to avoid unnecessary duplication of access doors.

E. The Contractor, along with the Owner's representative, shall complete the Mechanical Accessibility/Clearance Checklist at the end of this section for all mechanical equipment. The chart shall be submitted to the Architect for approval prior to substantial completion. All conflicts shall be resolved to the Architect's and Owner's satisfaction prior to submission.

3.10 ROOF FLASHINGS

A. Flash and counterflash all piping, conduits and ductwork penetrating roofing membrane with flashing per roofing manufacturer's recommendations. Refer to architectural drawings for detailing of duct and pipe penetrations through roof.

3.11 PRODUCT AND EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. All equipment, valves, sensors, dampers, detectors, etc., shall be installed in strict conformance with the manufacturer's recommendations and all codes.

B. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.

C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

D. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

E. Install equipment to allow right-of-way for piping installed at required slope.

F. Do not install any equipment in an application not recommended by the manufacturer.

3.12 EQUIPMENT ROUGH-IN

A. Rough in all equipment and fixtures as designated on the drawings and in the specifications. The drawings indicate only the approximate location of rough-ins. The exact rough-in locations must be determined from large-scale certified drawings. The Contractor shall obtain all certified rough-in information before progressing with any work for rough-in final connections.

B. Be responsible for providing all outlets and services of proper size at the required locations.

C. Minor changes in the contract drawings shall be anticipated and provided for under this contract.

1. Rough-in only (unless otherwise designated on the drawings) shall include providing all services as indicated and required, including all ductwork, piping and valves. Valve and cap all piping stub-outs. Cap all ductwork stub-outs in a manner suitable for future extension.

3.13 OWNER-FURNISHED AND OTHER EQUIPMENT

A. Rough-in only for all Owner-furnished equipment see Division 01 and all equipment furnished under other sections of the specifications, except as otherwise specified and/or noted on the drawings.

B. Provide all services designated, valve and cap all piping, cap all ductwork and leave in a clean and orderly manner.

3.14 EQUIPMENT FINAL CONNECTIONS

A. Provide all piping and duct final connections for all equipment under Division 23 and as indicated on the drawings.

3.15 MACHINERY DRIVES

A. After tests have been performed on the air conditioning and air handling systems, make without cost, not more than one change in the size of non-adjustable sheaves to obtain the required air quantities.

3.16 CLEANUP

A. In addition to cleanup specified under Division 01, thoroughly clean all parts of the equipment. Where exposed parts are to be painted, thoroughly clean off any splattered construction materials and remove all oil and grease spots. Wipe the surface carefully and scrape out all cracks and corners.

B. Thoroughly flush and clean out all water circulating systems. Remove, clean and replace all strainer elements.

C. During the progress of the work, keep the premises clean and free of debris.

3.17 PAINTING

A. Except as otherwise specified or indicated in the architectural drawings and/or specifications, paint all exposed unfinished metal with one coat of rust-inhibiting primer. Galvanized ductwork and factory painted equipment shall be considered as having primed surface.

B. Damage and Touch-Up: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

C. Finished painting is specified under Division 09.

3.18 FIRESTOPPING

A. Coordinate with the firestopping installer for sealing of all penetrations of fire and smoke barriers and other rated assemblies created during the installation of the Division 23 work.

3.19 OBJECTIONABLE NOISE AND VIBRATION

A. Construct and brace the metal partitions, ducts and sheet metal housings to prevent vibration or rattling when systems are in operation. Install connections to equipment so noise and vibration will not reach the conditioned area through ducts, piping, conduit, sheet metal work, or the building structure.

3.20 WELDING

A. Procedures:

1. All procedures and welders must be qualified in accordance with the requirements of Section IX, ASME Boiler and Pressure Vessel Code and ANSI code for power piping B31.1. Procedure qualification test records and acceptance shall be submitted with the welding procedure prior to the start of fabrication.
2. Architect's inspector or authorized representative will review performance qualification records of individual welders.

- END OF SECTION -

MECHANICAL ACCESSIBILITY / CLEARANCE CHECKLIST (See Paragraph 3.8.E)									
			Acceptable Access					Observer	
Bldg.	Location	Unit #	Yes	No	Conflict	Date	Action	Owner	Contractor

- SECTION 23 0501 -

DEMONSTRATION & TRAINING FOR HVAC SYSTEMS & COMPONENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for demonstration of proper operation of equipment and instructing Owner's personnel, including the following:
   1. Demonstration of operation of systems, subsystems, and equipment.
   2. Training in operation and maintenance of systems, subsystems, and equipment.

1.3 CLOSEOUT SUBMITTALS

A. At completion of training, submit complete training manual(s) for Owner's use.

1.4 QUALITY ASSURANCE

A. Instructor Qualifications: A factory-authorized service representative experienced in operation and maintenance procedures and training.

1.5 COORDINATION

A. Complete demonstrations prior to Substantial Completion.

B. Complete instruction prior to Final Completion.

C. Coordinate demonstration and instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.

D. Coordinate content of training modules with content of approved operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system. Include training for all HVAC systems and equipment such as heat pumps, air-conditioners, heating and ventilating units, evaporative coolers, make-up air units, chillers, cooling towers, pumps, fans, air handlers, etc. and as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
   a. System, subsystem, and equipment descriptions.
   b. Operating standards.
   c. Regulatory requirements.
   d. Equipment function.
   e. Operating characteristics.
   f. Limiting conditions.
   g. Performance curves.
2. Documentation: Review the following items in detail:
   a. Emergency manuals.
   b. Operations and Maintenance manuals.
   c. Project record documents.
   d. Identification systems.
   e. Warranties and bonds.
   f. Maintenance service agreements and similar continuing commitments.
3. Emergencies: Include the following, as applicable:
   a. Instructions on meaning of warnings, trouble indications, and error messages.
   b. Instructions on stopping.
   c. Shutdown instructions for each type of emergency.
   d. Operating instructions for conditions outside of normal operating limits.
   e. Sequences for electric or electronic systems.
   f. Special operating instructions and procedures.
4. Operations: Include the following, as applicable:
   a. Startup procedures.
   b. Equipment or system break-in procedures.
   c. Routine and normal operating instructions.
   d. Regulation and control procedures.
   e. Control sequences.
   f. Safety procedures.
   g. Instructions on stopping.

h. Normal shutdown instructions.
i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:
   a. Alignments.
   b. Checking adjustments.
   c. Noise and vibration adjustments.
   d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
   a. Diagnostic instructions.
   b. Test and inspection procedures.
7. Maintenance: Include the following:
   a. Inspection procedures.
   b. Types of cleaning agents to be used and methods of cleaning.
   c. List of cleaning agents and methods of cleaning detrimental to product.
   d. Procedures for routine cleaning
   e. Procedures for preventive maintenance.
   f. Procedures for routine maintenance.
   g. Instruction on use of special tools.
8. Repairs: Include the following:
   a. Diagnosis instructions.
   b. Repair instructions.
   c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   d. Instructions for identifying parts and components.
   e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

A. Inspect and test each system, subsystem and piece of equipment prior to demonstration. Confirm proper operation prior to scheduling demonstrations.
   1. Replace defective work or material.
   2. Repeat inspection and testing until defects are eliminated.

B. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements for "Operations and Maintenance Data."

3.2 DEMONSTRATION

A. Inspect and operate satisfactorily, in presence of Engineer and Owner, each system and item of equipment, including accessories.

3.3 INSTRUCTION

A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
   1. Owner will furnish Contractor with names and positions of participants.

B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
   1. Schedule training with Owner with at least seven days' advance notice.

C. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of an oral or a demonstration performance-based test.

- END OF SECTION -

- SECTION 23 0513 -

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Basic Motor Requirements
   2. Polyphase Motors
   3. Single Phase Motors

B. Related Sections:
   1. Division 23 Sections for application of motors and reference to specific motor requirements for motor-driven equipment.

1.3 SUBMITTALS

A. Submit “Letter of Conformance” in accordance with Section 01 33 00 (01330) indicating specified items selected for use in Project with the following supporting data:
   1. Product Data: Show nameplate data and ratings; characteristics; mounting arrangements; size and location of winding termination lugs, conduit entry, and grounding lug; and coatings.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Listing and Labeling: Provide motors specified in this Section that are listed and labeled.
   1. Terms "Listed and Labeled": As defined in the National Electrical Code, Article 100.

PART 2 - PRODUCTS

2.1 BASIC MOTOR REQUIREMENTS

A. Basic requirements apply to mechanical equipment motors, unless otherwise indicated.

B. Motors 1/2 HP and Larger: Polyphase.

C. Motors Smaller than 1/2 HP: Single phase.

D. Frequency Rating: 60 Hz.

E. Voltage Rating: Determined by voltage of circuit to which motor is connected.

F. Service Factor: According to NEMA MG 1, general purpose continuous duty, design type "B."

G. Capacity and Torque Characteristics: Rated for continuous duty and sufficient to start, accelerate, and operate connected loads at designated speeds, in indicated environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

H. Enclosure: Open drip-proof, unless otherwise indicated.

I. Efficiency: Motors shall have a higher efficiency rating than industry standard average motor as delineated in IEEE Standard 112, Test Method 13.

2.2 POLYPHASE MOTORS

A. Description: NEMA MG 1, medium induction motor.
   1. Design Characteristics: NEMA MG 1, Design B, unless otherwise indicated.
   2. Energy-Efficient Design: Where indicated.
   3. Stator: Copper windings, unless otherwise indicated. Multi-speed motors have separate winding for each speed.
   4. Rotor: Squirrel cage, unless otherwise indicated.
   5. Bearings: Double-shielded, pre-lubricated ball bearings suitable for radial and thrust loading.
   6. Temperature Rise: Match insulation rating, unless otherwise indicated.
   7. Insulation: Class F, unless otherwise indicated.

B. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for indicated controller, with required motor leads brought to motor terminal box to suit control method.

C. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
   1. Critical vibration frequencies are not within operating range of controller output.
   2. Temperature Rise: Match rating for Class B insulation.
   3. Insulation: Class H

4. Thermal Protection: Where indicated, conform to NEMA MG 1 requirements for thermally protected motors.

D. Source Quality Control: Perform the following routine tests according to NEMA MG 1:
1. Measurement of winding resistance.
2. No-load readings of current and speed at rated voltage and frequency.
3. Locked rotor current at rated frequency.
4. High-potential test.
5. Alignment

2.3 SINGLE-PHASE MOTORS

A. Type: As indicated or selected by manufacturer from one of the following, to suit starting torque and other requirements of specific motor application.
1. Permanent-split capacitor.
2. Split-phase start, capacitor run.
3. Capacitor start, capacitor run.

B. Shaded-Pole Motors: Do not use, unless motors are smaller than 1/20 hp.

C. Thermal Protection: Where indicated or required, internal protection automatically opens power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal protection device automatically resets when motor temperature returns to normal range, unless otherwise indicated.

D. Bearings: Ball-bearing type for belt-connected motors and other motors with high radial forces on motor shaft. Sealed, pre-lubricated sleeve bearings for other single-phase motors.

PART 3 - EXECUTION

3.1 ADJUSTING

A. Use adjustable motor mounting bases for belt-driven motors.

B. Align pulleys and install belts.

C. Tension according to manufacturer's written instructions.

- END OF SECTION -

- SECTION 23 0514 -

VARIABLE FREQUENCY MOTOR DRIVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes separately enclosed, pre-assembled, combination VFDs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

1.3 DEFINITIONS

A. BAS: Building automation system.

B. CE: Conformite Europeene (European Compliance).

C. CPT: Control power transformer.

D. EMI: Electromagnetic interference.

E. IGBT: Insulated-gate bipolar transistor.

F. LAN: Local area network.

G. LED: Light-emitting diode.

H. MCP: Motor-circuit protector.

I. NC: Normally closed.

J. NO: Normally open.

K. OCPD: Overcurrent protective device.

L. PID: Control action, proportional plus integral plus derivative.

M. PWM: Pulse-width modulated.

N. RFI: Radio-frequency interference.

O. VFD: Variable-frequency motor drive.

1.4 SUBMITTALS

A. Product Data: For each type and rating of VFD indicated.

B. Shop Drawings: For each VFD indicated. Include dimensioned plans, elevations, and sections; and conduit entry locations and sizes, mounting arrangements, and details, including required clearances and service space around equipment.
   1. Show tabulations of installed devices, equipment features, and ratings.
   2. Schematic and Connection Wiring Diagrams: For power, signal, and control wiring.

C. Product certificates.

D. Source quality-control reports.

E. Field quality-control reports.

F. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace VFDs that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Two years from date of Substantial Completion or beneficial use.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Basis-of-Design Product: Subject to compliance with requirements, provide ABB ACH drive.

B. General Requirements for VFDs: Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508C.

C. Application: variable torque.

D. VFD Description: Variable-frequency power converter (rectifier, dc bus, and IGBT, PWM inverter) factory packaged in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide

self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.

1. Units suitable for operation of NEMA MG 1, Design A and Design B motors as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."
2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.

E. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

F. Output Rating: Three-phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.

G. Unit Operating Requirements:
1. Input AC Voltage Tolerance: Plus 20 and minus 20 percent of VFD input voltage rating.
2. Input AC Voltage Unbalance: Not exceeding 5 percent.
3. Input Frequency Tolerance: Plus or minus 3 percent of VFD frequency rating.
4. Minimum Efficiency: 97 percent at 60 Hz, full load.
5. Minimum Displacement Primary-Side Power Factor: 98 percent under any load or speed condition.
6. Minimum Short-Circuit Current (Withstand) Rating: 100 kA.
7. Ambient Temperature Rating: Not less than 0 deg F and not exceeding 122 deg F.
8. Ambient Storage Temperature Rating: Not less than minus 4 deg F and not exceeding 140 deg F
9. Humidity Rating: Less than 95 percent (noncondensing).
10. Altitude Rating: Not exceeding 3300 feet.
11. Vibration Withstand: Comply with IEC 60068-2-6.
12. Overload Capability: 1.1 times the base load current for 60 seconds; minimum of 1.3 times the base load current for two seconds.
13. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
14. Output Carrier Frequency: Selectable; 0.5 to 15 kHz.
15. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.

H. Inverter Logic: Microprocessor based, 16 or 32 bit, isolated from all power circuits.

I. Isolated Control Interface: Allows VFDs to follow remote-control electrical signal over a minimum 40:1 speed range.

J. Internal Adjustability Capabilities:
1. Minimum Speed: 5 to 25 percent of maximum rpm.
2. Maximum Speed: 80 to 100 percent of maximum rpm.
3. Acceleration: 0.1 to 999.9 seconds.
4. Deceleration: 0.1 to 999.9 seconds.
5. Current Limit: 30 to minimum of 150 percent of maximum rating.

K. Self-Protection and Reliability Features:
   1. Input transient protection by means of surge suppressors to provide three-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.
   2. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
   3. Under- and overvoltage trips.
   4. Inverter overcurrent trips.
   5. VFD and Motor Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFDs and motor thermal characteristics, and for providing VFD overtemperature and motor overload alarm and trip; settings selectable via the keypad; NRTL approved.
   6. Critical frequency rejection, with three selectable, adjustable deadbands.
   7. Instantaneous line-to-line and line-to-ground overcurrent trips.
   8. Loss-of-phase protection.
   9. Reverse-phase protection.
   10. Short-circuit protection.
   11. Motor overtemperature fault.

L. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.

M. Bidirectional Autospeed Search: Capable of starting VFD into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.

N. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

O. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

P. Integral Input Disconnecting Means and OCPD: NEMA AB 1, thermal-magnetic circuit breaker with pad-lockable, door-mounted handle mechanism.
   1. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFD input current rating, whichever is larger.

2.2 CONTROLS AND INDICATION

A. Status Lights: Door-mounted LED indicator displaying unit status.
   1. Power on.

B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.
   1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.

2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.
    a. Control Authority: Supports at least four conditions: Off, local manual control at VFD, local automatic control at VFD, and automatic control through a remote source.

C. Historical Logging Information and Displays:
1. Running log of total power versus time.
2. Total run time.
3. Fault log, maintaining last three faults with time and date stamp for each.

D. Indicating Devices: Digital display mounted flush in VFD door and connected to display VFD parameters including, but not limited to:
1. Output frequency (Hz).
2. Motor speed (rpm).
3. Motor status (running, stop, fault).
4. Motor current (amperes).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (V dc).
9. Set point frequency (Hz).
10. Motor output voltage (V ac).

E. Control Signal Interfaces:
1. Electric Input Signal Interface:
    a. A minimum of two programmable analog inputs: Selectable 0- to 10-V dc or 4- to 20-mA dc.
    b. A minimum of six multifunction programmable digital inputs.
2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BAS or other control systems:
    a. 0- to 10-V dc.
    b. 4- to 20-mA dc.
    c. Potentiometer using up/down digital inputs.
    d. Fixed frequencies using digital inputs.
3. Output Signal Interface: A minimum of two programmable analog output signals (4- to 20-mA dc), which can be configured for any of the following:
    a. Output frequency (Hz).
    b. Output current (load).
    c. DC-link voltage (V dc).
    d. Motor torque (percent).
    e. Motor speed (rpm).
    f. Set point frequency (Hz).

4. Remote Indication Interface: A minimum of three programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
   a. Motor running.
   b. Set point speed reached.
   c. Fault and warning indication (overtemperature or overcurrent).
   d. PID high- or low-speed limits reached.

F. PID Control Interface: Provides closed-loop set point, differential feedback control in response to dual feedback signals. Allows for closed-loop control of fans and pumps for pressure, flow, or temperature regulation.
   1. Number of Loops: Two.

G. BAS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display VFD status and alarms and energy usage. Allows VFD to be used with an external system within a multidrop LAN configuration; settings retained within VFD's nonvolatile memory.
   1. Network Communications Ports: RS-422/485.
   2. Embedded BAS Protocols for Network Communications: BACnet, Johnson Metasys N2, Modbus/Memobus, Siemens Building Technologies FLN; protocols accessible via the communications ports. Provide optional, add-on, protocol if required for BAS interface.

2.3 LINE CONDITIONING AND FILTERING

A. Input Line Conditioning: Internal 5% impedance reactors. Reactors shall be dual positive and negative DC bus reactors, or AC line reactors.

B. EMI/RFI Filtering: CE marked; certify compliance with IEC 61800-3 for Category C2.

2.4 BYPASS SYSTEMS

A. Bypass Operation: Safely transfers motor between power converter output and bypass circuit, manually, automatically, or both. Selector switches set modes and indicator lights indicate mode selected. Unit is capable of stable operation (starting, stopping, and running) with motor completely disconnected from power converter. Bypass shall be able to operate with power converter removed from enclosure for repair or replacement.

B. Bypass Mode: Field-selectable automatic or manual, allows local and remote transfer between power converter and bypass contactor and retransfer, either via manual operator interface or automatic control system feedback.

C. Bypass Communications: Serial communications to allow BAS to monitor and control bypass including start/stop functions. Built-in communication protocol shall include ModBus, Johnson Controls N2, Siemens Building Technologies FLN (P1), and BACnet MS/TP. Lon Works shall be available. Select communication protocol to match BAS system native communications.

D. Bypass Controller: Two-contactor-style bypass allows motor operation via the power converter or the bypass controller.
   1. Bypass Contactor: Load-break, IEC-rated contactor.
   2. Output Isolating Contactor: Non-load-break, IEC-rated contactor.

E. Bypass Contactor Configuration: Full-voltage (across-the-line) type.
   1. NORMAL/BYPASS selector switch.
   2. HAND/OFF/AUTO selector switch.
   3. NORMAL/TEST Selector Switch: Allows testing and adjusting of VFD while the motor is running in the bypass mode.
   4. Contactor Coils: Pressure-encapsulated type.
      a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
      b. Power Contacts: Totally enclosed, double break, and silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
   5. Control Circuits: 24 Vdc; obtained from integral CPT, with primary and secondary fuses, with control power source of sufficient capacity to operate all integral devices and remotely located pilot, indicating, and control devices.
      a. CPT Spare Capacity: 250 mA.
   6. Overload Relays: NEMA ICS 2.

2.5 OPTIONAL FEATURES

A. Damper control circuit with end of travel feedback capability where indicated on drawings or needed for proper system operation.

B. Firefighter's Override (Smoke Purge) Input: On a remote contact closure from the firefighter's control station or smoke-control fan controller, this password-protected input:
   1. Overrides all other local and external inputs (analog/digital, serial communication, and all keypad commands).
   2. Forces VFD without bypass to operate motor, without any other run or speed command, at a field-adjustable, preset speed.
   3. Forces VFD with bypass to transfer to Bypass Mode and operate motor at full speed.
   4. Causes display of Override Mode on the VFD display.
   5. Reset VFD to normal operation on removal of override signal automatically.

C. Communication Port: RS-232 port, USB 2.0 port, or equivalent connection capable of connecting a printer and a notebook computer.

D. Motor Protecting Filter: Dampened low-pass filter designed for long motor lead applications. Filter shall consist of a NEMA 1, enameled steel housing with resistors, capacitors, and inductors selected to control harmonic distortion caused by IGBT drives connected to motors with leads exceeding 100 feet. Provide where indicated on drawings.
   1. Resistors: Wire-wound cement construction with thermal insulating terminations, derated to operate at twice the calculated worst case requirements for watts loss.
   2. Capacitors: Constructed of metallized polypropylene film material, Wye-connected with an ungrounded neutral, rated for a minimum of 700 VAC.
   3. Inductors: Three phase designed for harmonic filtering service with copper windings on magnetic steel core of laminated electrical steel grade M50 or better. Support brackets shall be ASTM structural steel or aluminum. Coils shall be wedged in place and core shall be locked in place using vertical ties or rods. Windings shall be copper wire or foil

and terminated in copper allow ring lugs, UL recognized terminal blocks, or solid copper bus. Inductor shall be impregnated with 100 percent solid epoxy resin.

2.6 ENCLOSURES

A. VFD Enclosures: NEMA 250, to comply with environmental conditions at installed location.
   1. Dry and Clean Indoor Locations: Type 1.
   2. Outdoor Locations: Type 3R.
   3. Kitchens or Wash-Down Areas: Type 4X, stainless steel.
   4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

B. Plenum Rating: UL 1995; NRTL certification label on enclosure, clearly identifying VFD as "Plenum Rated."

2.7 ACCESSORIES

A. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.
   1. Current Transformers: Continuous current rating, basic impulse insulating level (BIL) rating, burden, and accuracy class suitable for connected circuitry. Comply with IEEE C57.13.

B. Cooling Fan and Exhaust System: For NEMA 250, Type 1 or Type 12; UL 508 component recognized: Supply fan, with composite intake and exhaust grills; 120 -V ac; obtained from integral CPT.

C. Breather and drain assemblies, to maintain interior pressure and release condensation in NEMA 250, Type 4X and Type 12 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

D. Space heaters, with NC auxiliary contacts, to mitigate condensation in NEMA 250, Type 3R, Type 4X and Type 12 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

2.8 SOURCE QUALITY CONTROL

A. VFDs will be considered defective if they do not pass tests and inspections.

B. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Wall-Mounting Controllers: Install VFDs on walls with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished floor unless otherwise

indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Install fuses in control circuits if not factory installed. Comply with requirements in Division 26 Section "Fuses."

D. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.

E. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

F. Comply with NECA 1.

3.2 IDENTIFICATION

A. Identify VFDs, components, and control wiring. Comply with requirements for identification specified in Division 23 Section "Identification for HVAC Piping and Equipment."
1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each VFD with engraved nameplate.
3. Label each enclosure-mounted control and pilot device.

3.3 CONTROL WIRING INSTALLATION

A. Install wiring between VFDs and remote devices and facility's central-control system. Comply with requirements in Division 23 Section "Electrical and Control Wiring for Mechanical Systems."

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switches and other automatic control devices where applicable.
1. Connect selector switches to bypass only those manual- and automatic control devices that have no safety functions when switches are in manual-control position.
2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency or manufacturer’s representative to perform tests and inspections.

B. Perform tests and inspections.

C. Acceptance Testing Preparation:
   1. Test insulation resistance for each VFD element, bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

D. Tests and Inspections:
   1. Inspect VFD, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
   2. Test insulation resistance for each VFD element, component, connecting motor supply, feeder, and control circuits.
   3. Test continuity of each circuit.
   4. Verify that voltages at VFD locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Engineer before starting the motor(s).
   5. Test each motor for proper phase rotation.
   6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
   8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

E. VFDs will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports, including a certified report that identifies the VFD and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

G. Provide on-site harmonic distortion testing, if required by Owner or Engineer.

3.5 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to six times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Engineer before increasing settings.

D. Set field-adjustable circuit-breaker trip ranges as specified.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFDs. Provide minimum of four hours of on-site training at time of project closeout.

- END OF SECTION -

- SECTION 23 0515 -

ENCLOSED MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes the following enclosed controllers rated 600 V and less:
   1. Full-voltage manual.
   2. Full-voltage magnetic.
   3. Multispeed.

1.3 DEFINITIONS

A. CPT: Control power transformer.

B. MCCB: Molded-case circuit breaker.

C. MCP: Motor circuit protector.

D. N.C.: Normally closed.

E. N.O.: Normally open.

F. OCPD: Overcurrent protective device.

1.4 SUBMITTALS

A. Product Data: For each type of enclosed controller. Include dimensions, required clearances, and wiring diagrams for power, signal, and control wiring.

B. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 FULL-VOLTAGE CONTROLLERS

A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.

B. Motor-Starting Switches: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
      b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
      c. Rockwell Automation, Inc.; Allen-Bradley brand.
      d. Siemens Energy & Automation, Inc.
      e. Square D; a brand of Schneider Electric.
   2. Configuration: Nonreversing or two speed as required.
   3. Surface mounting.
   4. Pilot light.

C. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
      b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
      c. Rockwell Automation, Inc.; Allen-Bradley brand.
      d. Siemens Energy & Automation, Inc.
      e. Square D; a brand of Schneider Electric.
   2. Configuration: Nonreversing or two speed as required.
   3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.
   4. Surface mounting.
   5. Pilot light.

D. Integral Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
      b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
      c. Rockwell Automation, Inc.; Allen-Bradley brand.

d. Siemens Energy & Automation, Inc.
e. Square D; a brand of Schneider Electric.

2. Configuration: Nonreversing or two speed as required.
3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters and sensors in each phase, matched to nameplate full-load current of actual protected motor and having appropriate adjustment for duty cycle; external reset push button; bimetallic type.
4. Surface mounting.
5. Pilot light.

E. Definite Purpose Contactors: For remote control of single-phase motors.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Square D, Type DPA, Class 8910 or comparable product by one of the following:
a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
c. Rockwell Automation, Inc.; Allen-Bradley brand.
d. Siemens Energy & Automation, Inc.
e. Square D; a brand of Schneider Electric.
2. Configuration: Nonreversing, double break contacts.
3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.
4. Surface mounting.

F. Magnetic Controllers: Full voltage, across the line, electrically held, NEMA device.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Square D Class 8536 Type S or comparable product by one of the following:
a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
c. Rockwell Automation, Inc.; Allen-Bradley brand.
d. Siemens Energy & Automation, Inc.
e. Square D; a brand of Schneider Electric.
2. Configuration: Nonreversing.
3. Contactor Coils: Pressure-encapsulated type.
a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
4. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
5. Control Circuits: 24-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
6. Bimetallic Overload Relays:
a. Inverse-time-current characteristic.
b. Class 20 tripping characteristic.
c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.

7. Solid-State Overload Relay:
   a. Switch or dial selectable for motor running overload protection.
   b. Sensors in each phase.
   c. Class 20 or class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
8. External overload reset push button.

2.2 MULTISPEED MAGNETIC CONTROLLERS

A. General Requirements for Multispeed Magnetic Controllers: Comply with NEMA ICS 2, general purpose, Class A.

B. Multispeed Magnetic Controllers: Multispeed, full voltage, across the line, electrically held, NEMA device.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Square D Class 8810 Type S or comparable product by one of the following:
   a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
   c. Rockwell Automation, Inc.; Allen-Bradley brand.
   d. Siemens Energy & Automation, Inc.
   e. Square D; a brand of Schneider Electric.
2. Configuration: Nonreversing; consequent pole or two winding as required.
3. Contactor Coils: Pressure-encapsulated type.
   a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
4. Power Contacts: Totally enclosed, double break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
5. Control Circuits: 24-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate all integral devices and remotely located pilot, indicating, and control devices.
6. Accelerating timer relays shall ensure properly timed acceleration through speeds lower than that selected.
7. Bimetallic Overload Relays:
   a. Inverse-time-current characteristic.
   b. Class 20 tripping characteristic.
   c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
8. Solid-State Overload Relay:
   a. Switch or dial selectable for motor running overload protection.
   b. Sensors in each phase.
   c. Class 20 or class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
9. External overload reset push button.

2.3 ENCLOSURES

A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.
   1. Dry and Clean Indoor Locations: Type 1.
   2. Outdoor Locations: Type 3R.
   3. Kitchen Wash-Down Areas: Type 4X, stainless steel.
   4. Other Wet or Damp Indoor Locations: Type 4.
   5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

2.4 ACCESSORIES

A. Push Buttons, Pilot Lights, and Selector Switches: NEMA ICS 5; heavy-duty type; factory installed in controller enclosure cover unless otherwise indicated.

B. Control Relays: Auxiliary and adjustable time-delay relays.

C. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

PART 3 - EXECUTION

3.1 GENERAL

A. Controllers: Furnish controllers for all single-phase and polyphase motors provided as part of the Division 23 Work. Controllers shall be installed by Division 26 Contractor. Controllers are not required for the following:
   1. Motors controlled by a variable frequency drive.
   2. Motors that are provided with controllers as part of packaged equipment.
   3. Motors controlled through a motor control center. Motor control centers are specified in Division 26.

B. Accessories: Furnish controllers with the required accessories, auxiliary contacts, holding coils, etc. as required to achieve the sequence of controls, interlocking, etc. indicated on the drawings and as required for a fully functioning system.
   1. All definite purpose contactors and magnetic controllers shall be furnished with a hand-off-auto (HOA) switch.
   2. All single-phase controllers shall be provided with undervoltage and overvoltage relays.
   3. All polyphase controllers shall be provided with phase-failure, phase-reversal, and undervoltage and overvoltage relays.

3.2 APPLICATION

A. Manual Operation: Where only manual operation is indicated.

1. Fractional Horsepower Motors with Internal Overload Protection: Provide with motor-starting switches.
2. Fractional Horsepower Motors without Internal Overload Protection: Provide with fractional horsepower manual controllers.
3. Integral Horsepower Motors up to 10 Horsepower: Provide with integral horsepower manual controllers.

B. Automatic and/or Manual Operation: Where a motor is to be controlled manually or automatically by the building automation system, or other control scheme.
1. Fractional Horsepower Motors: Provide with definite purpose contactors or magnetic controllers.
2. Integral Horsepower Motors: Provide with magnetic controllers.
3. Multispeed Motors: Multispeed magnetic controller selected to match motor type.

3.3 INSTALLATION

A. Installation shall be by the Division 26 Contractor.

B. Installation of power wiring shall be by the Division 26 Contractor.

C. Install control wiring.

D. Install fuses in control circuits if not factory installed. Comply with requirements in Division 26.

E. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.

F. Comply with NECA 1.

3.4 IDENTIFICATION

A. Identification of controllers, line-voltage components, and power wiring shall be done by the Division 26 Contractor.

B. Identify low-voltage components and control wiring.

3.5 CONTROL WIRING INSTALLATION

A. Install wiring between enclosed controllers and remote devices and facility's building automation system. Comply with requirements in Division 23.

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switches and other automatic-control selection devices where applicable.
1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:
   1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each control circuit.

C. Tests and Inspections:
   1. Inspect controllers, control wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
   2. Test continuity of each control circuit.
   3. Test each motor for proper phase rotation.
   4. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   5. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
   6. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed controllers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports. Reports shall be on the Contractor's letterhead and shall include, at a minimum, the following information:
   1. Testing technician's name and signature.
   2. Data and time testing was performed.
   3. Ambient temperature and weather conditions.
   4. Manufacturer, model number, and other pertinent data of the test equipment.
   5. Statement of "As Left" condition.
   6. Pass/Fail statement relative to NETA Chapter 10 recommendations.
   7. Deficiencies detected.
   8. Remedial action taken.
   9. Observations after remedial action.
   10. Recommendations, if any.

F. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.7 ADJUSTING

A. Set field-adjustable switches and overload-relay pickup and trip ranges.

B. Adjust the settings of adjustable motor overloads to match the motor full-load amperes.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

- END OF SECTION -

- SECTION 23 0517 -

SLEEVES & SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Sleeves.
   2. Sleeve-seal systems.
   3. Grout.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

2.2 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Advance Products & Systems, Inc.
   2. CALPICO, Inc.
   3. Metraflex Company (The).
   4. GPT, an EnPro Industries Company.
   5. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
   1. Sealing Elements: EPDM-rubber or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   2. Pressure Plates: Stainless steel.
   3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch (25-mm) annular clear space between piping and concrete slabs and walls.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
   1. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level.
   2. Using grout, seal the space outside of sleeves in slabs and walls.

D. Install sleeves for pipes passing through interior partitions.
   1. Cut sleeves to length for mounting flush with both surfaces.
   2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
   3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07.

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior, above and below grade, concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:
   1. Exterior Concrete Walls above Grade:
      a. Piping Smaller Than NPS 4 (DN 100): Cast-iron wall sleeves, Galvanized-steel wall sleeves or Galvanized-steel-pipe sleeves.
      b. Piping NPS 4 (DN 100) and Larger: Cast-iron wall sleeves or Galvanized-steel-pipe sleeves.
   2. Exterior Concrete Walls below Grade:
      a. Piping Smaller Than NPS 4 (DN 100): Cast-iron wall sleeves with sleeve-seal system.
         1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
      b. Piping NPS 4 (DN 100) and Larger: Cast-iron wall sleeves with sleeve-seal system.
         1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
   3. Concrete Slabs-on-Grade: Cast-iron wall sleeves with sleeve-seal system.
         1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
   4. Concrete Slabs above Grade: Galvanized-steel-pipe sleeves.

5. Interior Partitions:
   a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves.
   b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-sheet sleeves.

- END OF SECTION -

- SECTION 23 0518 -

ESCUTCHEONS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Escutcheons.
   2. Floor plates.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

D. Split-casting, Cast-brass Type: With concealed hinge and set screw and polished chrome-plated finish.

2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

B. Split-Casting, Floor Plate Type: Cast-brass with concealed hinge and set screw.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
   1. Escutcheons for New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      b. Insulated Piping: One-piece, stamped-steel type.
      c. Bare Piping: One-piece, cast-brass type.
   2. Escutcheons for existing piping shall be split-casting, cast-brass type.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
   1. New Piping: One-piece, floor-late type,
   2. Existing Piping: Split-casting, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

- END OF SECTION -

- SECTION 23 0519 -

METERS & GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Thermometers.
   2. Thermowells.
   3. Dial-type pressure gages.
   4. Gage attachments.
   5. Turbine flowmeters.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Wiring Diagrams: For power, signal, and control wiring.

C. Product certificates.

D. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 THERMOMETERS

A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Miljoco Corporation.
      b. Palmer Wahl Instrumentation Group.
      c. Trerice, H.O. Co.

d. Weiss Instruments, Inc.
e. Winters Instruments – U.S.

2. Standard: ASME B40.200.
3. Case: Cast aluminum, 9-inch nominal size unless otherwise indicated.
4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Window: Glass.
8. Stem: Aluminum and of length to suit installation.
   a. Design for Air-Duct Installation: With ventilated shroud.
   b. Design for Thermowell Installation: Bare stem.
9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

B. Solar Powered Digital Thermometers
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Miljoco Corporation.
   b. Trerice, H.O. Co.
   c. Winters Instruments.
2. Case: High impact ABS plastic.
3. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.
4. Stem: Metal for thermowell installation and of length to suit installation, or sampling tube with flange for air duct application.
5. Accuracy: Maximum of 1 degree or 1% of reading.
6. Range: Negative 50 degrees to positive 300 degrees F.
7. Display: LCD with 1/2 inch tall black characters on a gray background, updated at 10 second intervals.
8. Illuminance: Front mounted or bi-directional solar collectors. Maximum required ambient lighting: 35 Lux.

2.2 DUCT-THERMOMETER MOUNTING BRACKETS

A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

2.3 THERMOWELLS

A. Thermowells:
1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.

3. Material for Use with Copper Tubing: Brass.
4. Material for Use with Steel Piping: Stainless Steel.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

2.4 PRESSURE GAGES

A. Metal-Case, Dial-Type Pressure Gages:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Marsh Bellofram.
   b. Miljoco Corporation.
   c. Palmer Wahl Instrumentation Group.
   d. Trerice, H. O. Co.
   e. Weiss Instruments, Inc.
   f. Weksler.
2. Standard: ASME B40.100.
3. Case: Cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi and kPa.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Metal.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.5 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and surge-dampening device. Include extension for use on insulated piping.

B. Valves: Bronze or stainless steel ball, with NPS 1/4 or NPS 1/2 ASME B1.20.1 pipe threads.

2.6 FLOWMETERS

A. Turbine Flowmeters:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide ONICON Incorporated, model F-1210 or comparable product by one of the following:
      a. Data Industrial Corp.
      b. Hoffer Flow Controls, Inc.
      c. ISTEC Corporation.
   2. Description: Flowmeter with sensor and indicator.
   3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
   4. Sensor: Dual impeller turbine; for inserting into pipe fitting or for installing in piping and measuring flow directly in gallons per minute.
      a. Design: Device or pipe fitting with dual inline turbines and integral direct-reading scale for water.
      b. Construction: Bronze or stainless-steel body, with plastic turbine or impeller.
      c. Minimum Pressure Rating: 150 psig.
      d. Minimum Temperature Rating: 180 deg F.
   5. Indicator: Integral part of sensor or a separate meter.
   6. Accuracy: Plus or minus 1-1/2 percent.
   7. Display: Shows rate of flow.
   8. Operating Instructions: Include complete instructions with each flowmeter.
   9. Building Automation System Interface: Selectable 4-20mA or 0-10 VDC output.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.

G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

H. Install valve and snubber in piping for each pressure gage for fluids (except steam).

I. Assemble and install connections, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.

J. Install flowmeter elements in accessible positions in piping systems.

K. Install flowmeter elements, with at least minimum straight lengths of pipe, upstream and downstream from element according to manufacturer's written instructions.

L. Install permanent indicators on walls or brackets in accessible and readable positions.

M. Install thermometers and pressure gages where indicated on drawings and in the following locations:
   1. Inlet and outlet of each hydronic boiler.
   2. Two inlets and two outlets of each chiller.
   3. Inlet and outlet of each hydronic coil in air-handling units.
   4. Two inlets and two outlets of each hydronic heat exchanger.
   5. Inlet and outlet of each thermal-storage tank.

N. Install pressure gages where indicated on drawings and in the following locations:
   1. Discharge of each pressure-reducing valve.
   2. Each hydronic pump. Provide one gage per pump with tubing and valves to allow measurement at strainer inlet, pump inlet and pump discharge.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

B. Connect flowmeter-system elements or transmitters to meters.

C. Connect thermal-energy elements or transmitters to meters.

3.3 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.

B. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Chilled-Water Piping: 0 to 100 deg F.

B. Scale Range for Condenser-Water Piping: 0 to 250 deg F.

C. Scale Range for Heating, Hot-Water Piping: 20 to 240 deg F.

3.5 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Chilled-Water Piping: 0 to 100 psi.

B. Scale Range for Condenser-Water Piping: 0 to 100 psi.

C. Scale Range for Heating, Hot-Water Piping: 0 to 100 psi.

- END OF SECTION -

- SECTION 23 0520 -

ELECTRICAL & CONTROL WIRING FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section is to be used for all low- and line- voltage wiring for mechanical controls. All line-voltage work shall be performed by a licensed contractor qualified to perform the work and shall comply with the requirements contained in this section or in Division 26.

B. This Section does not apply to plenum rated cables used for electrically activated remote damper operators.

C. This Section includes the following:
1. Metal conduits, tubing, and fittings.
2. Nonmetallic conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Surface raceways.
5. Boxes, enclosures, and cabinets.
6. Low-voltage control cabling.
7. Conductors and cables rated 600 V and less.
8. Connectors, splices, and terminations rated 600 V and less.
9. Identification products.
10. Identification of power and control cables.
11. Identification for conductors.
12. Underground-line warning tape.

1.3 DEFINITIONS

A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated, include manufacturer's technical data, materials of construction and listings.

B. Field quality-control test reports.

C. Maintenance data.

1.5 QUALITY ASSURANCE

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame-Spread Index: 25 or less.
   2. Smoke-Developed Index: 50 or less.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

D. Comply with ANSI A13.1 for identification devices.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. GRC: Comply with ANSI C80.1 and UL 6.

C. IMC: Comply with ANSI C80.6 and UL 1242.

D. EMT: Comply with ANSI C80.3 and UL 797.
   1. Color: Factory applied color per schedule below.
      a. HVAC Control Wiring: White
      b. Power – Normal: Natural
      c. Power – Standby: Orange

E. FMC: Comply with UL 1; zinc-coated steel or aluminum.

F. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

G. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
   1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
   2. Fittings for EMT:
      a. Material: Steel.
      b. Type: Setscrew or compression.
   3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

H. Joint Compound for IMC or GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

C. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Description: Sheet metal, complying with UL 870 and NEMA 250; Type 1, Type 3R, Type 4 or Type 12, as required by location; and sized according to NFPA 70.
   1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

2.4 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Where installed in finished spaces, match color of adjacent surfaces.

2.5 BOXES, ENCLOSURES, AND CABINETS

A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

C. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

D. Device Box Dimensions: 4 inches square by 2-1/8 inches deep or 4 inches by 2-1/8 inches by 2-1/8 inches deep.

E. Gangable boxes are prohibited.

F. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250; Type 1, Type 3R, Type 4 or Type 12, as required by location; with continuous-hinge cover with flush latch unless otherwise indicated.
   1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
   2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

G. Cabinets:
   1. NEMA 250; Type 1, Type 3R or Type 12, as required by location; galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
   2. Hinged door in front cover with flush latch and concealed hinge.
   3. Key latch to match panelboards.
   4. Metal barriers to separate wiring of different systems and voltage.
   5. Accessory feet where required for freestanding equipment.

2.6 LOW-VOLTAGE CONTROL CABLE

A. Paired Cable: NFPA 70, Type CMG.
   1. One pair, twisted, No. 16 or 18 AWG, stranded (19x29) tinned-copper conductors.
   2. PVC insulation.
   3. Unshielded.
   4. PVC jacket.
   5. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
   1. One pair, twisted, No. 16 or 18 AWG, stranded (19x29) tinned-copper conductors.
   2. PVC insulation.
   3. Unshielded.
   4. PVC jacket.
   5. Flame Resistance: Comply with NFPA 262.

2.7 CONDUCTORS AND CABLES

A. Copper Conductors: Comply with NEMA WC 70.

B. Conductor Insulation: Comply with the following:
   1. NEMA WC 70 for Types THHN-THWN and XHHW.
   2. UL 83 for Types TW and TF.

2.8 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AFC Cable Systems, Inc.
   2. Hubbell Power Systems, Inc.
   3. O-Z/Gedney; EGS Electrical Group LLC.
   4. 3M; Electrical Products Division.
   5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.9 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

2.10 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.11 UNDERGROUND-LINE WARNING TAPE

A. Tape:
   1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and control lines.
   2. Printing on tape shall be permanent and shall not be damaged by burial operations.
   3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:
1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
3. Inscriptions for Orange-Colored Tapes: CONTROL CABLE.

C. Tag: Type ID:
1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Overall Thickness: 5 mils
3. Foil Core Thickness: 0.35 mil
4. Weight: 28 lb/1000 sq. ft.
5. 3-Inch Tensile According to ASTM D 882: 70 lbf and 4600 psi.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed Conduit: GRC or IMC.
2. Concealed Conduit, Aboveground: GRC, IMC or EMT.
3. Underground Conduit: RNC, Type EPC-40-PVC or Type EPC-80-PVC, direct buried or concrete encased.
4. Connection to Vibrating Equipment (Including Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated.
1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: GRC or IMC. Raceway locations include the following but not limited to:
   a. Loading dock.
   b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
   c. Gymnasiums.
4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: GRC or IMC.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.
   1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
   2. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
   3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Do not install aluminum conduit, boxes, or fittings in contact with concrete or earth.

F. Install surface raceways only in retrofit applications where indicated.

3.2 RACEWAY INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Comply with requirements in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment" for hangers and supports.

D. Arrange stub-ups so curved portions of bends are not visible above finished slab.

E. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

F. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

G. Support conduit within 12 inches of enclosures to which attached.

H. Raceways Embedded in Slabs:
   1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
   2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
   3. Arrange raceways to keep a minimum of 1 inch of concrete cover in all directions.
   4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

I. Stub-ups to Above Recessed Ceilings:
   1. Use EMT, IMC, or GRC for raceways.
   2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

K. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

L. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

M. Surface Raceways:
1. Install surface raceway with a minimum 2-inch radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

N. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces.

O. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

P. Expansion-Joint Fittings:
1. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
2. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

Q. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 48 inches of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for motors.
1. Use FMC in indoor, dry locations.
2. Use LFMC in all other locations.

R. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

S. Locate boxes so that cover or plate will not span different building finishes.

T. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

U. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:
   1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 for pipe less than 6 inches in nominal diameter.
   2. Install backfill as specified in Division 31.
   3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31.
   4. Install manufactured rigid steel conduit elbows for stub-ups at equipment and at building entrances through floor.
      a. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

3.4 CONDUCTOR MATERIAL APPLICATIONS

A. Control Circuit Sizing: Minimum sizes are listed below:
   1. Class 1 remote-control and signal circuits, No 14 AWG.
   2. Class 2 low-energy, remote-control, and signal circuits, No. 16 AWG.
   3. Class 3 low-energy, remote-control, alarm, and signal circuits, No 12 AWG.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

C. Branch Circuit Sizing: Size conductors for circuits with less than a 20 ampere connected load, maximum of 16 amperes actual load, as follows:
   1. For 120V circuits up to 65 feet in length from panel to center of load: Not smaller than No. 12.
   2. For 120V circuits up to 110 feet in length from panel to center of load: Not smaller than No. 10.
   3. For 120V circuits up to 165 feet in length from panel to center of load: Not smaller than No. 8.
   4. For 120V circuits up to 255 feet in length from panel to center of load: Not smaller than No. 6.
   5. For 208V circuits up to 110 feet in length from panel to center of load: Not smaller than No. 12.
   6. For 208V circuits up to 185 feet in length from panel to center of load: Not smaller than No. 10.
   7. For 208V circuits up to 280 feet in length from panel to center of load: Not smaller than No. 8.

8. For 208V circuits up to 440 feet in length from panel to center of load: Not smaller than No. 6.
9. For 277V circuits up to 150 feet in length from panel to center of load: Not smaller than No. 12.
10. For 277V circuits up to 250 feet in length from panel to center of load: Not smaller than No. 10.
11. For 277V circuits up to 380 feet in length from panel to center of load: Not smaller than No. 8.
12. For 277V circuits up to 590 feet in length from panel to center of load: Not smaller than No. 6.

3.5 CONDUCTOR INSULATION APPLICATIONS AND WIRING METHODS

A. Comply with NECA 1.

B. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-THWN or XHHW, single conductors in raceway.

C. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN or XHHW, single conductors in raceway.

D. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN or XHHW, single conductors in raceway.

E. Class 1 and 2 Control Circuits: Type THHN-THWN or XHHW, in raceway.
1. Final raceway connections for low-voltage control wiring to equipment, actuators and similar devices may be omitted where the devices are located above lay-in ceilings. Length of exposed wire is to be less than 24 inches.

F. Class 3 Control Circuits: Type TW or TF in raceway.
1. Final raceway connections for low-voltage control wiring to equipment, actuators and similar devices may be omitted where the devices are located above lay-in ceilings. Length of exposed wire is to be less than 24 inches.

3.6 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 23 Sections "Hangers and Supports for HVAC Piping and Equipment."

F. Identify and color-code conductors and cables.

G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

H. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

3.7 IDENTIFICATION INSTALLATION

A. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

C. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

3.8 IDENTIFICATION SCHEDULE

A. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
   1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded branch-circuit conductors.
      a. Color shall be factory applied.
      b. Colors for 208/120-V Circuits:
         1) Phase A: Black.
         2) Phase B: Red.
         3) Phase C: Blue.
         4) Neutral: White.
      c. Colors for 480/277-V Circuits:
         1) Phase A: Brown.
         2) Phase B: Orange.
         3) Phase C: Yellow.
         4) Neutral: Gray.

B. Control Systems Conductor Identification: Identify field-installed control, and signal connections.
   1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
   2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.

3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

C. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
1. Limit use of underground-line warning tape to direct-buried cables.
2. Install underground-line warning tape for both direct-buried cables and cables in raceway.

3.9 REMOVAL OF CONDUCTORS AND CABLES

A. Remove abandoned conductors and cables.

3.10 GROUNDING

A. For low-voltage wiring and cabling, comply with requirements in Division 26.

3.11 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Division 23 "Sleeves and Sleeve Seals for HVAC Piping."

3.12 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Comply with requirements in Division 07.

3.13 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.
1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to paint finishes with matching touchup coating recommended by manufacturer.

3.14 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:
1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

C. Test Reports: Prepare a written report to record the following:
1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Remove and replace malfunctioning units and retest as specified above.

- END OF SECTION -

- SECTION 23 0523 -

GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. General Duty Valves Common to Several Mechanical Piping Systems.

B. Related Sections:
   1. Section 01 81 13 - Sustainable Design Requirements
   2. Section 23 05 00 - Common Work Results for HVAC
   3. Section 23 31 13.51 - Hydronic Piping - Metal
   4. Division 23 piping Sections for specialty valves applicable to those Sections only.
   5. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and charts.
   6. Division 23 Section "Instrumentation and Control for HVAC" for control valves and actuators.

1.3 REFERENCES

A. ASTM International (ASTM) Publications: (Former American Society for Testing and Materials)
   1. A126 "Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings"
   2. B32 "Standard Specification for Solder Metal"
   3. B62 “Standard Specification for Composition Bronze or Ounce Metal Castings”
   4. B584 “Standard Specification for Copper Alloy Sand Castings for General Applications”
   5. B828 “Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings”

B. The American Society of Mechanical Engineers (ASME) Publications:
   1. B1.20.1 "Pipe Threads, General Purpose, Inch"
   2. B16.1 “Cast Iron Pipe Flanges and Flanged Fittings”

3. B16.5 “Pipe Flanges and Flanged Fittings”
4. B16.10 “Face-to-Face and End-to-End Dimensions of Valves”
5. B16.18 “Cast Copper Alloy Solder Joint Pressure Fittings”
6. B16.24 “Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 400, 600, 900, 1500 and 2500”
7. B16.34 “Valves Flanged, Threaded and Welding End”
8. B31.1 “Power Piping”
9. B31.9 “Building Services Piping”

1.4 DEFINITIONS

A. The following are standard abbreviations for valves:
1. CWP: Cold working pressure.
2. EPDM: Ethylene-propylene-diene terpolymer rubber.
3. PTFE: Polytetrafluoroethylene plastic.
4. TFE: Tetrafluoroethylene plastic.

1.5 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

B. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

C. Maintenance data for valves to include in the operation and maintenance manuals. Include detailed manufacturer's instructions on adjusting, servicing, disassembling, and repairing.

1.6 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.

B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

C. MSS Compliance: Comply with the various MSS Standard Practice documents referenced.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and weld ends.
3. Set ball valves open to minimize exposure of functional surfaces.
4. Set butterfly valves closed or slightly open.

5. Block check valves in either closed or open position.

B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store indoors and maintain valve temperature higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use a sling to handle large valves. Rig to avoid damage to exposed parts. Do not use handwheels and stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved Manufacturers:
   1. Ball Valves:
      a. Conbraco Industries, Inc.; Apollo Division. (704-841-6000)
      b. NIBCO Inc. (574-295-3000)
      c. Milwaukee Valve Company, Inc. (262-432-2700)
      d. Stockham Valves & Fittings, Inc. (800-786-2526)
   2. Butterfly Valves:
      a. Bray (888-390-8037)
      b. General Signal; DeZurik Unit. (320-259-2000)
      c. NIBCO Inc. (574-295-3000)
      d. Milwaukee Valve Company, Inc. (262-432-2700)
      e. Stockham Valves & Fittings, Inc. (800-786-2526)
   3. Swing Check Valves:
      a. Milwaukee Valve Company, Inc. (262-432-2700)
      b. NIBCO Inc. (574-295-3000)
      c. Stockham Valves & Fittings, Inc. (800-786-2526)

2.2 BASIC, COMMON FEATURES

A. Pressure and Temperature Ratings: As indicated in the "Application Schedule" of Part 3 of this Section and as required to suit system pressures and temperatures.

B. Sizes: Same size as upstream pipe, unless otherwise indicated.

C. Operators:
   1. Lever Handles: For quarter-turn valves 4 inches and smaller.
   2. Gear-Drive Operators: For quarter-turn valves 6 inches and larger.

D. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.

E. Bypass and Drain Connections: Comply with MSS SP-45 bypass and drain connections.

F. Threads: ASME B1.20.1.

G. Flanges: ASME B16.1 for cast iron, ASME B16.5 for steel, and ASME B16.24 for bronze valves.

H. Solder Joint: ASME B16.18.
   1. Caution: Where soldered end connections are used, use solder having a melting point below 840 deg F for check valves; below 421 deg F for ball valves.

2.3 BALL VALVES

A. Ball Valves, 2 Inches and Smaller: MSS SP-110, Class 150, 600-psi CWP, ASTM B584 bronze body and bonnet, 2-piece construction; chrome-plated brass ball; full port; blowout proof; bronze or brass stem; teflon seats and seals; threaded or soldered end connections:
   1. Operator: Vinyl-covered steel lever handle.
   2. Stem Extension: For valves installed in insulated piping.

2.4 BUTTERFLY VALVES

A. Resilient Seated Butterfly Valves, 2-1/2 inches and Larger: MSS SP-67, Class 150, 200-psi CWP dead-end service, bi-directional, ASTM A126 cast-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals, lug style body with ANSI Class 150 tapped lugs and flange bolts. Bolts shall be installed at each side of the lugs to allow downstream piping to be disconnected:
   1. Disc Type: Type 316 stainless steel.
   2. Operator for Sizes 2-1/2 Inches to 4 Inches: Standard lever handle with memory stop.
   3. Operator for Sizes 6 Inches and Larger: Gear operator with position indicator.

2.5 CHECK VALVES

A. Swing Check Valves, 2 Inches and Smaller: MSS SP-80; Class 150, 300-psi CWP; horizontal swing, Y-pattern, ASTM B62 cast-bronze body and cap, rotating bronze disc with rubber seat or composition seat, threaded or soldered end connections:

B. Swing Check Valves, 2-1/2 Inches and Larger: MSS SP-71, Class 125, 200-psi CWP, ASTM A126 cast-iron body and bolted cap, horizontal-swing bronze disc, flanged end connections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of valves. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

C. Operate valves from fully open to fully closed positions. Examine guides and seats made accessible by such operation.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.

F. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION

A. Install valves as indicated, according to manufacturer's written instructions.

B. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.

C. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.

D. Locate valves for easy access and provide separate support where necessary.

E. Install valves in horizontal piping with stem at or above the center of the pipe.

F. Install valves in a position to allow full stem movement.

G. Installation of Check Valves: Install for proper direction of flow as follows:
   1. Swing Check Valves: Horizontal position with hinge pin level.

3.3 SOLDERED CONNECTIONS

A. Cut tube square and to exact lengths.

B. Clean end of tube to depth of valve socket with steel wool, sand cloth, or a steel wire brush to a bright finish. Clean valve socket.

C. Apply proper soldering flux in an even coat to inside of valve socket and outside of tube.

D. Open gate and globe valves to fully open position.

E. Remove the cap and disc holder of swing check valves having composition discs.

F. Insert tube into valve socket, making sure the end rests against the shoulder inside valve. Rotate tube or valve slightly to ensure even distribution of the flux.

G. Apply heat evenly to outside of valve around joint until solder melts on contact. Feed solder until it completely fills the joint around tube. Avoid hot spots or overheating valve. Once the solder starts cooling, remove excess amounts around the joint with a cloth or brush.

3.4 THREADED CONNECTIONS

A. Note the internal length of threads in valve ends and proximity of valve internal seat or wall to determine how far pipe should be threaded into valve.

B. Align threads at point of assembly.

C. Apply appropriate tape or thread compound to the external pipe threads, except where dry seal threading is specified.

D. Assemble joint, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

3.5 FLANGED CONNECTIONS

A. Align flange surfaces parallel.

B. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

C. For dead-end service, butterfly valves require flanges both upstream and downstream for proper shutoff and retention.

3.6 VALVE END SELECTION

A. Select valves with the following ends or types of pipe/tube connections:
   1. Copper Tube Size, 2 Inches and Smaller: Solder ends.
   2. Steel Pipe Sizes, 2 Inches and Smaller: Threaded end.
   3. Steel Pipe Sizes, 2-1/2 Inches and Larger: Flanged.

3.7 APPLICATION SCHEDULE

A. General Application: Use ball and butterfly valves for shutoff duty. Refer to piping system Specification Sections for specific valve applications and arrangements. Provide valves suitable for working pressures encountered in each system.

B. Make-Up Water Systems: Use the following valve types:
   1. Ball Valves: Class 150, 600-psi CWP, with stem extension.
   2. Check Valves: Class 125, swing type.

C. Chilled & Heating Water Systems: Use the following valve types:
   1. Ball Valves: Class 150, 600-psi CWP, with stem extension.
   2. Resilient Seated Butterfly Valves: Class 150, stainless steel disc; EPDM or Buna N sleeve and stem seals.

3. Check Valves: Class 150, bronze body swing check with rubber seat or Class 125, cast-iron body swing check. Provide "spring-loaded globe type" check valves at pumps as specified in Section "Hydronic Piping".

D. Condenser Water Systems: Use the following valve types:

1. Ball Valves: Class 150, 600-psi CWP, with stem extension.
2. Resilient Seated Butterfly Valves: Class 150, stainless steel disc; EPDM or Buna N sleeve and stem seals.
3. Check Valves: Class 150, bronze body swing check with rubber seat or Class 125, cast-iron body swing check. Provide "spring-loaded globe type" check valves at pumps as specified in Section 23 31 13 "Hydronic Piping".

3.8 JOINT CONSTRUCTION

A. Refer to Section 23 05 00 "Common Work Results for HVAC" for basic piping joint construction.

B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B32, lead-free-alloy solder; and ASTM B828 procedure, unless otherwise indicated.

3.9 ADJUSTING

A. Adjust or replace packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves if leak persists.

- END OF SECTION -

- SECTION 23 0529 -

HANGERS & SUPPORTS FOR HVAC PIPING & EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Hangers And Supports For HVAC System Piping And Equipment.

B. Related Sections:
   1. Section 05 50 00 (05500) - Metal Fabrications
   2. Section 09 90 00 (09900) - Painting
   3. Section 23 05 48 (15070) – Vibration and Seismic Control for HVAC Piping and Equipment

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports.

1.4 SUBMITTALS

A. Submit “Letter of Conformance” in accordance with Section 01 33 00 (01330) with the following supporting data:
   1. Product Data:
      a. For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated.

1.5 QUALITY ASSURANCE

A. Engineering Responsibility: Where required by the local authority having jurisdiction design and preparation of Shop Drawings and calculations for each multiple pipe support, trapeze, and seismic restraint by a qualified professional engineer.

1. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of hangers and supports that are similar to those indicated for this Project in material, design, and extent.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved Manufacturers:

1. Pipe Hangers, Supports, and Components:
   a. Cooper B-Line, Inc. (618-654-2184)
   b. Grinnell Mechanical Products, A Tyco International Company (800-500-4768)
   c. National Pipe Hanger Corporation (609-261-5353)
2. Channel Support Systems:
   a. Cooper B-Line, Inc. (618-654-2184)
   b. Grinnell Mechanical Products, A Tyco International Company (800-500-4768)
   c. National Pipe Hanger Corporation (609-261-5353)
3. Thermal-Hanger Shield Inserts:
   a. Carpenter & Patterson, Inc. (301.333.4631)
   b. Erico (Michigan Hanger) (440-248-0100)
   c. PHS Industries, Inc. (800-626-2336)
4. Powder-Actuated and Mechanical Anchor Fastener Systems:
   a. Gunnebo Fastening Corp. (800-336-1640)
   b. Hilti, Inc.(800-879-8000)
   c. ITW Ramset/Red Head (800-899-7890)

2.2 HANGERS AND SUPPORTS

A. Pipe Hangers, Supports, and Components:

1. MSS SP-58, factory-fabricated components. Refer to "Hanger and Support Applications" Article in Part 3 for where to use specific hanger and support types.
   a. Galvanized, Metallic Coatings: For piping and equipment that will not have field-applied finish.
   b. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

B. Channel Support Systems:
   1. MFMA-2, factory-fabricated components for field assembly.
   2. Coatings: Manufacturer's standard finish.
   3. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

C. Thermal-Hanger Shield Inserts:
   1. 100-psi minimum compressive-strength insulation, encased in sheet metal shield.
   2. Material for Cold Piping: ASTM C552, Type I cellular glass.
   3. Material for Hot Piping: ASTM C552, Type I cellular glass.
   4. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
   5. For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.
   6. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.3 MISCELLANEOUS MATERIALS

A. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

C. Structural Steel: ASTM A36, steel plates, shapes, and bars, black and galvanized.

D. Grout: ASTM C1107, Grade B, factory-mixed and -packaged, non-shrink and nonmetallic, dry, hydraulic-cement grout.
   1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
   2. Properties: Nonstaining, noncorrosive, and nongaseous.
   3. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. General:
   1. Specific hanger requirements are specified in Sections specifying equipment and systems.
   2. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification Sections.

B. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Adjustable Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
2. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24 if little or no insulation is required.
3. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4 to allow off-center closure for hanger installation before pipe erection.
4. Adjustable Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
5. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
6. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
7. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
8. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.

C. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20 (DN20 to DN500).

D. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.

E. Building Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
2. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
3. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
4. C-Clamps (MSS Type 23): For structural shapes.
5. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
   a. Light (MSS Type 31): 750 lb.
   b. Medium (MSS Type 32): 1500 lb.

F. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended by manufacturer to prevent crushing insulation.

3.2 HANGER AND SUPPORT INSTALLATION

A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.
   1. Field assemble and install according to manufacturer's written instructions.

C. Install building attachments to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, and at changes in direction of piping.

D. Install powder-actuated drive-pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.

E. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

H. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

I. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.

J. Insulated Piping: Comply with the following:
   1. Attach clamps and spacers to piping.
      a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
      b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
      c. Do not exceed pipe stress limits according to ASME B31.9.
   2. Install MSS SP-58, Type 39 protection saddles, if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
   3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span arc of 180 degrees.
   4. Shield Dimensions for Pipe: Not less than the following:
      a. NPS 1/4 to NPS 3-1/2 (DN8 to DN90): 12 inches long and 0.048 inch thick.
      b. NPS 4 (DN100): 12 inches long and 0.06 inch thick.
   5. Insert Material: Length at least as long as protective shield.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Prime and Paint Equipment Supports as specified in Section 09 90 00 “Painting”.

3.4 METAL FABRICATION

A. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.

B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments to level equipment and to achieve indicated slope of pipe.

3.6 PAINTING

A. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 09 90 00 “Painting”.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

- END OF SECTION -

- SECTION 23 0548 -

VIBRATION CONTROLS FOR HVAC PIPING & EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
1. Isolation pads.
2. Isolation mounts.
3. Freestanding spring isolators.
4. Housed spring mounts.
5. Spring hangers.
6. Spring hangers with vertical-limit stops.
7. Thrust restraints.
8. Saddles and brackets.
9. Floating concrete bases.
10. Rooftop spring curbs.
11. Wall, floor, and ceiling seals.
12. Pipe riser resilient supports.
13. Resilient pipe guides.

1.3 DEFINITIONS

A. Sound Critical: Assembly spaces such as classrooms, auditoriums, etc.; normally occupied rooms such as offices, call centers, etc.; vibration critical areas such as data rooms, technical manufacturing areas, etc.; or other areas as indicated.

B. Non-sound Critical: Not normally occupied areas such as storage rooms, electrical rooms, mechanical yards, commercial kitchens, scullery areas, etc.

1.4 SUBMITTALS

A. Product Data: For each product indicated.

B. Welding certificates.

C. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Manufacturers: The following products are based on Mason Industries. Subject to compliance with requirements, provide comparable products by one of the following:
   1. Amber/Booth Company, Inc.
   2. Kinetics Noise Control.
   3. Mason Industries.
   4. Vibration Mountings & Controls, Inc.

B. Neoprene Pad: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
   1. Resilient Material: Oil- and water-resistant neoprene.

C. Style A - Mounts: Double-deflection type, with molded, oil-resistant neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
   1. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

D. Style B - Spring Isolators: Freestanding, laterally stable, open-spring isolators.
   1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch-thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

E. Style D - Restrained Spring Isolators: Freestanding, steel, open-spring isolators with limit-stop restraint.
1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch-thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Restraint: Limit-stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

F. Style F - Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Elements: Molded, oil-resistant rubber or neoprene.
   a. Minimum 1-1/4 inch thick element at top of hanger with steel-washer-reinforced rod support and bushing projecting through top of frame.
   b. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

G. Style G - Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Elements: Molded, oil-resistant rubber or neoprene.
   a. Minimum 1-1/4 inch thick element at top of hanger with steel-washer-reinforced rod support and bushing projecting through top of frame.
   b. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

H. Style H - Spring Hangers with Vertical-Limit Stop: Coil-spring compression hanger with a vertical-limit stop.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Elements: Molded, oil-resistant rubber or neoprene, steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

I. Style I – Thrust Restraint: Open-spring thrust restraint.
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Attachments: Factory drilled, steel angles with backing plates for attachment to both duct and equipment or structure.
6. Adjustable Precompression and Stop Nut: Adjustable nut to set spring precompression and limit travel when fan is off.

J. Style K – Saddles and Brackets: Steel members welded to height saving brackets to cradle equipment having legs or bases that do not require complete supplementary base. Select steel members with sufficient rigidity to prevent distortion of equipment.

K. Style L – Floating Concrete Base: Rectangular, welded or bolted, structural or formed, steel pouring form for field provided concrete. The depth of the base shall be a minimum of 1/12th the longest dimension of the base but no less than 6 inches. The maximum base depth is not required to be more than 12 inches. Bases shall include 1/2-inch reinforcing bars running in both directions welded in place at 6" centers located 1-1/2 inches above the bottom of the base. Forms shall be furnished with steel templates to secure the anchor bolts and anchor bolt sleeves during pouring activities. Bases shall be provided with height saving brackets to maintain a 1-inch clearance below the base. Bases for pumps shall be sized to support the suction and discharge elbows.

L. Style Q – Wall, Floor, and Ceiling Seals: Minimum 3/4-inch-thick neoprene sponge cemented to inner face of split pipe halves. Seals shall extend 1" beyond both faces of the element being penetrated.

M. Style R - Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch-thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.

N. Style S - Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch-thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits.

C. Select vibration isolation elements and deflections in accordance with the following table:

Equipment	Location	Vibration Isolation Element (Minimum Deflection)
Chiller	Slab Not On-Grade	Style D (1.5 inches)
Pump	Slab Not On-Grade Suspended In-Line Type	Style B and L (1.5 inches ≤ 60 HP) (2.5 inches > 60 HP) Style F (1.5 inches)
Cooling Tower or Fluid Cooler	Slab Not On-Grade	Style D (3.5 inches)
Air Handling Units Without Internal Isolation	Slab On-Grade Slab Not On-Grade	Neoprene Pad Style K (1.5 inches ≤ 40 HP) (2.5 inches ≥ 50 HP)
Condensing Unit	Slab Not On-Grade	Neoprene Pad ≤ 20 Tons or Style D >20 Tons (1.5 inches)
Utility Set Fans	Slab On-Grade (Sound Critical) or Slab Not On-Grade	Style B and L (3.5 inches)
Ceiling Mounted Equipment Fan Coil Units Indoor Units Inline Fans	Suspended	Style F (0.75 inches ≤ 5 HP) (1.5 inches ≥ 7.5 HP)
Piping	Where connected to equipment with spring isolators. Building element penetrations between central plants and sound critical spaces.	Style G on first 4 hangers (match equipment deflection) Style Q
Air Moving Equipment	External Static Pressure >2 inches	Style I
Duct	Where connected to equipment with Style I thrust restraints.	Style H on first 4 hangers (match equipment deflection)

3.2 VIBRATION-CONTROL INSTALLATION

A. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

B. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

C. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.3 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

- END OF SECTION -

- SECTION 23 0553 -

IDENTIFICATION FOR HVAC PIPING & EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Identifying Devices and Labels

B. Related Sections:
   1. Section 23 05 00 (15050) – Common Work Results for HVAC

1.3 SUBMITTALS

A. Submit “Letter of Conformance” in accordance with section 01 33 00 (01330) indicating specified items selected for use in Project with the following supporting data:
   1. Product Data: For identification materials and devices.
   2. Samples: Of color, lettering style, and graphic representation required for each identification material and device.

1.4 QUALITY ASSURANCE

A. Comply with ASME A13.1, "Scheme for the Identification of Piping Systems" for lettering size, length of color field, colors, and viewing angles of identification devices.

1.5 SEQUENCING AND SCHEDULING

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 GENERAL

A. General: Products specified are for applications referenced in other Division 23 Sections. If more than single type is specified for listed applications, selection is Installer's option.

B. Pipes Including Insulation: Full-band pipe markers, extending 360 degrees around pipe at each location.

2.2 IDENTIFYING DEVICES AND LABELS

A. Lettering: Manufacturer's standard preprinted captions as selected by Owner's Representative.

B. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.

1. Arrows: Either integrally with piping system service lettering, to accommodate both directions, or as separate unit, on each pipe marker to indicate direction of flow.

C. Plastic Duct Markers: Manufacturer's standard laminated plastic, in the following color codes:

1. Green: Cold-air supply.
2. Yellow: Hot-air supply.
3. Blue: Exhaust, outside, return, and mixed air.
4. Terminology: Include direction of airflow; duct service such as supply, return, and exhaust; duct origin, duct destination, and design flow.

D. Plastic Tape: Manufacturer's standard color-coded, pressure-sensitive, self-adhesive, vinyl tape, at least 3 mils thick.

1. Width: 1-1/2 inches on pipes with OD, including insulation, less than 6 inches; 2-1/2 inches for larger pipes.
2. Color: Comply with ASME A13.1, unless otherwise indicated.

E. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch sequenced numbers. Include 5/32-inch hole for fastener.

1. Material: 0.032-inch thick, polished brass.
2. Size: 1-1/2-inches diameter, unless otherwise indicated.

F. Valve Tag Fasteners: Brass, wire-link chain and S-hooks.

G. Access Panel Markers: 1/16-inch thick, engraved plastic-laminate markers, with abbreviated terms and numbers corresponding to concealed valve. Provide 1/8-inch center hole for attachment.

H. Valve Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include screws.

1. Frame: Extruded aluminum.
2. Glazing: ASTM C1036, Type I, Class 1, Glazing quality B, 2.5-mm, single-thickness glass.

I. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in mechanical identification with corresponding designations indicated. Use numbers, letters, and terms indicated for proper identification, operation, and maintenance of mechanical systems and equipment.

1. Multiple Systems: Identify individual system number and service if multiple systems of same name are indicated.

PART 3 - EXECUTION

3.1 LABELING AND IDENTIFYING PIPING SYSTEMS

A. Install pipe markers on each system as indicated below. Include arrows showing normal direction of flow.

1. Condensate.
2. Vent.
3. Chilled Water Supply
4. Chilled Water Return
5. Heating Hot Water Supply
6. Heating Hot Water Return
7. Condenser Water Supply
8. Condenser Water Return

B. Marker Type: Plastic markers, with application systems. Install on pipe insulation segment where required for hot, noninsulated pipes.

C. Fasten markers on pipes and insulated pipes by one of following methods:

1. Snap-on application of pretensioned, semirigid plastic pipe marker.

D. Locate pipe markers where piping is exposed in machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations according to the following:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Mark each pipe at branch, where flow pattern is not obvious.
3. Near penetrations through walls, floors, ceilings, or nonaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at a maximum of 50-foot intervals along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

3.2 VALVE TAGS

A. Install on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, plumbing fixture supply stops, shutoff valves, faucets, convenience and lawn-watering hose connections, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in valve schedule.

B. Valve Tag Application Schedule: Tag valves according to size, shape, color scheme, and with captions similar to those indicated in the following:
   1. Chilled Water
   2. Heating Hot Water
   3. Condenser Water

C. Tag Material: Brass.

D. Tag Size and Shape: According to the following:
   1. Cold Water: 1-1/2 inches round.
   2. Hot Water: 1-1/2 inches round.
   3. Gas: 1-1/2 inches round.

E. Install framed valve schedule in each major mechanical equipment room.

F. Valve schedule and tag locations shall be shown on record drawings.

3.3 LABELING AND IDENTIFYING DUCT SYSTEMS.

A. Duct Systems: Identify air supply, return, exhaust, intake, and relief ducts with duct markers; or provide stenciled signs and arrows showing service and direction of flow.
   1. Location: Locate signs near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.4 ADJUSTING AND CLEANING

A. Relocate HVAC identification materials and devices that have become visually blocked by work of this or other Divisions.

B. Clean faces of identification devices and glass frames of valve charts

- END OF SECTION -

- SECTION 23 0593 -

TESTING, ADJUSTING & BALANCING FOR HVAC & PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Balancing Air Systems.
2. Balancing Hydronic Systems.
3. Balancing HVAC Equipment.
4. Testing and Certifying the Proper Operation of Fire and Smoke Control Devices.
5. Testing and Certifying the Proper Operation of Refrigeration Room Safety Systems.
6. Testing and Certifying the Proper Operation of Boiler Room Safety Systems.

1.3 APPROVED CONTRACTORS

A. Approved Contractors: Engage the services of one of the following:
1. ABM Building Services, LLC., Phoenix, Arizona Balance Division
2. Arizona Air Balance Co.
3. Precision Air.
4. Technical Air Balance.

1.4 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TAB Specialist: An entity engaged to perform TAB Work.

1.5 SUBMITTALS

A. Contractor Qualifications: Include AABC or NEBB certificates for proposed personnel, test instrument certifications.

B. Special Inspection Form: Provide a completed, project specific Special Inspection Form to be stamped and signed by the Engineer of Record and submitted to the Authority having Jurisdiction.

C. Certified TAB reports.

D. Sealed special inspection reports.

1.6 QUALITY ASSURANCE

A. Certify TAB field data reports and perform the following:
   1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
   2. Certify that the TAB team complied with the TAB plan and the procedures specified and referenced in this Specification.

B. TAB Report Forms: Use standard TAB contractor's forms.

C. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

D. Perform special inspections as required herein and by Authorities Having Jurisdiction.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents and approved submittals for the HVAC systems and equipment to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment or inefficient operation. Report findings and recommendations directly to the Engineer within thirty days of document review.

B. Examine ceiling plenums used for return or relief air to verify that there is a proper path for return and relief air from all areas of the building. Verify that penetrations through walls between plenum and non-plenum areas are sealed.

C. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

D. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

E. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

F. Examine placement of the hydronic differential pressure sensor and confirm it is installed where indicated on the drawings.

G. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

H. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

I. Examine system pumps to ensure absence of entrained air in the suction piping.

J. Examine operating safety interlocks and controls on HVAC equipment.

K. Report deficiencies discovered before and during performance of TAB procedures directly to Engineer and Mechanical Contractor. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

L. The General or Mechanical Contractor shall not in any way prohibit the TAB Contractor from communicating directly and freely with the Engineer. The TAB Contractor is required to copy the Engineer on all communications to the Contractor.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:
   1. Permanent electrical-power wiring is complete.
   2. Hydronic systems are filled, clean, and free of air.
   3. Automatic temperature-control systems are operational.
   4. Equipment and duct access doors are securely closed.
   5. Balance, smoke, and fire dampers are open.
   6. Isolating and balancing valves are open and control valves are operational.
   7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
   8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" or NEBB's “Procedural Standards for Testing Adjusting and Balancing of Environmental Systems,” and in this Section.
   1. Comply with requirements in ASHRAE 62.1, Section 7.2.2, "Air Balancing."

B. Cut insulation and ducts for installation of test probes to the minimum extent necessary for TAB procedures.
   1. After testing and balancing, patch probe holes in ducts airtight.
   2. Coordinate with mechanical contractor to restore insulation, coverings, vapor barrier, and finish according to Division 23 Sections.

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes. Correct variations that exceed plus or minus 10 percent.

B. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

C. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

D. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

E. Verify that motor starters are equipped with properly sized thermal protection.

F. Check dampers for proper position to achieve desired airflow path.

G. Check for airflow blockages.

H. Check condensate drains for proper connections.

I. Check for proper sealing of air-handling-unit components.

J. Verify that joints and seams in air duct systems are sealed as specified in Division 23 Sections.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
   1. Measure total airflow.
      a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
   2. Measure fan static pressures as follows to determine actual static pressure:
      a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
      b. Measure static pressure directly at the fan outlet or through the flexible connection.
      c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.

d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment. Exception: Individual component measurement is not required for unitary equipment 5-tons and less in capacity. Provide external static pressure measurement across unit only.
   a. Report the cleanliness status of filters and the time static pressures are measured.
4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
7. Instruct Mechanical Contractor to replace fan and motor sheaves and belts as required to achieve design airflow or pressurization.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
   1. Measure airflow of submain and branch ducts.
      a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
   2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
   3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.
   1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
   1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
   2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at minimum set-point airflow with the remainder at maximum airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units from the terminal units closest to the air handling unit.

B. Pressure-Independent, Variable-Air-Volume Systems: Adjust the variable-air-volume systems as follows:

1. Set outdoor-air dampers at minimum-minimum, and set return- and relief-air dampers at a position that simulates full-cooling load.
2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
3. Measure total system airflow. Adjust to within indicated airflow.
4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total terminal unit airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
    a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
6. Measure static pressure at the most critical terminal unit and set the supply duct static-pressure control setpoint in the building control system to ensure that adequate static pressure is maintained at the most critical unit. Set and record maximum speed of supply fan VFD to not exceed this speed.
7. With supply fan operating at scheduled airflow, adjust the return fan speed to scheduled airflow. On ducted return systems, balance the return-air ducts and inlets as described for constant-volume air systems. Set and record maximum speed of return fan VFD to not exceed this speed.
8. Confirm that the outdoor-air damper minimum-minimum and maximum-minimum positions are properly set and maintained throughout the operating range of the supply fan.
9. Measure and record the following airflows and airflow measuring station readings with supply fan operating at 100 percent and 50 percent speeds: Supply air, return air, outdoor air.
10. Calibrate misreading airflow measuring stations.
11. Record final supply and return fan-performance data.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.
2. Check pressure in expansion tank.
3. Check makeup water-station pressure gage for adequate pressure for highest vent.

4. Check flow-control valves for specified sequence of operation, and set at indicated flow. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
5. Set differential-pressure control valves as directed by the valve manufacturer to maintain the required downstream differential pressure.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.8 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:

1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
   a. Impeller sizes must be adjusted to achieve pump performance, if the flow exceeds 130% of the design flow. Impeller is to be trimmed by the pump manufacturer at no additional cost to the Owner.
2. Check system resistance. With all valves open and pump at full speed, read pressure differential across the pump and mark pump manufacturer's head-capacity curve.
   a. Pumps with VFD: Adjust VFD speed until indicated water flow is achieved.
      1) Set maximum VFD output for indicated pump flow.
      2) Set minimum VFD output at 18 Hz.
      3) Place label on VFD stating, “Do not adjust maximum or minimum VFD speed settings. These were set by Test and Balance Contractor for proper pump flow on (mm/dd/yyyy).”
      4) Do not use pump discharge valve to balance pumps with VFD.
   b. Pump without VFD: Adjust pump discharge valve until indicated water flow is achieved.
   c. Monitor motor performance during procedures and do not operate motors in overload conditions.
3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
4. Report flow rates that are not within plus or minus 10 percent of design.

B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.

C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.

D. Set calibrated balancing valves, if installed, at calculated presettings.

E. Measure flow at all stations and adjust, where necessary, to obtain first balance.

1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
1. Determine the balancing station with the highest percentage over indicated flow.
2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
3. Record settings and mark balancing devices.

H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

I. Measure and record the differential-pressure-control-valve settings at the conclusion of balancing.

J. Check settings and operation of each safety valve. Record settings.

3.9 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Determine if the system has diversity. If the sum of the flows through the motorized control valves is greater than the flow of the pump, the system has diversity.

B. Systems Without Diversity: Balance as specified above for constant volume system.

C. Systems With Diversity:
1. Compensating for Diversity:
a. When the total flow of all motorized control valves is more than the indicated flow of the pump, close a selected number of motorized control valves with the remainder of the valves fully open until the total flow of the open valves equals the indicated flow of the pump. Select the closed valves so they farthest from the pump.
b. Balance the components connected to the open valves as specified above for constant volume hydronic systems.
c. Fully open the closed control valves. Close a different group of motorized control valves until the total flow of the open valves equals the indicated flow of the pump. Select the closed valves so they are closest to the pump.
d. Balance the components connected to the open valves as specified above for constant volume hydronic systems.
2. Determine the system differential pressure (DP setpoint).
a. After balancing all the components but prior to opening the closed valves, reduce the pump speed until the flow through the most hydraulically remote valve falls to 5% below design. Increase pump speed until valve reaches design flow and record reading at system differential pressure sensor. Set the building automation system to maintain this differential pressure.

3.10 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
   1. Manufacturer's name, model number, and serial number.
   2. Motor horsepower rating.
   3. Motor rpm.
   4. Efficiency rating.
   5. Nameplate and measured voltage, each phase.
   6. Nameplate and measured amperage, each phase.
   7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Set minimum motor speed to 20 percent. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.11 PROCEDURES FOR CHILLERS

A. Balance water flow through each evaporator, and condenser on water- cooled chillers to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:
   1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
   2. For water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
   3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
   4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
   5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
   6. Capacity: Calculate in tons of cooling.
   7. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.12 PROCEDURES FOR COOLING TOWERS

A. Shut off makeup water for the duration of the test, and verify that makeup and blowdown systems are fully operational after tests and before leaving the equipment. Balance water flow through each cell on multi- cell systems. Perform the following tests and record the results:
   1. Measure condenser-water flow to each cell of the cooling tower.
   2. Measure entering- and leaving-water temperatures.
   3. Measure wet- and dry-bulb temperatures of entering air.
   4. Measure wet- and dry-bulb temperatures of leaving air.
   5. Measure condenser-water flow rate recirculating through the cooling tower.
   6. Adjust water level and feed rate of makeup water system.
   7. Measure flow through bypass.

3.13 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.14 PROCEDURES FOR BOILERS

A. Hydronic Boilers: Balance water flow through each boiler to within specified tolerances of indicated flow with all pumps operating. With only one boiler operating in a multiple boiler installation, do not exceed the flow for the maximum velocity recommended by the boiler manufacturer. Measure and record the following data with each boiler operating at design conditions:
   1. Entering- and leaving-water temperature.
   2. Water flow.

B. Steam Boilers: Measure and record entering-water temperature and flow and leaving-steam pressure, temperature, and flow.

3.15 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:
   1. Entering- and leaving-water temperature.
   2. Water flow rate.
   3. Water pressure drop.
   4. Dry-bulb temperature of entering and leaving air.
   5. Wet-bulb temperature of entering and leaving air for cooling coils.
   6. Airflow.
   7. Air pressure drop.

B. Measure, adjust, and record the following data for each electric heating coil:
   1. Nameplate data.
   2. Airflow.
   3. Entering- and leaving-air temperature at full load.
   4. Voltage and amperage input of each phase at full load and at each incremental stage.
   5. Calculated kilowatt at full load.
   6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each refrigerant coil:
   1. Dry-bulb temperature of entering and leaving air.
   2. Wet-bulb temperature of entering and leaving air.
   3. Airflow.
   4. Air pressure drop.

3.16 PROCEDURES FOR TESTING FIRE AND SMOKE CONTROL DEVICES

A. Record manufacturer and model number for each fire damper, smoke detector, smoke damper, combination fire/smoke damper, and damper actuator.

B. Confirm access door has been installed at each damper location and is properly labeled.

C. Fire Dampers:
   1. Disconnect the fusible link and confirm that damper closes smoothly and completely.
   2. Reset the damper and replace the fusible link.

D. Duct Mounted Smoke Detectors:
   1. Verify the proper operation of the smoke detector using a test gas, “canned smoke”, acceptable to the Authorities Having Jurisdiction or Engineer. (Magnets are not acceptable.)
   2. Verify activation of the smoke detector closes the appropriate smoke or combination fire/smoke damper(s) and/or de-energizes the appropriate air-moving device(s).
   3. Verify activation of the smoke detector is shown by the fire alarm system where monitoring of the detector is required.

E. Smoke and Combination Fire/Smoke Dampers: Verify dampers controlled by a Total Coverage Smoke Detection System operate correctly on a signal from the system.

F. Air-Moving Device Shut-down: Verify air-moving device(s) that are to be de-energized by a Total Coverage Smoke Detection System de-energize on a signal from the system.

G. After all smoke control devices have been successfully tested, the TAB firm shall engage the services of a Professional Mechanical Engineer, registered in the State of Arizona, to submit a signed and sealed report attesting to the proper operation of the smoke control devices and air-moving device shut-downs.

3.17 PROCEDURES FOR TESTING REFRIGERANT ROOM SAFETY SYSTEMS

A. Witness the Operational Test of the refrigerant monitor. Verify the system performs the actions listed in the Sequence of Control.

B. Witness the Operational Test of the “Emergency Chiller Off” switch. Verify the chiller(s) shutdown upon activation of the switch.

C. Witness the Operational Test of the “Ventilation System On” switch. Verify the switch activates the system(s) listed in the Sequence of Control.

D. Provide a signed statement on company letterhead in the Certified TAB Report that the Operational Test was completed successfully. Include the following:
   1. Name and company of person conducting the tests.
   2. Time and date of the tests.
   3. Concentrations and type of refrigerant used.
   4. Statement that the test was completed and the system operates as specified.
   5. Name and signature of witness.

3.18 PROCEDURES FOR TESTING BOILER ROOM SAFETY SYSTEMS

A. Witness the Operational Test of the boiler shutdown system.

B. Verify the system performs the actions listed in the Sequence of Control.

C. Provide a signed statement on company letterhead in the Certified TAB Report that the Operational Test was completed successfully. Include the following:
   1. Name and company of person conducting the test.
   2. Time and date of the test(s).
   3. Statement that the test was completed and the system operates as specified.
   4. Name and signature of witness.

3.19 PROCEDURES FOR COMMERCIAL KITCHEN HOODS

A. Measure, adjust, and record the airflow of each kitchen hood. For kitchen hoods designed with integral makeup air, measure and adjust the exhaust and makeup airflow. Measure airflow by duct Pitot-tube traverse. If a duct Pitot-tube traverse is not possible, provide an explanation in the report of the reason(s) why and also the reason why the method used was chosen.
   1. Coordinate with the Mechanical Contractor for installation of welded test ports in the sides of the exhaust duct for the duct Pitot-tube traverse. Each test port shall be provided with a threaded cap that is liquid tight.

B. After balancing is complete, do the following:
   1. Measure and record the static pressure at the hood exhaust-duct connection.
   2. Measure and record the hood face velocity. Make measurements at multiple points across the face of the hood. Perform measurements at a maximum of 12 inches between points and between any point and the perimeter. Calculate the average of the measurements recorded. Verify that the hood average face velocity complies with the Contract Documents and governing codes.
   3. Check the hood for capture and containment of smoke using a smoke emitting device. Observe the smoke pattern. Make adjustments to room airflow patterns to achieve optimum results.

C. Report deficiencies.

3.20 PROCEDURES FOR VERIFICATION OF HVAC SYSTEM INTERLOCKS

A. Verification of HVAC System Interlocks: Test and verify that interlocks between make-up air and exhaust air systems function correctly and do not allow the exhaust system to operate without the make-up air system in operation.
   1. Verify that all control components are installed in accordance with project requirements.
   2. Test the interlocks between the equipment to confirm that fans operate according to the sequence of controls on the drawings.

3.21 PROCEDURES FOR TESTING STAIRWELL PRESSURIZATION

A. Stairwell Pressurization: test and adjust stairwell pressurization system to provide design air flow into the stairwell. Adjust relief dampers to maintain required pressurization. Confirm door pull force on all exit doors are no greater than specified requirements.

3.22 PROCEDURES FOR TESTING SMOKE EVACUATION SYSTEMS

A. Smoke Evacuation: Test smoke evacuation systems by activating the system, either manually or at the direction of the Owner and Local Authority, by the introduction of test smoke. As determined by design and test requirements, observe and record system performance by time of smoke removal, pressurization readings or duct pitot-tube traverse.

3.23 TOLERANCES

A. Set HVAC system's air flow and water flow rates within the following tolerances:
   1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
   2. Air Outlets and Inlets: Plus or minus 10 percent.
   3. Heating-Water Flow Rate: Plus or minus 10 percent.
   4. Cooling-Water Flow Rate: Plus or minus 10 percent.

3.24 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

3.25 OUTDOOR AIR SUMMARY REPORT

A. Outdoor Air Summary Report: Prepare a summary report for review by the Authorities Having Jurisdiction that lists each supply- air system on the project. The report shall indicate the system or equipment designation, the scheduled outdoor- air flow rate and the balanced outdoor- air flow rate.

3.26 SPECIAL INSPECTIONS

A. Prepare special inspection reports, signed and sealed by a professional engineer, as required by the Authority Having Jurisdiction or as required above.

3.27 FINAL REPORT

A. General: Prepare certified reports in both paper and PDF format; tabulate and divide the report into separate sections for tested systems and balanced systems. Submit three (3) copies of paper reports and one (1) copy of report in PDF format.

1. Assemble paper reports in 3-ring binders. Separate and order sections within each binder. Provide labeled tabs at each section with a table of contents at the front of the binder. The table of contents shall indicate the tab number and the information contained at that tab.
2. Assemble PDF report in one PDF file. Separate and order sections within the file to match the paper copy. Provide bookmarks at the first page of each section and label each bookmark with the information contained in that section.

B. Final Report Contents: In addition to certified field-report data, include the following:
1. Pump curves.
2. Fan curves.
3. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Certification sheet signed and sealed by the certified testing and balancing engineer.
11. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
12. Summary of contents including the following:
    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.
13. Nomenclature sheets for each item of equipment.
14. Data for terminal units, including manufacturer's name, type, size, and fittings.
15. Notes to explain why certain final data in the body of reports vary from indicated values.
16. Test conditions for fans and pump performance forms including the following:
    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Variable frequency drive settings including maximum and minimum setpoints.
    g. Inlet vane settings for variable-air-volume systems.
    h. Settings for supply-air, static-pressure controller.
    i. Other system operating conditions that affect performance.

17. Include a list of instruments used for procedures, along with proof of calibration.

3.28 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. TAB Report Verification: The TAB Agency may be required to recheck, in the presence of the Owner's representative, specific or random selections of data recorded in the certified report. Points and areas for recheck shall be selected by the Owner's representative. Measurements and test procedures shall be the same as approved for the initial work for the certified report. Selections for verification, specific plus random, will not exceed 10 percent of the total number of measurements tabulated in the report. If the values measured during the verification process exceed plus or minus 10 percent of the values recorded in the report, the TAB Agency may be required to re-perform the TAB work outlined above.

- END OF SECTION -

- SECTION 23 0713 -

DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes duct exterior insulation systems.

B. Related Sections:
1. Division 23 Section "Metal Ducts" for duct liner.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated, include manufacturer's technical data with proposed thickness and R-value indicated, and application.

1.4 QUALITY ASSURANCE

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule" article for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. All materials shall conform to NFPA 90A and NFPA 90B, ASHRAE 90.1 and the International Energy Construction Code (IECC).

F. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket composed of aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. CertainTeed Corp.; SoftTouch Duct Wrap.
      b. Johns Manville; Microlite.
      c. Knauf Insulation; Friendly Feel Duct Wrap.
      d. Manson Insulation Products Ltd.; Alley Wrap.
      e. Owens Corning; SOFTR All-Service Duct Wrap.
      f. Bonded Logic Ultra-touch.

H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB with factory-applied ASJ or FSK jacket.
   1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
   2. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
   3. Products: Subject to compliance with requirements, provide one of the following:
      a. CertainTeed Corp.; Commercial Board.
      b. Johns Manville; 800 Series Spin-Glas.
      c. Knauf Insulation; Insulation Board.
      d. Owens Corning; Fiberglas 700 Series.
      e. Bonded Logic Ultra-touch.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
   1. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. PVC Jacket Adhesive: Compatible with PVC jacket.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below and above ambient services.

1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
4. Color: White.

2.4 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.
5. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

2.5 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Adhesive: As recommended by jacket material manufacturer.
2. Color: White.

C. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
   1. Sheet and roll stock ready for shop or field sizing or Factory cut and rolled to size.
   2. Finish and thickness are indicated in field-applied jacket schedules.
   3. Moisture Barrier: 3-mil- thick, heat-bonded polyethylene and kraft paper or 2.5-mil- thick polysurlyn.

D. Self-Adhesive Outdoor Jacket: 60-mil- thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with stucco-embossed aluminum-foil facing.

2.6 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Width: 3 inches.
   2. Thickness: 11.5 mils.
   3. Adhesion: 90 ounces force/inch in width.
   4. Elongation: 2 percent.
   5. Tensile Strength: 40 lbf/inch in width.
   6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
   1. Width: 3 inches.
   2. Thickness: 6.5 mils.
   3. Adhesion: 90 ounces force/inch in width.
   4. Elongation: 2 percent.
   5. Tensile Strength: 40 lbf/inch in width.
   6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
   1. Width: 2 inches.
   2. Thickness: 6 mils.
   3. Adhesion: 64 ounces force/inch in width.
   4. Elongation: 500 percent.
   5. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
   1. Width: 2 inches.
   2. Thickness: 3.7 mils.
   3. Adhesion: 100 ounces force/inch in width.
   4. Elongation: 5 percent.
   5. Tensile Strength: 34 lbf/inch in width.

2.7 SECUREMENTS

A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020-inch-thick, 1/2-inch-wide with wing seal or closed seal.

B. Insulation Pins and Hangers:

1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030-inch-thick by 2 inches square.
   b. Spindle: Copper- or zinc-coated, low carbon steel, or stainless steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
   c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
2. Metal, Capacitor-Discharge-Weld Pin, Insulation Hangers: Copper-coated, low carbon steel, or stainless steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated. May be provided with base.
3. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized or stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
   a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
4. Metal, Cupped-Head, Capacitor-Discharge-Weld Pins:
   a. Head: Galvanized, carbon-steel or stainless steel sheet, minimum of 0.016-inch-thick with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
   b. Spindle: Copper- or zinc-coated, low carbon steel, or stainless steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

2.8 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040-inch-thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
   a. For below ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.3 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends below roof surface. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends inside building. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
1. Comply with requirements in Division 07 for firestopping and fire-resistive joint sealers.

E. Insulation Installation at Floor Penetrations:
   1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
   2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07.

3.4 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
   1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
   2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
   3. Install either adhesively attached or capacitor-discharge-weld pins and speed washers, or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
      a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
      b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
      c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
      d. Do not overcompress insulation during installation.
      e. Impale insulation over pins and attach speed washers.
      f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
   4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
      a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
      b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
   5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
   6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either adhesively attached or capacitor-discharge-weld pins and speed washers, or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
   a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
   b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   d. Do not overcompress insulation during installation.
   e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.5 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.6 DUCT INSULATION SCHEDULE

A. Duct, Plenums and Accessories Not Requiring Insulation:
1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1. See Section “Metal Ducts” for duct lining requirements.
2. Factory-insulated flexible ducts.
3. Factory-insulated plenums and casings.
4. Flexible connectors.
5. Vibration-control devices.
6. Factory-insulated access panels and doors.

B. Duct and Plenum Insulation: Insulate ducts and plenums in accordance with the Duct and Plenum Insulation Schedule Table.

Duct & Plenum Insulation Schedule Table

Duct/Plenum System	Duct Type	Duct Location**	Insulation Type	Minimum Insulation Density (PCF)	Minimum Insulation R-Value (Thickness)
Supply	Round	Interior, Concealed	Mineral-Fiber Blanket	0.75	R-5 (2 inches)
Supply	Rectangular	Interior, Concealed	Duct Lining*	--	--
Supply & Return (Within Room it Serves)	Round	Interior, Exposed	None	--	--
Supply & Return (Within Room it Serves)	Rectangular	Interior, Exposed	Duct Lining*	--	--
Supply & Return (Within Mechanical Rooms)	Round	Interior, Exposed	Mineral-Fiber Blanket	0.75	R-5 (2 inches)
Supply & Return (Within Mechanical Rooms)	Rectangular	Interior, Exposed	Duct Lining*	--	--

Duct & Plenum Insulation Schedule Table					
Duct/Plenum System	**Duct Type**	**Duct Location****	**Insulation Type**	**Minimum Insulation Density (PCF)**	**Minimum Insulation R-Value (Thickness)**
Return	Round	Interior, Concealed	Mineral-Fiber Blanket	0.75	R-5 (2 inches)
Return & Exhaust	Rectangular	Interior, Concealed	Duct Lining*	--	--
Exhaust	Round	Interior, Concealed	None	--	--
Unconditioned Outside Air	Round/ Rectangular	Interior, Concealed or Exposed	Mineral-Fiber Blanket	0.75	R-8 (3 inches)
Conditioned Outside Air	Round/ Rectangular	Interior, Concealed or Exposed	Duct Lining*	--	--
Conditioned Outside Air	Round branch to guestroom	Interior, Concealed	None	--	--
Supply & Return	Round/ Rectangular	Exterior, Concealed or Exposed	Duct Lining*	--	--
Outside Air	Round/ Rectangular	Exterior, Concealed	Mineral-Fiber Blanket	0.75	R-5 (2 inches)

* See Division 23 Section "Metal Ducts" for liner requirements.

** Interior means within the insulated building envelope.
Exterior means outside the building envelope.

3.7 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums, Concealed: None.

D. Externally Insulated Ducts and Plenums, Exposed:
   1. PVC: 20 mils.

3.8 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums, Concealed: None.

D. Ducts and Plenums, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:

1. Aluminum, Stucco Embossed: 0.020 inch thick.

E. Ducts and Plenums, Exposed, Larger than 48 Inches in Diameter or with Flat Surfaces Larger than 72 Inches:

1. Aluminum, stucco embossed with 1-1/4-inch-deep corrugations 0.040 inch thick.

- END OF SECTION -

- SECTION 23 0716 -

HVAC EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes insulating the following HVAC equipment that is not factory insulated:
   1. Heat exchangers.
   2. Chilled-water pumps.
   3. Heating, hot-water pumps.
   4. Expansion/compression tanks.
   5. Air separators.
   6. Engine exhaust accessories.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated, include manufacturer's technical data with proposed thickness and R-value indicated, and application.

1.4 QUALITY ASSURANCE

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
   1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
   2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Products shall not contain asbestos, lead, mercury, or mercury compounds.

B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Armstrong.
      b. Halstead-Nomalco.
      c. Imcoa.
      d. Nomaco.
      e. Rubatex.

F. Mineral-Fiber Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I or Type II with factory-applied vinyl jacket.
   1. Products: Subject to compliance with requirements provide one of the following:
      a. CertainTeed Corp.; SoftTouch Duct Wrap.
      b. Johns Manville; Microlite.
      c. Knauf Insulation; Friendly Feel Duct Wrap.
      d. Manson Insulation Inc.; Alley Wrap.
      e. Owens Corning; SOFTR All-Service Duct Wrap.

G. High-Temperature, Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without factory-applied jacket.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Industrial Insulation Group (IIG); MinWool-1200 Flexible Batt.
      b. Johns Manville; HTB 26 Spin-Glas.
      c. Roxul Inc.; Roxul RW.

H. Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. Provide insulation with factory-applied ASJ. ASJ shall be white, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
   1. Products: Subject to compliance with requirements provide one of the following:
      a. CertainTeed Corp.; CertaPro Commercial Board.

b. Fibrex Insulations Inc.; FBX.
c. Johns Manville; 800 Series Spin-Glas.
d. Knauf Insulation; Insulation Board.
e. Manson Insulation Inc.; AK Board.
f. Owens Corning; Fiberglas 700 Series.

I. High-Temperature, Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type III, without factory-applied jacket.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Fibrex Insulations Inc.; FBX.
b. Industrial Insulation Group (IIG); MinWool-1200 Industrial Board.
c. Rock Wool; Delta Board.
d. Roxul Inc.; RHT and RockBoard.
e. Thermafiber, Inc.; Thermafiber Industrial Felt.

J. Mineral-Fiber Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. ASJ shall be white, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
1. Products: Subject to compliance with requirements, provide one of the following:
a. CertainTeed Corp.; CrimpWrap.
b. Johns Manville; MicroFlex.
c. Knauf Insulation; Pipe and Tank Insulation.
d. Manson Insulation Inc.; AK Flex.
e. Owens Corning; Fiberglas Pipe and Tank Insulation.

K. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
a. Armacell LLC.
b. Nomaco Insulation.

2.2 INSULATING CEMENTS

A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

D. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

E. PVC Jacket Adhesive: Compatible with PVC jacket.

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
   1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
   1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
   2. Service Temperature Range: Minus 20 to plus 180 deg F.
   3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
   4. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
   1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
   2. Service Temperature Range: Minus 20 to plus 180 deg F.
   3. Solids Content: 60 percent by volume and 66 percent by weight.
   4. Color: White.

2.5 SEALANTS

A. Joint Sealants:
   1. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Materials shall be compatible with insulation materials, jackets, and substrates.
   3. Permanently flexible, elastomeric sealant.
   4. Service Temperature Range: Minus 100 to plus 300 deg F.
   5. Color: White or gray.

B. Metal Jacket Flashing Sealants:
   1. Materials shall be compatible with insulation materials, jackets, and substrates.
   2. Fire- and water-resistant, flexible, elastomeric sealant.
   3. Service Temperature Range: Minus 40 to plus 250 deg F.
   4. Color: Aluminum.
   5. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:
   1. Materials shall be compatible with insulation materials, jackets, and substrates.
   2. Fire- and water-resistant, flexible, elastomeric sealant.
   3. Service Temperature Range: Minus 40 to plus 250 deg F.
   4. Color: White.
   5. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for equipment.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
   1. Adhesive: As recommended by jacket material manufacturer.
   2. Color: To match adjacent surfaces.
   3. Factory-fabricated tank heads and tank side panels.

D. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
   1. Sheet and roll stock ready for shop or field sizing or Factory cut and rolled to size.
   2. Finish and thickness are indicated in field-applied jacket schedules.
   3. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
   4. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
   5. Factory-Fabricated Fitting Covers:
      a. Same material, finish, and thickness as jacket.
      b. Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      c. Tee covers.
      d. Flange and union covers.
      e. End caps.
      f. Beveled collars.
      g. Valve covers.
      h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

E. Self-Adhesive Outdoor Jacket: 60-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with stucco-embossed aluminum-foil facing.

2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Width: 3 inches.
   2. Thickness: 11.5 mils.
   3. Adhesion: 90 ounces force/inch in width.
   4. Elongation: 2 percent.
   5. Tensile Strength: 40 lbf/inch in width.
   6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
   1. Width: 3 inches.
   2. Thickness: 6.5 mils.
   3. Adhesion: 90 ounces force/inch in width.
   4. Elongation: 2 percent.
   5. Tensile Strength: 40 lbf/inch in width.
   6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
   1. Width: 2 inches.
   2. Thickness: 6 mils.
   3. Adhesion: 64 ounces force/inch in width.
   4. Elongation: 500 percent.
   5. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
   1. Width: 2 inches.
   2. Thickness: 3.7 mils.
   3. Adhesion: 100 ounces force/inch in width.
   4. Elongation: 5 percent.
   5. Tensile Strength: 34 lbf/inch in width.

2.9 SECUREMENTS

A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.

B. Insulation Pins and Hangers:

1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
   b. Spindle: Copper- or zinc-coated, low carbon steel, or stainless steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
   c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
2. Metal, Capacitor-Discharge-Weld Pin, Insulation Hangers: Copper-coated, low carbon steel, or stainless steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated. May be provided with base.
3. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized or stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
   a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
4. Metal, Cupped-Head, Capacitor-Discharge-Weld Pins:
   a. Head: Galvanized, carbon-steel or stainless steel sheet, minimum of 0.016-inch-thick with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
   b. Spindle: Copper- or zinc-coated, low carbon steel, or stainless steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

2.10 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: .040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
      a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

O. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.3 INSTALLATION OF EQUIPMENT, TANK, AND VESSEL INSULATION

A. Mineral-Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
a. Do not weld anchor pins to ASME-labeled pressure vessels.
b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
d. Do not overcompress insulation during installation.
e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
f. Impale insulation over anchor pins and attach speed washers.
g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.

6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches.
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.

C. Insulation Installation Pumps:
1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch-diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
2. Fabricate boxes from aluminum, at least 0.040 inch thick.
3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.4 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturers recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.5 BREECHING INSULATION SCHEDULE

A. Round, Exposed Breeching and Connector: High-temperature mineral-fiber board, 3 inches thick and 3-lb/cu. ft. nominal density.

B. Round, Concealed Breeching and Connector Insulation: High-temperature mineral-fiber blanket or board, 3 inches thick and 3-lb/cu. ft. nominal density.

3.6 EQUIPMENT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

B. Insulate indoor and outdoor equipment that is not factory insulated.

C. Chilled-water service pump insulation shall be one of the following:
1. Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density.
2. Phenolic: 2 inches thick.

D. Heating-hot water and dual service cooling and heating pump insulation: Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density.

E. Heat-Exchanger (Water-to-Water for Thermal or Ice Storage Service) Insulation:
1. Flexible Elastomeric: 1 inch thick.
2. Polyolefin: 1 inch thick.

F. Heat-Exchanger (Water-to-Water for Heating Service) Insulation: Mineral-fiber pipe and tank, 2 inches thick.

G. Heat-Exchanger (Shell and Tube Type, Steam-to-Water for Heating Service) Insulation: Mineral-fiber pipe and tank, 2 inches thick.

H. Heating hot water and dual service expansion/compression tank insulation shall be one of the following:
1. Flexible Elastomeric: 1 inch thick.
2. Mineral-fiber pipe and tank, 1 inch thick.
3. Polyolefin: 1 inch thick.

I. Chilled-water, heating-hot-water and dual service air-separator insulation shall be one of the following:
1. Flexible Elastomeric: 1 inch thick.
2. Polyolefin: 1 inch thick.

J. Heating-Hot-Water air-separator insulation: Mineral-fiber pipe and tank, 2 inches thick.

K. Engine exhaust accessories such as silencers and mufflers, and single wall engine exhaust piping: High-temperature, mineral-fiber blanket and mineral-fiber board insulation, 6 inches thick.

3.7 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Equipment, Concealed:
   1. None.

D. Engine Exhaust Systems: Aluminum, Stucco Embossed: 0.020 inch thick.

E. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches (Excluding Engine Exhaust Systems):
   1. PVC 30 mils thick.
   2. Aluminum, Stucco Embossed: 0.020 inch thick.

F. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:
   1. Aluminum, Stucco Embossed with 1-1/4-Inch-Deep Corrugations: 0.032 inch thick.

3.8 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
   1. Aluminum, Stucco Embossed with Z-Shaped Locking Seam: 0.024 inch thick.

D. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:
   1. Aluminum, Stucco Embossed with 1-1/4-Inch-Deep Corrugations 0.040 inch thick.

- END OF SECTION -

- SECTION 23 0719 -

HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes insulating the following HVAC piping systems:
   1. Chilled-water and brine piping.
   2. Heating hot-water piping.
   3. Refrigerant piping.
   4. Make-up water piping.
   5. Condensate drain piping.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated, include manufacturer's technical data with proposed thickness and R-value indicated, and application.

1.4 QUALITY ASSURANCE

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
   1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
   2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Products shall not contain asbestos, lead, mercury, or mercury compounds.

B. All insulating materials shall conform to NFPA 90A and NFPA 90b, ASHRAE 90.1 and the International Energy Construction Code (IECC).

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
   1. Manufacturers: Subject to compliance with requirements, provide product by one of the following manufacturers:
      a. Armacell LLC.
      b. Halstead-Nomalco.
      c. Imcoa.
      d. Nomaco.
      e. Rubatex

G. Mineral-Fiber Insulation:
   1. Manufacturers: Subject to compliance with requirements, provide product by one of the following manufacturers:
      a. CertainTeed Corp.
      b. Johns Manville.
      c. Knauf Insulation.
      d. Manson Insulation Products Ltd.
      e. Owens Corning.
   2. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 1290, Type I.
   3. Mineral-Fiber, Preformed Pipe Insulation: Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ or with factory-applied ASJ-SSL. Omit jacket on all but outermost layer where multiple insulation layers are required. Jacket shall comply with the following:
      a. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
      b. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

H. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.
   1. Manufacturers: Subject to compliance with requirements, provide product by one of the following manufacturers:
      a. Armacell LLC.
      b. Imcoa.
      c. Nomaco.

2.2 INSULATING CEMENTS

A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
   1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

D. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

E. PVC Jacket Adhesive: Compatible with PVC jacket.

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
   1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
   1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
   2. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
   3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
   4. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
   1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
   2. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
   3. Solids Content: 60 percent by volume and 66 percent by weight.
   4. Color: White.

2.5 SEALANTS

A. Joint Sealants:
1. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
5. Color: White or gray.

B. Metal Jacket Flashing Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
4. Color: Aluminum.

C. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
4. Color: To match jacket.

2.6 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm), in a Leno weave, for pipe.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Adhesive: As recommended by jacket material manufacturer.
2. Color: Color-code jackets based on system within mechanical rooms, white in all other areas.
3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, traps, and mechanical joints.

C. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.
1. Sheet and roll stock ready for shop or field sizing, or factory cut and rolled to size.
2. Finish and thickness are indicated in field-applied jacket schedules.
3. Moisture Barrier for Indoor and Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.

4. Factory-Fabricated Fitting Covers:
   a. Same material, finish, and thickness as jacket.
   b. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
   c. Tee covers.
   d. Flange and union covers.
   e. End caps.
   f. Beveled collars.
   g. Valve covers.
   h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

D. Self-Adhesive Outdoor Jacket: 60-mil- (1.5-mm-) thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with stucco-embossed aluminum-foil facing.

2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Width: 3 inches (75 mm).
   2. Thickness: 11.5 mils (0.29 mm).
   3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
   4. Elongation: 2 percent.
   5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
   6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
   1. Width: 2 inches (50 mm).
   2. Thickness: 6 mils (0.15 mm).
   3. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
   4. Elongation: 500 percent.
   5. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
   1. Width: 2 inches (50 mm).
   2. Thickness: 3.7 mils (0.093 mm).
   3. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
   4. Elongation: 5 percent.
   5. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.9 SECUREMENTS

A. Aluminum Bands: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

C. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) o.c.
   a. For below-ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.3 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends below roof surface. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.

4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends inside building. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Division 07 for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 for firestopping and fire-resistive joint sealers.

G. Installation of Pipe Hangers and Rollers: Install thermal-hanger shield inserts complying with Section 230529 “Hangers and Supports for HVAC Piping and Equipment” at all hangers and rollers.

3.4 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated and where required for maintenance. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 INSTALLATION OF MINERAL-FIBER PREFORMED PIPE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation without jacket to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.7 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes: Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.
   1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

B. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal seams and end joints with weatherproof sealant recommended by insulation manufacturer or if no sealant is recommended with silicone caulk. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.9 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on pre-insulated underground piping.

3.10 INDOOR PIPING INSULATION SCHEDULE

A. Chilled Water, above 40 Deg F: Insulation shall have a maximum k-factor of 0.27 at a mean rating temperature of 75 Deg F and be one of the following:
   1. Flexible Elastomeric: 1 inch (50 mm) thick. Do not use on piping larger than 1-1/2 inches (38 mm).
   2. Mineral-Fiber, Preformed Pipe, Type I 1 inch (25 mm) thick for pipe 1-1/2 inches (38mm) and smaller, 1-1/2 inches (38 mm) thick for piping larger than 1-1/2 inches (38mm).
   3. Polyolefin: 1 inch (25 mm) thick. Do not use on piping larger than 1-1/2 inches (38 mm).

B. Heating-Hot-Water Supply and Return, 200 Deg F (93 Deg C) and Below: Mineral-Fiber, Preformed Pipe, Type I with a maximum k-factor of 0.29 at a mean rating temperature of 125: 1 inch (25 mm) thick for pipe 1-1/2 inches (38mm) and smaller, 2 inches (50 mm) thick for pipe larger than 1-1/2 inches (38mm).

C. Refrigerant Suction Piping: Insulation shall be one of the following:
   1. Flexible elastomeric: 1 inch (25 mm) thick.
   2. Mineral-fiber, preformed pipe insulation: 1 inch (25 mm) thick.
   3. Polyolefin: 1 inch (25 mm) thick.

D. Refrigerant Suction Flexible Tubing: Insulation shall be one of the following:
   1. Flexible elastomeric, 1 inch (25 mm) thick.
   2. Polyolefin, 1 inch (25 mm) thick.

E. Air Conditioning Condensate Drain Piping: Flexible elastomeric or polyolefin 3/4 inch (19 mm) thick.

3.11 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Chilled Water, above 40 Deg F: Mineral-Fiber, Preformed Pipe, Type I with a maximum k-factor of 0.27 at a mean rating temperature of 75 Deg F: 1-1/2 inch thick for pipe 1-1/2 inches and smaller, 2 inches thick for piping larger than 1-1/2 inches (38mm).

B. Heating-Hot-Water Supply and Return, 200 Deg F (93 Deg C) and Below: Mineral-Fiber, Preformed Pipe Insulation, Type I with a maximum k-factor of 0.29 at a mean rating temperature of 125: 1-1/2 inches (38 mm) thick for pipe 1-1/2 inches (38 mm) and smaller, 2 inches (50 mm) thick for pipe larger than 1-1/2 inches (38 mm).

C. Refrigerant Suction Piping: Insulation shall be one of the following:
1. Flexible Elastomeric: 1 inch (50 mm) thick.
2. Polyolefin: 1 inch (50 mm) thick.

D. Refrigerant Suction Flexible Tubing: Insulation shall be one of the following:
1. Flexible Elastomeric: 1 inch (50 mm) thick.
2. Polyolefin: 1 inch (50 mm) thick.

E. Make-up Water Piping: Flexible elastomeric or polyolefin 3/4 inch (19 mm) thick.

F. Air Conditioning Condensate Drain Piping: Flexible elastomeric or polyolefin 3/4 inch (19 mm) thick.

3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option or as directed on the drawings.

C. Piping, Concealed: None.

D. Piping, Exposed:
1. PVC Color-Coded by System: 30 mils (0.8 mm) thick.

3.13 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed: None.

D. Piping, Exposed:

1. Aluminum, Corrugated or Stucco Embossed: 0.020 inch (0.51 mm) thick.

3.14 PVC JACKET COLOR CODING SCHEDULE

A. Where directed, provide PVC jacketing in the following colors or as selected by the Owner:
   1. Chilled Water Supply: Dark Blue
   2. Chilled Water Return: Light Blue
   3. Heating Hot Water: Yellow

- END OF SECTION -

- SECTION 23 0800 -

COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. The purpose of this section is to specify Division 23 responsibilities in the commissioning process.
      a. The systems to be commissioned are listed in Section 01 91 13.
      b. Commissioning requires the participation of Division 23 to ensure that all systems are operating in a manner consistent with the Contract Documents. The general commissioning requirements and coordination are detailed in Division 01. Division 23 shall be familiar with all parts of Division 01 and the commissioning plan issued by the CxA and shall execute all commissioning responsibilities assigned to them in the Contract Documents.

B. Related Sections:
   1. Section 01 91 13 – General Commissioning Requirements.
   2. Section 23 08 00.01 – HVAC Testing Requirements
   3. Section 23 08 00.02 – HVAC Prefunctional Checklists
   4. Section 23 08 00.03 – HVAC Sample Functional Test Procedures

C. Related Work:
   1. Refer to Section 01 91 13 for a listing of all Sections where commissioning requirements are found.
   2. Refer to Section 01 91 13 for systems to be commissioned and Sections 23 08 00 through 23 08 00.03 for functional testing requirements.

1.3 RESPONSIBILITIES

A. HVAC, Controls and TAB Contractors. The commissioning responsibilities applicable to each of the mechanical, controls and TAB contractors of Division 23 are as follows (all references apply to commissioned equipment only):
   1. Construction and Acceptance Phases:
      a. Include and itemize the cost of commissioning in the contract price.

b. In each purchase order or subcontract written, include requirements for submittal data, commissioning documentation, O&M data and training.

c. Attend a commissioning scoping meeting and other meetings necessary to facilitate the Cx process.

d. Contractors shall provide the CxA with normal cut sheets and shop drawing submittals of commissioned equipment.

e. Provide additional requested documentation, prior to normal O&M manual submittals, to the CxA for development of start-up and functional testing procedures.

   1) Typically this will include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, full details of any owner-contracted tests, fan and pump curves, full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation, start-up and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Agent.

   2) The Commissioning Agent may request further documentation necessary for the commissioning process.

   3) This data request may be made prior to normal submittals.

f. Provide a copy of the O&M manuals and submittals of commissioned equipment, through normal channels, to the CxA for review and approval.

g. Contractors shall assist (along with the design engineers) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.

h. Provide limited assistance to the CxA in preparing the specific functional performance test procedures as specified in Section. Subs shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.

i. Develop a full start-up and initial checkout plan using manufacturer's start-up procedures and the prefunctional checklists from the CxA for all commissioned equipment. Submit to CxA for review and approval prior to startup. Refer to Section 01 91 13 for further details on start-up plan preparation.

j. During the startup and initial checkout process, execute the mechanical-related portions of the prefunctional checklists for all commissioned equipment.

k. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CxA.

l. Address current A/E punch list items before functional testing. Air and water TAB shall be completed with discrepancies and problems remedied before functional testing of the respective air- or water-related systems.

m. Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.

n. Provide skilled technicians to perform functional performance testing under the direction of the CxA for specified equipment in Section 01 91 13 and 23 08 00 through 23 08 00.03. Assist the CxA in interpreting the monitoring data, as necessary.

o. Correct deficiencies (differences between specified and observed performance) as interpreted by the CxA, CM and A/E and retest the equipment.

p. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.

q. During construction, maintain as-built red-line drawings for all drawings and provide final CAD record drawings for owner and contractor-generated coordination drawings. Update after completion of commissioning (excluding deferred testing).

r. Provide training of the Owner's operating staff using expert qualified personnel, as specified.

s. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

2. Warranty Period:

a. Execute seasonal or deferred functional performance testing, witnessed by the CxA, according to the specifications.

b. Correct deficiencies and make necessary adjustments to O&M manuals and record drawings for applicable issues identified in any seasonal testing.

B. Mechanical Contractor. The responsibilities of the HVAC mechanical contractor, during construction and acceptance phases in addition to those listed in (A) are:

1. Provide startup for all HVAC equipment, except for the building automation control system.

2. Assist and cooperate with the TAB contractor and CxA by:

a. Putting all HVAC equipment and systems into operation and continuing the operation during each working day of TAB and commissioning, as required.

b. Including cost of sheaves and belts that may be required by TAB.

c. Providing test holes in ducts and plenums where directed by TAB to allow air measurements and air balancing. Providing an approved plug.

d. Providing temperature and pressure taps according to the Construction Documents for TAB and commissioning testing.

3. Install a P/T plug at each water sensor which is an input point to the control system.

4. List and clearly identify on the as-built drawings the locations of all air-flow stations.

5. Prepare a preliminary schedule for Division 23 pipe and duct system testing, flushing and cleaning, equipment start-up and TAB start and completion for use by the CxA. Update the schedule as appropriate.

6. Notify the Owner, GC or CxA depending on protocol, when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment and TAB will occur. Be responsible to notify the Owner, GC or CxA, ahead of time, when commissioning activities not yet performed or not yet scheduled will delay construction. Be proactive in seeing that commissioning processes are executed and that the CxA has the scheduling information needed to efficiently execute the commissioning process.

C. Controls Contractor (if Applicable). The commissioning responsibilities of the controls contractor, during construction and acceptance phases in addition to those listed in (A) are:

1. Sequences of Operation Submittals. The Controls Contractor's submittals of control drawings shall include complete detailed sequences of operation for each piece of equipment, regardless of the completeness and clarity of the sequences in the specifications. They shall include:

a. An overview narrative of the system (1 or 2 paragraphs) generally describing its purpose, components and function.
b. All interactions and interlocks with other systems.
c. Detailed delineation of control between any packaged controls and the building automation system, listing what points the BAS monitors only and what BAS points are control points and are adjustable.
d. Written sequences of control for packaged controlled equipment. (Equipment manufacturers' stock sequences may be included, but will generally require additional narrative).
e. Start-up sequences.
f. Warm-up mode sequences.
g. Normal operating mode sequences.
h. Unoccupied mode sequences.
i. Shutdown sequences.
j. Capacity control sequences and equipment staging.
k. Temperature and pressure control: setbacks, setups, resets, etc.
l. Detailed sequences for all control strategies, e.g., economizer control, optimum start/stop, staging, optimization, demand limiting, etc.
m. Effects of power or equipment failure with all standby component functions.
n. Sequences for all alarms and emergency shut downs.
o. Seasonal operational differences and recommendations.
p. Initial and recommended values for all adjustable settings, set points and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.
q. Schedules, if known.
r. To facilitate referencing in testing procedures, all sequences shall be written in small statements, each with a number for reference. For a given system, numbers will not repeat for different sequence sections, unless the sections are numbered.

2. Control Drawings Submittal:
   a. The control drawings shall have a key to all abbreviations.
   b. The control drawings shall contain graphic schematic depictions of the systems and each component.
   c. The schematics will include the system and component layout of any equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
   d. Provide a full points list with at least the following included for each point:
   e. Controlled System:
      1) Point abbreviation
      2) Point description
      3) Display unit
      4) Control point or set point (Yes / No)
      5) Monitoring point (Yes / No)
      6) Intermediate point (Yes / No)
      7) Calculated point (Yes / No)

Key
- Point Description: DB temp, airflow, etc.
- Control or Set point: Point that controls equipment and can have its set point changed (OSA, SAT, etc.)
- Intermediate Point: Point whose value is used to make a calculation which then controls equipment (space temperatures that are averaged to a virtual point to control reset).
- Monitoring Point: Point that does not control or contribute to the control of equipment, but is used for operation, maintenance, or performance verification.
- Calculated Point: "Virtual" point generated from calculations of other point values.
- The Controls Contractor shall keep the CxA informed of all changes to this list during programming and setup.

3. An updated as-built version of the control drawings and sequences of operation shall be included in the final controls O&M manual submittal.
4. Assist and cooperate with the TAB contractor in the following manner:
   a. Meet with the TAB contractor prior to beginning TAB and review the TAB plan to determine the capabilities of the control system toward completing TAB. Provide the TAB any needed unique instruments for setting terminal unit boxes and instruct TAB in their use (handheld control system interface for use around the building during TAB, etc.).
   b. For a given area, have all required prefunctional checklists, calibrations, startup and selected functional tests of the system completed and approved by the CxA prior to TAB.
   c. Provide a qualified technician to operate the controls to assist the TAB contractor in performing TAB, or provide sufficient training for TAB to operate the system without assistance.
5. Assist and cooperate with the CxA in the following manner:
   a. Using a skilled technician who is familiar with this building, execute the functional testing of the controls system as specified for the controls contractor in Sections 23 08 00 through 23 08 00.03 and 26 08 00 through 26 08 00.03. Assist in the functional testing of all equipment specified in Sections 23 08 00 through 23 08 00.03 and 26 08 00 through 26 08 00.03. Provide two-way radios during the testing.
   b. Execute all control system trend logs specified in Sections 23 08 00 through 23 08 00.03 and 26 08 00 through 26 08 00.03.
6. The controls contractor shall prepare a written plan indicating in a step-by-step manner, the procedures that will be followed to test, checkout and adjust the control system prior to functional performance testing, according to the process in Section 01 91 13. At minimum, the plan shall include for each type of equipment controlled by the automatic controls:
   a. System name.
   b. List of devices.
   c. Step-by-step procedures for testing each controller after installation, including:
      1) Process of verifying proper hardware and wiring installation.
      2) Process of downloading programs to local controllers and verifying that they are addressed correctly.
      3) Process of performing operational checks of each controlled component.

4) Plan and process for calibrating valve and damper actuators and all sensors.

5) A description of the expected field adjustments for transmitters, controllers and control actuators should control responses fall outside of expected values.

d. A copy of the log and field checkout sheets that will document the process. This log must include a place for initial and final read values during calibration of each point and clearly indicate when a sensor or controller has "passed" and is operating within the contract parameters.

e. A description of the instrumentation required for testing.

f. Indicate what tests on what systems should be completed prior to TAB using the control system for TAB work. Coordinate with the CxA and TAB contractor for this determination.

7. Provide a signed and dated certification to the CxA and GC upon completion of the checkout of each controlled device, equipment and system prior to functional testing for each piece of equipment or system, that all system programming is complete as to all respects of the Contract Documents, except functional testing requirements.

8. Beyond the control points necessary to execute all documented control sequences, provide monitoring, control and virtual points as specified in Section 23 09 00.

9. List and clearly identify on the as-built duct and piping drawings the locations of all static and differential pressure sensors (air, water and building pressure).

D. TAB Contractor. The duties of the TAB contractor, in addition to those listed in (A) are:

1. Six weeks prior to starting TAB, submit to the GC the qualifications of the site technician for the project, including the name of the contractors and facility managers of recent projects the technician on which was lead. The Owner will approve the site technician's qualifications for this project.

2. Submit the outline of the TAB plan and approach for each system and component to the Owner, CxA, GC and the controls contractor six weeks prior to starting the TAB. This plan will be developed after the TAB has some familiarity with the control system.

3. The submitted plan will include:

a. Certification that the TAB contractor has reviewed the construction documents and the systems with the design engineers and contractors to sufficiently understand the design intent for each system.

b. An explanation of the intended use of the building control system. The controls contractor will comment on feasibility of the plan.

c. All field checkout sheets and logs to be used that list each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.

d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.

e. Final test report forms to be used.

f. Detailed step-by-step procedures for TAB work for each system and issue: terminal flow calibration (for each terminal type), diffuser proportioning, branch / submain proportioning, total flow calculations, rechecking, diversity issues, expected problems and solutions, etc. Criteria for using air flow straighteners or relocating flow stations and sensors will be discussed. Provide the analogous explanations for the water side.

g. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.

h. Details of how total flow will be determined (Air: sum of terminal flows via BAS calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations. Water: pump curves, circuit setter, flow station, ultrasonic, etc.).

i. The identification and types of measurement instruments to be used and their most recent calibration date.

j. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and provide methods to verify this.

k. Confirmation that TAB understands the outside air ventilation criteria under all conditions.

l. Details of whether and how minimum outside air cfm will be verified and set, and for what level (total building, zone, etc.).

m. Details of how building static and exhaust fan / relief damper capacity will be checked.

n. Proposed selection points for sound measurements and sound measurement methods.

o. Details of methods for making any specified coil or other system plant capacity measurements.

p. Details of any TAB work to be done in phases (by floor, etc.), or of areas to be built out later.

q. Details regarding specified deferred or seasonal TAB work.

r. Details of any specified false loading of systems to complete TAB work.

s. Details of all exhaust fan balancing and capacity verifications, including any required room pressure differentials.

t. Details of any required interstitial cavity differential pressure measurements and calculations.

u. Plan for hand-written field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).

v. Plan for formal progress reports (scope and frequency).

w. Plan for formal deficiency reports (scope, frequency and distribution).

4. A running log of events and issues shall be kept by the TAB field technicians. Submit hand-written reports of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests to the Owner, CxA and GC at least twice a week.

5. Communicate in writing to the controls contractor all set point and parameter changes made or problems and discrepancies identified during TAB which affect the control system setup and operation.

6. Provide a draft TAB report within two weeks of completion. A copy will be provided to the CxA. The report will contain a full explanation of the methodology, assumptions and the results in a clear format with designations of all uncommon abbreviations and column headings. The report should follow the latest and most rigorous reporting recommendations by AABC, NEBB or ASHRAE Standard 111 (as specified).

7. Provide the CxA with any requested data, gathered, but not shown on the draft reports.

8. Provide a final TAB report for the CxA with details, as in the draft.

9. Conduct functional performance tests and checks on the original TAB as specified for TAB in Sections 23 08 00 thru 23 08 00.03.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. Division 23 shall provide all test equipment necessary to fulfill the testing requirements of this Division.

B. Refer to Section 01 91 13 for additional Division 23 requirements.

PART 3 - EXECUTION

3.1 STARTUP

A. The HVAC mechanical and controls contractors shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this Section and in 01 91 13. Division 23 has start-up responsibility and is required to complete systems and sub-systems so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the commissioning agent or Owner.

B. Functional testing is intended to begin upon completion of a system. Functional testing may proceed prior to the completion of systems or sub-systems at the discretion of the CxA and GC. Beginning system testing before full completion does not relieve the Contractor from fully completing the system, including all prefunctional checklists as soon as possible.

3.2 TAB

A. Refer to the TAB responsibilities in Article 1.03 “Responsibilities” of this Section.

3.3 FUNCTIONAL PERFORMANCE TESTS

A. Refer to Section 01 91 13 for a list of systems to be commissioned and to Section 01 91 13, Article 3.06 “Documentation, Non-Conformance and Approval of Tests” for a description of the process and to Sections 23 08 00 through 23 08 00.03 for specific details on the required functional performance tests.

3.4 TESTING DOCUMENTATION, NON-CONFORMANCE AND APPROVALS

A. Refer to Section 01 91 13 for specific details on non-conformance issues relating to prefunctional checklists and tests.

B. Refer to Section 01 91 13 for issues relating to functional performance tests.

3.5 DEFERRED TESTING

A. Refer to Section 01 91 13 for requirements of deferred testing.

3.6 WRITTEN WORK PRODUCTS

A. Written work products of Contractors will consist of the start-up and initial checkout plan described in Section 01 91 13 and the filled out start-up, initial checkout and prefunctional checklists.

- END OF SECTION -

- SECTION 23 0800.01 -

HVAC TESTING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. This Section specifies the functional testing requirements for Division 23 systems and equipment.

B. Related Sections:
   1. Section 01 91 13 – General Commissioning Requirements.
   2. Section 23 08 00 – Commissioning of HVAC
   3. Section 23 08 00.02 – HVAC Prefunctional Checklists
   4. Section 23 08 00.03 – HVAC Sample Functional Test Procedures

1.3 INCLUDED SYSTEMS AND EQUIPMENT

A. The following is a list of the equipment and system test requirements included in this section:
   1. Instrumentation and Controls for HVAC
   2. Exhaust Fans
   3. Terminal Units
      a. Fan Coil Units
      b. VAV Boxes
   4. Air Handling Units
      a. VAV Air Handling Units
      b. Constant Volume Air Handling Units
   5. Chilled Water Plant
      a. Chillers
      b. Cooling Towers
      c. Heat Exchangers
      d. Pumps.

6. Boiler Plant
   a. Boilers
   b. Heat Exchangers
   c. Pumps
   d. Storage Tanks
7. Swimming Pool Dehumidifiers
8. Test and Balance Work (TAB)

1.4 DESCRIPTION

A. This section specifies the functional testing requirements for Division 23 systems and equipment. From these requirements, the Commissioning Authority (CxA) shall develop step-by-step procedures to be executed by the subcontractors or the Commissioning Authority. The general functional testing process, requirements and test method definitions are described in Section 01 91 13. The test requirements for each piece of equipment or system contain the following:
   1. The contractors responsible to execute the tests, under the direction of the CxA.
   2. A list of the integral components being tested.
   3. Prefunctional checklists associated with the components.
   4. Functions and modes to be tested.
   5. Required conditions of the test for each mode.
   6. Special procedures.
   7. Required methods of testing.
   8. Required monitoring.
   9. Acceptance criteria.
   10. Sampling strategies allowed.

1.5 PREREQUISITES

A. The following applicable generic prerequisite checklist items are listed on each written functional test form and shall be completed and checked off by CxA prior to functional testing:
   1. All related equipment has been started up and start-up reports and prefunctional checklists submitted and approved ready for functional testing:
   2. All control system functions for this and all interlocking systems are programmed and operable per contract documents, including final setpoints and schedules with debugging, loop tuning and sensor calibrations completed.
   3. Piping system flushing complete and required report approved.
   4. Water treatment system complete and operational.
   5. Vibration control report approved (if required).
   6. Test and balance (TAB) complete and approved for the hydronic system.
   7. All A/E punchlist items for this equipment corrected.
   8. These functional test procedures reviewed and approved by installing contractor.
   9. Safeties and operating ranges reviewed by the CxA.
   10. Test requirements and sequences of operation attached.
   11. Schedules and setpoints attached.

12. False loading equipment, system and procedures ready.
13. Crankcase heaters have been on long enough for immediate startup.
14. Sufficient clearance around equipment for servicing.
15. Record of all values for pre-test setpoints changed to accommodate testing has been made and a check box provided to verify return to original values (control parameters, limits, delays, lockouts, schedules, etc.).
16. Other miscellaneous checks of the prefunctional checklist and start-up reports completed successfully.

1.6 MONITORING

A. Monitoring is a method of testing as a stand-alone method or to augment manual testing.

B. All points listed in the required monitoring section of the test requirements which are control system monitored points shall be trended by the controls contractor. At the option of the CxA, some control system monitoring may be replaced with datalogger monitoring. At the CxA's request, the controls contractor shall trend up to 20% more points than listed herein at no extra charge.

C. Hard copies of monitored data must be in columnar format with time down the left column and at least 5 columns of point values on the same page.

D. Graphical output is desirable, and will be required for all output, if the system can produce it.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 AIR HANDLER UNITS (AHU)

A. Parties Responsible to Execute Functional Test:
1. Controls contractor: operate the controls to activate the equipment as needed.
2. Mechanical contractor: Witnesses, document testing, assist in testing, and correct deficiencies.
3. CxA: to witness, direct and document testing.
4. Owners Representative: witness

B. Integral Components or Related Equipment Being Tested:

	Prefunctional Checklist
AHU and Components (Fans, Coils, Valves, Ducts, VFD):	Air Handling Units
	Ductwork
	Energy Recovery Wheel

C. Prerequisites: The applicable prerequisite checklist items listed in Section 23 08 00.01 shall be listed on each functional test form and checked off prior to functional testing. The commissioning agent will also spot-check misc. items and calibrations on the prefunctional checklists previously completed by the installer, before the beginning of functional testing.

D. Functions/Modes Required to Be Tested, Test Methods and Seasonal Test Requirements: The following testing requirements are an addition to and do not replace any testing requirements elsewhere in this Division.

Function/Mode	Test Method Manual, Monitoring, Either or Both[3]	Required Seasonal Test[1]
General		
1. Test each sequence in the sequence of operations, and other significant modes and sequences not mentioned; including startup, shutdown, unoccupied & manual modes and power failure. Test functionality of this piece of equipment or system in all control strategies or interlocks with which it is associated.	Manual	
In addition to, or as part of (1) above, the following modes or tests are required:		
2. Mixed & supply air, & reset temperature control functions.	Both	
3. Economizer functions.	Both	Cooling
4. SF, RF and exhaust fan interlocks.	Either	
5. Duct static pressure (SP) control.	Both	
6. Return or exhaust fan tracking and building SP.	Monitoring	
7. VFD (or inlet vanes) operation on SF and RF: modulation to minimum, control system PID, proportional band of speed vs controlling parameter, constancy of static pressure, verification of program settings, alarms, etc.	Both	[2]
8. Damper interlocks and correct modulation in all modes, including smoke and fire dampers.	Manual	
9. Temperature difference across HC & CC per specifications.	Manual	
10. Verification of minimum OSA control through varying VAV box positions.	Either	[2]
11. Branch duct control damper control.	Manual	
12. Night low limit, morning warmup cycle.	Either	
13. Heat recovery operation.	Monitoring	
14. Verify TAB reported SF cfm with control system reading.	Manual	[2]
15. All alarms (low limits, high static, etc.)	Manual	
16. Heating and cooling coil capacity test, optional.	Manual	Design
17. Sensor and actuator calibration checks: on duct static pressure sensor on SAT, MAT, OSAT, OSA & RA damper and valve positions, SF cfm reading with TAB, and other random checks (EMS readout against hand-held calibrated instrument or observation must be within specified tolerances)	Manual	

Function/Mode	Test Method Manual, Monitoring, Either or Both[3]	Required Seasonal Test[1]
18. Verify schedules and setpoints to be reasonable and appropriate.		

[1]Cooling season, Heating season or both. "Design" means within 5 deg of season design (ASHRAE 2 1/2%), or 95% of loading design. A blank cell denotes no special seasonal test is required and that test can be executed during any season, if condition simulation is appropriate.
[2]Seasonal test not required if seasonal conditions can be adequately simulated.
[3]Refer to Special Procedures.

E. Special Procedures:

1. Reduced Testing for Smaller Units. For standard application AHU's less than 15 tons, the following modifications to the testing requirements apply:
   a. Either Manual or Monitoring will satisfy the verification requirement--where Both is listed, choose one.
   b. Testing Modes 6, 8, 11, 13 and 16 are not required.

F. Required Monitoring: All points listed below which are control system monitored points shall be trended by the controls contractor. Refer to the Monitoring section at the beginning of Section 23 08 00.01 for additional monitoring details.

Point	Time Step (min.)	Minimum Time Period of Trend	Hard Copy? (Y/N)	ASCII File? (Y/N)	Function Being Tested
For each AHU being tested:					
RAT	5	5 days incl. weekend	Y	Y	1-3, 5
SAT	5	5 days incl. weekend	Y	Y	1-3, 5
MAT	5	5 days incl. weekend	Y	Y	1, 3
Indoor WB or enthalpy, if enthalpy economizer	5	5 days incl. weekend	Y	Y	1, 3
SF speed, if variable, else status	5	5 days incl. weekend	Y	Y	1, 5-9
RF speed, if variable, else status	5	5 days incl. weekend	Y	Y	1, 5-9
Duct SP	5	5 days incl. weekend	Y	Y	1, 7, 9
Building SP differential	5	5 days incl. weekend	Y	Y	8
OSAT	5	5 days incl. weekend	Y	Y	All
OSA-WB or enthalpy, if enthalpy economizer	5	5 days incl. weekend	Y	Y	1, 3
Indoor dry-bulb ___ zones (expected to be most problematic)	5	5 days incl. weekend	Y	Y	All

Remarks:
SF cfm not required if not monitored.
RF cfm not required if not monitored.

G. Acceptance Criteria (referenced by function or mode ID):

1. 1 - 21. For the conditions, sequences and modes tested, the AHU, integral components and related equipment respond to varying loads and changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice.
2. 2. AHU with supporting systems shall be able to maintain the SA temperature within 1.0F either side of the deadband of the current setpoint without excessive hunting.
3. 7. AHU and controls shall control the duct static pressure so that it does not drift more than an amount equal to 10% of the setpoint value either side of the deadband without excessive hunting.

H. Sampling Strategy for Identical Units:

1. AHU's shall not have any sampling--test all units. However, 25% of the units may have monitoring be the verification method for modes listed with Monitoring or Both as testing methods, with no less than three units being fully tested per the above requirements.
2. All units not included in the sampling testing and monitoring shall be fully monitored for the monitoring modes listed above in the monitoring section.

3.2 INSTRUMENTATION AND CONTROLS FOR HVAC (IF APPLICABLE)

A. Parties Responsible to Execute Functional Test

1. Controls contractor: operate the controls to activate the equipment.
2. CxA: to witness, direct and document testing.
3. Owners Representative: witness
4. Integral Components or Related Equipment Being Tested:

	Prefunctional Checklist
Building Automation System	BAS
All Pre-Functional Checklists of Controlled Equipment	---

B. Prerequisites The applicable prerequisite checklist items listed in the beginning of Section 23 08 00.01 shall be listed on each functional test form and checked off prior to functional testing. The commissioning agent will also spot-check misc. items and calibrations on the prefunctional checklists previously completed by the installer, before the beginning of functional testing.

C. A significant part of the BAS functional testing requirements is the successful completion of the functional tests of equipment the BAS controls or interlocks with. Uncompleted equipment functional tests or outstanding deficiencies in those tests lend the required BAS functional testing incomplete.

D. Integral or stand-alone controls are functionally tested with the equipment they are attached to, including any interlocks with other equipment or systems and thus are not covered under the BAS testing requirements, except for any integrated functions or interlocks listed below.

E. In addition to the controlled equipment testing, the following tests are required for the BAS, where features have been specified. The following testing requirements are in addition to and do not replace any testing requirements elsewhere in the specifications.

Function/Mode		Test Method Manual (demonstration), Monitoring, Either or Both
MISC. FUNCTIONS		
1.	All specified functions and features are set up, debugged and fully operable	Verbal discussion of features
2.	Power failure and battery backup and power-up restart functions	Demonstration
3.	Specified trending and graphing features demonstration	See equipment trends
4.	Global commands features	Demonstration
5.	Security and access codes	Demonstration
6.	Occupant over-rides (manual, telephone, key, keypad, etc.)	Demonstration
7.	O&M schedules and alarms	Demonstration
8.	Scheduling features fully functional and setup, including holidays	Observation in terminal screens or printouts
9.	Date and time setting in central computer and verify field panels read the same time	Demonstration
10.	Included features not specified to be setup are installed (list)	Demonstration
11.	Occupancy sensors and controls	Demonstration
12.	Demonstrate functionality of field panels using local operator keypads and local ports (plug-ins) using portable computer/keypad	Demonstration of 100% of panels and 10% of ports
13.	All graphic screens and value readouts completed	Demonstration
14.	Setpoint changing features and functions	Done during equipment testing
15.	Communications to remote sites	Demonstration
16.	Sensor calibrations	Sampled during equipment tests
17.	“After hours” use tracking and billing	
18.	Final as-builts or redlines (per spec) control drawings, final points list, program code, setpoints, schedules, warranties, etc. per specs, submitted for O&Ms.	Observation
19.	Verify that points that are monitored only, having no control function, are checked for proper reporting to BAS.	Observation
INTEGRATED TESTS		
20.	Fire alarm interlocks and response	Demonstration
21.	Duty cycling (if specified)	Monitoring
22.	Demand limiting (including over-ride of limiting)	Monitoring
23.	Sequential staging ON of equipment	Either
24.	Optimum start-stop functions	Monitoring
25.	All control strategies and sequences not tested during controlled equipment testing	Either
26.	Other integrated tests specified in the contract documents	
27.	Security system interlocks	Demonstration
28.	Fire protection and suppression systems	Demonstration

F. Special Procedures: None

G. Additional Required Monitoring: Besides the trending and monitoring required with the functional testing of equipment, all points listed below which are control system monitored points shall be trended by the controls contractor. Refer to the Monitoring section at the beginning of Section 23 08 00.01 for additional monitoring details.

Point	Time Step (min.)	Minimum Time Period of Trend	Hard Copy? (Y/N)	ASCII File? (Y/N)	Function Being Tested
Misc. equipment current or status for duty cycling and demand limiting	5	5 days incl. weekend	Y	Y	21-22
Equipment or building kW or current for demand limiting	5	5 days incl. weekend	Y	Y	21-22
Optimum start/stop equip.	5	5 days incl. weekend	Y	Y	24

H. Acceptance Criteria (referenced by function or mode ID):

1. All: For the conditions, sequences and modes tested, the BAS, integral components and related equipment respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice.

I. Sampling Strategy for Identical Units: Sample 10% of the field panels for procedure 9, and 10% of the local ports for procedure 12. If 10% fail, test another 10%. If 10% of those fail, test all remaining units at the contractor's expense.

J. Parties Responsible to Execute Functional Test:

1. Controls contractor: operate the controls to activate the equipment as needed.
2. Mechanical contractor: Witnesses, document testing, assist in testing, and correct deficiencies.
3. CxA: to witness, direct and document testing.
4. Owners Representative: witness
5. Integral Components or Related Equipment Being Tested:

	Prefunctional Checklist
AHU and components (fans, ducts, VFD):	Air Handling Units
	Ductwork
	Energy Recovery Wheel
Exhaust Fans (If BAS Controlled)	Exhaust Fans
	Prerequisites

K. The applicable prerequisite checklist items listed in Section 23 08 00.01 shall be listed on each functional test form and checked off prior to functional testing. The commissioning agent will also spot-check misc. items and calibrations on the prefunctional checklists previously completed by the installer, before the beginning of functional testing.

L. Functions/Modes Required To Be Tested, Test Methods and Seasonal Test Requirements: The following testing requirements are an addition to and do not replace any testing requirements elsewhere in this Division.

Function/Mode	Test Method Manual, Monitoring, Either or Both[3]	Required Seasonal Test[1]
General		
1. Test each sequence in the sequence of operations, and other significant modes and sequences not mentioned; including startup, shutdown, unoccupied & manual modes and power failure. Test functionality of this piece of equipment or system in all control strategies or interlocks with which it is associated.	Manual	
In addition to, or as part of (1) above, the following modes or tests are required:		
2. Mixed & supply air, & reset temperature control functions.	Both	
3. Economizer functions.	Both	Cooling
4. SF, RF and exhaust fan interlocks.	Either	
5. Duct static pressure (SP) control.	Both	
6. Return or exhaust fan tracking and building SP.	Monitoring	
7. VFD (or inlet vanes) operation on SF and RF: modulation to minimum, control system PID, proportional band of speed vs controlling parameter, constancy of static pressure, verification of program settings, alarms, etc.	Both	[2]
8. Damper interlocks and correct modulation in all modes, including smoke and fire dampers.	Manual	
9. Temperature difference across HC & CC per specifications.	Manual	
10. Verification of minimum OSA control through varying VAV box positions.	Either	[2]
11. Branch duct control damper control.	Manual	
12. Night low limit, morning warmup cycle.	Either	
13. Heat recovery operation.	Monitoring	
14. Verify TAB reported SF cfm with control system reading.	Manual	[2]
15. All alarms (low limits, high static, etc.).	Manual	
16. Heating and cooling capacity test, optional.	Manual	Design
17. Sensor and actuator calibration checks: on duct static pressure sensor on SAT, MAT, OSAT, OSA & RA damper and valve positions, SF cfm reading with TAB, and other random checks (EMS readout against hand-held calibrated instrument or observation must be within specified tolerances)	Manual	
18. Verify schedules and setpoints to be reasonable and appropriate		
19. CO2 demand control function	?	?
20. DOAS fan alarm function	?	?

[1]Cooling season, Heating season or Both. "Design" means within 5 deg of season design (ASHRAE 2 1/2%), or 95% of loading design. A blank cell denotes no special seasonal test is required and that test can be executed during any season, if condition simulation is appropriate.
[2]Seasonal test not required if seasonal conditions can be adequately simulated.
[3]Refer to Special Procedures.

M. Special Procedures:

1. Reduced Testing for Smaller Units: For standard application AHU's less than 15 tons, the following modifications to the testing requirements apply: 1) either Manual or Monitoring will satisfy the verification requirement--where Both is listed, choose one. 2) Testing Modes 6, 8, 11, 13 and 16 are not required.

N. Required Monitoring: All points listed below which are control system monitored points shall be trended by the controls contractor. Refer to the Monitoring section at the beginning of Section 23 08 00.01 for additional monitoring details.

Point	Time Step (min.)	Minimum Time Period of Trend	Hard Copy? (Y/N)	ASCII File? (Y/N)	Function Being Tested
For each AHU being tested:					
RAT	5	5 days incl. weekend	Y	Y	1-3, 5
SAT	5	5 days incl. weekend	Y	Y	1-3, 5
MAT	5	5 days incl. weekend	Y	Y	1, 3
Indoor WB or enthalpy, if enthalpy economizer	5	5 days incl. weekend	Y	Y	1, 3
SF speed, if variable, else status	5	5 days incl. weekend	Y	Y	1, 5-9
RF speed, if variable, else status	5	5 days incl. weekend	Y	Y	1, 5-9
Duct SP	5	5 days incl. weekend	Y	Y	1, 7, 9
Building SP differential	5	5 days incl. weekend	Y	Y	8
OSAT	5	5 days incl. weekend	Y	Y	All
OSA-WB or enthalpy, if enthalpy economizer	5	5 days incl. weekend	Y	Y	1, 3
Indoor dry-bulb ___zones (expected to be most problematic)	5	5 days incl. weekend	Y	Y	All

Remarks:
SF cfm not required if not monitored
RF cfm not required if not monitored

O. Acceptance Criteria (referenced by function or mode ID):

1. 1 - 21. For the conditions, sequences and modes tested, the AHU, integral components and related equipment respond to varying loads and changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice.
2. 2. AHU with supporting systems shall be able to maintain the SA temperature within 1.0F either side of the deadband of the current setpoint without excessive hunting.
3. 7. AHU and controls shall control the duct static pressure so that it does not drift more than an amount equal to 10% of the setpoint value either side of the deadband without excessive hunting.

P. Sampling Strategy for Identical Units:

1. AHU's shall not have any sampling--test all units. However, 25% of the units may have monitoring be the verification method for modes listed with Monitoring or Both as testing methods, with no less than three units being fully tested per the above requirements.

2. All units not included in the sampling testing and monitoring shall be fully monitored for the monitoring modes listed above in the monitoring section.

3.3 CHILLER & BOILER PLANTS

A. Parties Responsible to Execute Functional Test:
1. Controls Contractor: Operate the controls to activate the equipment as needed.
2. Mechanical Contractor: Witnesses, document testing, assist in testing, and correct deficiencies.
3. CxA: To witness, direct and document testing.
4. Owners Representative: Witness

B. Integral Components or Related Equipment Being Tested:

Prefunctional Checklist
Chillers
Boilers
Cooling Towers
Pumps
Heat Exchanger
Ductwork
Solids Separator

C. Prerequisites: The applicable prerequisite checklist items listed in Section 23 08 00.01 shall be listed on each functional test form and checked off prior to functional testing. The commissioning agent will also spot-check misc. items and calibrations on the prefunctional checklists previously completed by the installer, before the beginning of functional testing.

D. Functions/Modes Required To Be Tested, Test Methods and Seasonal Test Requirements: The following testing requirements are an addition to and do not replace any testing requirements elsewhere in this Division.

Function/Mode	Test Method Manual, Monitoring, Either or Both[3]	Required Seasonal Test[1]
General		
1. Test each sequence in the sequence of operations, and other significant modes and sequences not mentioned; including startup, shutdown, unoccupied & manual modes and power failure. Test functionality of this piece of equipment or system in all control strategies or interlocks with which it is associated.	Manual	
In addition to, or as part of (1) above, the following modes or tests are required:		
2. Mixed & supply air, & reset temperature control functions.	Both	
3. Economizer functions.	Both	Cooling
4. Fan interlocks.	Either	
5. Duct static pressure (SP) control.	Both	

Function/Mode	Test Method Manual, Monitoring, Either or Both[3]	Required Seasonal Test[1]
6. Damper interlocks and correct modulation in all modes, including smoke and fire dampers.	Both	
7. Temperature difference across HC & CC per specifications.	Manual	[2]
8. Branch duct control damper control.	Manual	
9. Verify TAB reported SF cfm with control system reading.	Manual	[2]
10. All alarms (low limits, high static, etc.).	Manual	
11. Heating and cooling capacity test, optional.	Manual	Design
12. Sensor and actuator calibration checks: on duct static pressure sensor on SAT, MAT, OSAT, OSA & RA damper and valve positions, SF cfm reading with TAB, and other random checks (EMS readout against hand-held calibrated instrument or observation must be within specified tolerances)	Manual	Design
13. Verify schedules and setpoints to be reasonable and appropriate		

[1]Cooling season, Heating season or Both. "Design" means within 5 deg of season design (ASHRAE 2 1/2%), or 95% of loading design. A blank cell denotes no special seasonal test is required and that test can be executed during any season, if condition simulation is appropriate.
[2]Seasonal test not required if seasonal conditions can be adequately simulated.
[3]Refer to Special Procedures.

E. Special Procedures:

1. Reduced Testing for Smaller Units. For standard application AHU's less than 15 tons, the following modifications to the testing requirements apply:
   a. Either Manual or Monitoring will satisfy the verification requirement--where Both are listed, choose one.
   b. Testing Modes 6, 8, 11, 13 and 16 are not required.

F. Required Monitoring: All points listed below which are control system monitored points shall be trended by the controls contractor. Refer to the Monitoring section at the beginning of Section 23 08 00.01 for additional monitoring details.

Point	Time Step (min.)	Minimum Time Period of Trend	Hard Copy? (Y/N)	ASCII File? (Y/N)	Function Being Tested
For each air handler and fan coil unit being tested:					
RAT	5	5 days incl. weekend	Y	Y	1-3, 5
SAT	5	5 days incl. weekend	Y	Y	1-3, 5
MAT	5	5 days incl. weekend	Y	Y	1, 3
Duct SP	5	5 days incl. weekend	Y	Y	1, 7, 9
OSAT	5	5 days incl. weekend	Y	Y	All
OSA-WB or enthalpy, if enthalpy economizer	5	5 days incl. weekend	Y	Y	1, 3

Point	Time Step (min.)	Minimum Time Period of Trend	Hard Copy? (Y/N)	ASCII File? (Y/N)	Function Being Tested
Indoor dry-bulb ___zones (expected to be most problematic)	5	5 days incl. weekend	Y	Y	All

Remarks:
SF cfm not required if not monitored
RF cfm not required if not monitored

G. Acceptance Criteria (referenced by function or mode ID):
1. 1 - 21. For the conditions, sequences and modes tested, the AHU, integral components and related equipment respond to varying loads and changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice.
2. 2. AHU with supporting systems shall be able to maintain the SA temperature within 1.0F either side of the deadband of the current setpoint without excessive hunting.
3. 7. AHU and controls shall control the duct static pressure so that it does not drift more than an amount equal to 10% of the setpoint value either side of the deadband without excessive hunting.

H. Sampling Strategy for Identical Units:
1. AHU's shall not have any sampling--test all units. However, 25% of the units may have monitoring be the verification method for modes listed with Monitoring or Both as testing methods, with no less than three units being fully tested per the above requirements.
2. All units not included in the sampling testing and monitoring shall be fully monitored for the monitoring modes listed above in the monitoring section.

3.4 EXHAUST FANS

A. Parties Responsible to Execute Functional Test:
1. Controls contractor: operate the controls to activate the equipment, if BAS controlled.
2. Mechanical contractor: Witnesses, document testing, assist in testing, and correct deficiencies.
3. CxA: to witness, direct and document testing.
4. Owners Representative: witness

B. Integral Components or Related Equipment Being Tested:

	Prefunctional Checklist
Exhaust fans	Exhaust Fans
	Fans
Ductwork	Ductwork

C. Prerequisites: The applicable prerequisite checklist items listed in the beginning of Section 23 08 00.01 shall be listed on each functional test form and checked off prior to functional testing. The commissioning agent will also spot-check misc. items and calibrations on the prefunctional checklists previously completed by the installer, before the beginning of functional testing.

D. Functions/Modes Required To Be Tested, Test Methods and Seasonal Test requirements: The following testing requirements are in addition to and do not replace any testing requirements elsewhere in this Division.

Function/Mode	Test Method Manual, Monitoring, Either or Both[1]	Required Seasonal Test
General		
1. Test each sequence in the sequence of operations, and other significant modes and sequences not mentioned; including startup, shutdown, unoccupied & manual modes and power failure. Test functionality of this piece of equipment or system in all control strategies or interlocks that it is associated with.	Manual	
In addition to, or as part of (1) above, the following modes or tests are required:		
2. Verify schedules and setpoints to be reasonable and appropriate		
3. Function at fire alarm (off, depressurization, etc.)	Manual	
4. Interlocks to building pressurization control	Manual	
5. Speed controls	Either	
6. Check TAB report record of sound power level tests and space pressures and compare to specifications	Review	
7. Sensor calibration checks on any controlling temperature or pressure sensor	Manual	

[1]Refer to Special Procedures.

E. Special Procedures: None.

F. Required Monitoring: All points listed below which are control system monitored points shall be trended by the controls contractor. Refer to the Monitoring section at the beginning of Section 23 08 00.01 for additional monitoring details.

Point	Time Step (min.)	Minimum Time Period of Trend	Hard Copy? (Y/N)	ASCII File? (Y/N)	Function Being Tested
For each Fan:					
To be determined					

G. Acceptance Criteria (referenced by function or mode ID):

1. 1 - 6. For the conditions, sequences and modes tested, the fans, integral components and related equipment respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice.
2. Sampling Strategy for Identical Units of the same type and function, but different in size, are considered identical for sampling purposes.

3. Randomly test at least 10% of each group of identical equipment (the 1st sample). In no case test less than three units in each group. If 10% of the units in the first sample fail the functional performance tests, test another 10% of the group (the 2nd sample). If 10% of the units in the 2nd sample fail, test all remaining units in the whole group, fully at the contractor's expense. This sampling applies to the testing subsections. That is, if calibration is off on more than 10% of the tested piece of equipment, then another sample shall have calibrations checked, but not all other tests need to be done on the second sample.

3.5 TERMINAL UNITS

A. Parties Responsible to Execute Functional Test
   1. Controls contractor: operate the controls to activate the equipment.
   2. Mechanical contractor: witness, document testing, assist in testing, and correct deficiencies.
   3. CxA: to witness, direct and document testing.
   4. Owners Representative: witness

B. Integral Components or Related Equipment Being Tested:

	Prefunctional Checklist
Terminal Unit	Fan Coil Units
	VAV Boxes
	Indoor DX Units

C. Prerequisites: The applicable prerequisite checklist items listed in the beginning of Section 23 08 00.01 shall be listed on each functional test form and checked off prior to functional testing. The commissioning agent will also spot-check misc. items and calibrations on the prefunctional checklists previously completed by the installer, before the beginning of functional testing.

D. Functions / Modes Required To Be Tested, Test Methods and Seasonal Test Requirements: The following testing requirements are in addition to and do not replace any testing requirements elsewhere in this Division.

Function/Mode	Test Method Manual, Monitoring, Either or Both[3]	Required Seasonal Test[1]
General		
1. Test each sequence in the sequence of operations, and other significant modes and sequences not mentioned; including startup, warmup, shutdown, unoccupied & manual modes and power failure and restoration. Test functionality of this piece of equipment or system in all control strategies or interlocks that it is associated with, including all damper and fan functions.	Manual	
In addition to, or as part of (1) above, the following modes or tests are required:		

Function/Mode		Test Method Manual, Monitoring, Either or Both[3]	Required Seasonal Test[1]
2.	Sensor activator calibration checks on: SAT, MAT, zone air temperature damper position and other random checks (EMS readout against visual or hand-held calibrated instrument must be within 0.5°F for temps. or within a tolerance equal to 10% of static pressure setpoint, with an inclined manometer)	Manual	
3.	Device and actuator calibration and stroke checks for non-DDC dampers	Manual	
4.	For the TU's tested, check the prefunctional checklist items.	Observation	
5.	Verify control parameters and setpoints to be reasonable and appropriate by reviewing the full program of 5% of all the TU's with each other for consistency. Verify the max. and min. cfm setpoints of all tested TU's against the control drawing and TAB values. Verify other TU programming parameters such as K-factors, deadbands, setpoints, stroke times, etc.	Observation	
6.	Verify no hunting or significant overshoot by damper or valves.	Either	
7.	All alarms (fan status, low limits, high static, etc.)	Manual	
8.	Verify that TU is maintaining space setpoint temperatures	Monitoring	Both Design
9.	Verify airflows and pressures (this random test is part of the TAB test)	--	

[1]Cooling season, Heating season or Both. "Design" means within 5 deg of season design (ASHRAE 2 1/2%), or 95% of loading design. A blank cell denotes no special seasonal test is required and that test can be executed during any season, if condition simulation is appropriate.
[2]Seasonal test not required if seasonal conditions can be adequately simulated.
[3]Refer to Special Procedures.

E. Special Procedures: None

F. Required Monitoring: All points listed below which are control system monitored points shall be trended by the controls contractor. Refer to the Monitoring section at the beginning of Section 23 08 00.01 for additional monitoring details.

Point	Time Step (min.)	Minimum Time Period of Trend	Hard Copy? (Y/N)	ASCII File? (Y/N)	Function Being Tested
For each zone thermostat and space sensor and other critical areas, monitor:					
Space temperature	10	3 weekdays, summer design	Y	Y	11
Space temperature	10	3 weekdays, winter design	Y	Y	11
Space temperature	2	8 hours, occupied	Y	Y	7
Damper position or cfm	2	8 hours, occupied	Y	Y	7

G.

H. Acceptance Criteria (referenced by function or mode ID)

1. 1 - 11. For the conditions, sequences and modes tested, the TU, integral components and related equipment respond to varying loads and changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice.
2. 10. Space temperature during occupied modes shall average within +/- 1 deg F of setpoint and always remain within 1 deg F of the ends of the deadband without excessive hunting of either the damper or coil valve, or complaints of drafts or stuffiness from occupants.

I. Sampling Strategy for Identical Units of the same type and function, but different in size, are considered identical for sampling purposes.

1. Testing: Randomly test at least 10% of each group of identical equipment (the 1st sample). In no case test less than three units in each group. If 10% of the units in the first sample fail the functional performance tests, test another 10% of the group (the 2nd sample). If 10% of the units in the 2nd sample fail, test all remaining units in the whole group, fully at the contractor's expense. This sampling applies to the testing subsections. That is, if calibration is off on more than 10% of the tested piece of equipment, then another sample shall have calibrations checked, but not all other tests need to be done on the second sample.
2. Monitoring: Ten percent of the total number of zones in the building, chosen by the Owner, shall be monitored. Within this 10%, shall be included a distribution of all air handlers, zones expected to have the greatest heating and cooling demand, perimeter and core zones and zones identified from the commissioning process that have exhibited potential problems.

3.6 TEST AND BALANCE WORK (TAB)

A. Parties Responsible to Execute Functional Test

1. TAB contractor: perform checks using test instruments.
2. Controls contractor: operate the controls to activate the equipment.
3. CxA: to witness, direct and document testing.

B. Integral Components or Related Equipment Being Tested

	Prefunctional Checklist
TAB	TAB

C. Prerequisites: The applicable prerequisite checklist items listed in the beginning of Section 23 08 00.01 shall be listed on each functional test form and checked off prior to functional testing. The commissioning agent will also spot-check misc. items and calibrations on the prefunctional checklists previously completed by the installer, before the beginning of functional testing.

D. Purpose: The purpose of this test is to spot check the TAB work to verify that it was done in accordance with the contract documents and acceptable practice and that the TAB report is accurate.

E. The following tests and checks will be conducted. The following testing requirements are in addition to and do not replace any testing requirements elsewhere in this Division.

	Test or Check	Test Method	Required Seasonal Test[3]
1.	A random sample of up to 25 % the TAB report data shall be selected for verification (air velocity, air or water flow rate, pressure differential, electrical or sound measurement, etc.). The original TAB contractor will execute the checks, witnessed by the commissioning authority. The TAB contractor will use the same test instruments as used in the original TAB work. A failure[1] of more than 10% of the selected items of a given system[2] shall result in the failure of acceptance of the system TAB report and the TAB contractor shall be responsible to rebalance the system, provide a new system TAB report and repeat random verifications of the new TAB report. The random testing will include the verification of minimum outdoor air intake flows at minimum, maximum and intermediate total airflow rates for up to 100% of the air handlers. Other selected data to be verified will be made known upon day of testing.	Demonstration	
2.	Verify that final settings of all valves, splitters, dampers and other adjustment devices have been permanently marked by the TAB Contractor.	Demonstration	
3.	Verification that the air system is being controlled to the lowest possible static pressure while still meeting design loads, less diversity. This shall include a review of TAB methods, control setpoints established by TAB and a physical verification of at least one leg from fan to diffuser having all balancing dampers wide open and that during full cooling of all TUs taking off downstream of the static pressure sensor, the TU on the critical leg has its damper 90% or more open.	Demonstration	

[1]Failure of an item is defined as follows:
For air flow of supply and return: a deviation of more than 10% of instrument reading
For minimum outside air flow: 20% of instrument reading (30% for reading at intermediate supply flow for inlet vane or VFD OSA compensation system using linear proportional control)
For temperatures: a deviation of more than 1 deg F
For air and water pressures: a deviation of more than 10% of full scale of test instrument reading
For sound pressures: a deviation of more than 3 decibels. (Variations in background noise must be considered)

[2]Examples of a "system" are: the air distribution system served by one air handler. Systems can be defined smaller if inaccuracies in TAB work within the smaller defined system will have little or no impact on connected systems.

[3]Cooling season, Heating season or Both. "Design" means within 5 deg of season design (ASHRAE 2 1/2%), or 95% of loading design. A blank cell denotes no special seasonal test is required and that test can be executed during any season, if condition simulation is appropriate.

F. Special Procedures: None

G. Required Monitoring: None

H. Acceptance Criteria: Provided in footnote to test table above.

I. Sampling Strategy for Identical Units: Described in test table above.

- END OF SECTION -

- SECTION 23 0800.02 -

HVAC PREFUNCTIONAL CHECKLISTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Prefunctional Checklists (PC) in a form format. The Prefunctional Checklists consist of Instructions Sheets and Record Sheets.

B. Related Sections:
   1. Section 01 33 00 - Submittal and Substitution Procedures
   2. Section 01 91 13 – General Commissioning Requirements.
   3. Section 23 08 00 – Commissioning of HVAC
   4. Section 23 08 00.01– HVAC Testing Requirements
   5. Section 23 08 00.03– HVAC Sample Functional Test Procedures

1.3 DESCRIPTION

A. The PC procedures displayed in a form format here are intended to provide the Contractor with an example of the format and an indication of the rigor of the required prefunctional checklists (Instruction Sheets and Record Sheets) and documentation for various equipment types. Though they were not developed specifically for this project, they are generally applicable.

B. The checklists contain items for both Division 23 and 26 contractors to perform.

C. Those executing the checklists are only responsible to perform items that apply to the specific application at hand. These checklists do not take the place of the manufacturer's recommended checkout and start-up procedures or report. Some checklist procedures may be redundant of some checkout procedures that will be documented on typical factory field checkout sheets. Double documenting is required in those cases.

D. Refer to Section 01 91 13 for additional requirements regarding prefunctional checklists, startup and initial checkout. Items that do not apply should be noted along with the reasons on the form. If supplied Prefunctional Checklist forms are not used for documenting, one of similar rigor and clarity shall be used. Contractors assigned responsibility for sections of the checklist

shall be responsible to see that checklist items by their subcontractors are completed and checked off.

E. The following is a list of the equipment and systems which will require Prefunctional Checklists (Instruction Sheets and Record Sheets) to be completed by the Contractors.
   1. Packaged Outdoor Air Handling Unit (Each Unit)
   2. Boilers
   3. Chillers
   4. Cooling Towers
   5. Pumps Heat Exchangers
   6. Solids Separator
   7. Instrumentation and Controls for HVAC (If Applicable)
   8. Heat Exchangers
   9. Air Handling Units
   10. Fan Coil Units
   11. Ductwork (Each Air System)
   12. Exhaust Fan (Each Unit)
   13. Swimming Pool Dehumidifiers
   14. Fire and Smoke Dampers (Each Unit)
   15. Testing, Adjusting and Balancing

F. Refer to Section 01 33 00 - Submittal and Substitution Procedures for Prefunctional Checklists.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

- END OF SECTION -

- SECTION 23 0800.03 -

HVAC SAMPLE FUNCTIONAL TEST PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. This Section contains the Functional Testing Procedures for Mechanical Systems

B. Related Sections:
   1. Section 01 33 00 - Submittal and Substitution Procedures
   2. Section 01 91 13 – General Commissioning Requirements.
   3. Section 23 08 00 – Commissioning of HVAC
   4. Section 23 08 00.01 – HVAC Testing Requirements
   5. Section 23 08 00.02 – HVAC Prefunctional Checklists

1.3 DESCRIPTION

A. The CxA will use the functional testing requirements in Sections 23 08 00 thru 23 08 00.03 and the testing protocols specified in Section 01 91 13 for developing site-specific functional test procedures and forms for this project. For illustrative purposes, sequences of operation associated with a few pieces of the equipment for which tests are included are also provided.

B. The following is a list of the equipment and systems which will require Prefunctional Checklists (Instruction Sheets and Record Sheets) to be completed by the Contractors.
   1. Dedicated Outdoor Air Unit (Each Unit)
   2. Instrumentation and Controls for HVAC
   3. Boilers
   4. Chillers
   5. Cooling Towers
   6. Pumps Heat Exchangers
   7. Solids Separator
   8. Air Handling Units

9. Fan Coil Units
10. Swimming Pool Dehumidifiers

C. Refer to Section 01 33 00 - Submittal and Substitution Procedures for Prefunctional Checklists.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

- END OF SECTION -

- SECTION 23 2113 -

HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
   1. Hot-water heating piping.
   2. Chilled-water piping.
   3. Condenser-water piping.
   4. Makeup-water piping.
   5. Blowdown-drain piping.
   6. Air-vent piping.
   7. Safety-valve-inlet and -outlet piping.

1.3 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
   1. Hot-Water Heating Piping: 300 psig at 200 deg F (93 deg C).
   2. Chilled-Water Piping: 300 psig at 100 deg F (47 deg C).
   3. Condenser-Water Piping: 125 psig (860 kPA) at 150 deg F (66 deg C).
   4. Makeup-Water Piping: 80 psig (552 kPa) at 100 deg F (47 deg C).
   5. Blowdown-Drain Piping: 150 deg F (66 deg C).
   6. Air-Vent Piping: 200 deg F (93 deg C).
   7. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

1.4 SUBMITTALS

A. Product Data: Include manufacturer's product literature indicating materials of construction, ratings, options and accessories for each type of the following:
   1. Pipe, couplings and fittings.

2. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves, automatic flow-control valves, reduced-pressure-principle backflow preventers.
3. Air control devices.
4. Hydronic specialties.

B. Field quality-control test reports.

C. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

B. Single Manufacturer: To assure uniformity in grooved piping systems, all couplings, fittings, and components shall be supplied by a single manufacturer.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B).

B. Wrought-Copper Fittings: ASME B16.22.

C. Grooved Mechanical-Joint Fittings and Couplings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Anvil International, Inc.
   b. Grinnell by Tyco Products, LP.
   c. Victaulic Company of America.
2. Grooved-End Copper Fittings: ASTM B 75 (ASTM B 75M), copper tube or ASTM B 584, bronze casting.
3. Grooved-End Tube Couplings: Rigid pattern, unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, EPDM gasket rated for minimum 250 deg F (110 deg C) for use with housing, and steel bolts and nuts.
4. Grooved-End Flange Adapter: Flat face ductile iron housing with minimum pressure rating of 300 psi.

D. Wrought-Copper Unions: ASME B16.22.

2.2 STEEL PIPE AND FITTINGS

A. Steel Pipe: Use the following types and grades. Wall thickness is indicated in Part 3 “Piping Applications” Article. Standard weight may be substituted for Schedule 40.
   1. NPS 2 and Smaller: ASTM A 53, Type S (seamless), Grade B, black steel, plain ends.
   2. NPS 2-1/2 through 12: ASTM A 53, Type E (electric-resistance welded), Grade B, black steel, plain ends.
   3. NPS 4 and Larger: ASTM A 53, Type E (electric-resistance welded), Grade B, black steel, plain ends.
   4. Provide hot-dipped zinc coating where required.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article. Provide hot-dipped zinc coated as required to match adjacent piping.

C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications" Article. Provide hot-dipped zinc coated as required to match adjacent piping.

D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article. Provide hot-dipped zinc coated as required to match adjacent piping.

E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 125 and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article. Provide hot-dipped zinc coated to as required to match adjacent piping.

F. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, hot-dipped zinc coating as required to match adjacent piping, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
   1. Material Group: 1.1.
   2. End Connections: Butt welding.
   3. Facings: Raised face.

G. Grooved Mechanical-Joint Fittings and Couplings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Grinnell by Tyco Products, LP.
      b. Victaulic Company of America.
   2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings. Provide hot-dipped zinc coated to as required to match adjacent piping.
   3. Couplings: Ductile-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings. Provide hot-dipped zinc coated to as required to match adjacent piping.
      a. Gasket: Suitable for both pressure, 300-psig (2070-kPA) maximum, and vacuum service, between minus 30 deg F and 250 deg F.
      b. Coupling: Provide rigid type couplings except where indicated otherwise.

4. Flange Adapter: Flat-faced, ductile-iron casting for transitioning between grooved and flanged piping systems or for connecting to equipment.

2.3 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

E. Grooved Joint Lubricants: Lubricant shall be compatible with the gasket material, suitable for the intended service, and supplied by the coupling manufacturer.

F. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.4 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).

D. Dielectric Nipples: Galvanized- or electroplated-steel, or ductile iron nipple with inert and noncorrosive thermoplastic lining; threaded or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

2.5 VALVES

A. Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."

B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 25 Sections.

C. Bronze, Calibrated-Orifice, Balancing Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Armstrong Pumps, Inc.
      b. Bell & Gossett Domestic Pump; a division of ITT Industries.
      c. Griswold Controls.
      d. Oventrop; available through Grinnell
      e. Taco.
      f. Tour & Andersson; available through Victaulic Company.
   2. Body: Bronze or Ametal®, globe type with calibrated orifice or venturi.
   3. Ball: Brass or stainless steel.
   4. Plug: Resin.
   5. Seat: PTFE or Ametal®.
   6. End Connections: Threaded or socket.
   7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
   8. Handle Style: Lever or handwheel, with memory stop to retain set position.
   9. CWP Rating: Minimum 125 psig (860 kPa).
   10. Maximum Operating Temperature: 250 deg F (121 deg C).

D. Cast-Iron, Ductile-Iron or Steel, Calibrated-Orifice, Balancing Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Armstrong Pumps, Inc.
      b. Bell & Gossett Domestic Pump; a division of ITT Industries.
      c. Griswold Controls.
      d. Oventrop; available through Grinnell
      e. Taco.
      f. Tour & Andersson; available through Victaulic Company.
   2. Body: Cast-iron, ductile-iron or steel body, globe pattern with calibrated orifice or venturi.
   3. Ball: Brass or stainless steel.
   4. Stem Seals: EPDM O-rings.
   5. Disc: Glass and carbon-filled PTFE.
   6. Seat: PTFE or ductile iron.
   7. End Connections: Flanged or grooved.
   8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
   9. Handle Style: Lever or handwheel, with memory stop to retain set position.
   10. CWP Rating: Minimum 125 psig (860 kPa).
   11. Maximum Operating Temperature: 250 deg F (121 deg C).

E. Differential Pressure Control Valve: Pilot operated valve to maintain an adjustable differential pressure in a hydronic piping zone.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Tour & Andersson AB.

2. Differential Pressure Control Valve:
   a. Body: AMETAL or cast iron.
   b. Bonnet, Cone, Spindles: AMETAL.
   c. Stem Seals: EPDM O-rings.
   d. O-rings: EPDM rubber.
   e. Membrane: Reinforced EPDM or HNBR rubber.
   f. Spring: Stainless steel.
   g. End Connections: Threaded or flanged or grooved.
   h. Pressure Gage Connections: Integral seals for portable differential pressure meter.
   i. Handle Style: Plastic handwheel, with memory stop to retain set position.
   j. CWP Rating: Minimum 125 psig (860 kPa).
   k. Maximum Operating Temperature: 250 deg F (121 deg C).
3. Balancing Valve:
   a. Body: Cast- or ductile-iron globe pattern with calibrated orifice or venturi.
   b. Bonnet: AMETAL or ductile-iron.
   c. Cone: AMETAL, bronze, or brass.
   d. Spindle: AMETAL.
   e. Seat Seals: EPDM O-rings.
   f. End Connections: Threaded or flanged or grooved.
   g. Pressure Gage Connections: Integral seals for portable differential pressure meter.
   h. Handle Style: Plastic handwheel, with memory stop to retain set position.
   i. CWP Rating: Minimum 125 psig (860 kPa).
   j. Maximum Operating Temperature: 250 deg F (121 deg C).
4. Interconnection Tubing: Copper tube.

F. Diaphragm-Operated, Pressure-Reducing Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Bell & Gossett Domestic Pump; a division of ITT Industries.
   d. Conbraco Industries, Inc.
   e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Low inlet-pressure check valve.
8. Inlet Strainer: stainless steel, removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.

10. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

G. Diaphragm-Operated Safety Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Bell & Gossett Domestic Pump; a division of ITT Industries.
   d. Conbraco Industries, Inc.
   e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Wetted, Internal Work Parts: Brass and rubber.
8. Inlet Strainer: stainless steel, removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

H. Reduced-Pressure-Principle Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Conbraco Industries, Inc.
   b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
   c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 15 psig (83 kPa) maximum, through middle third of flow range.
5. Pressure Loss at Design Flow Rate: 12 psig (kPa).
6. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 (DN 65) and larger.
7. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
8. Configuration: Designed for horizontal, straight-through flow.
9. Accessories:
   a. Valves NPS 2 (DN 50) and Smaller: Ball type with threaded ends on inlet and outlet.
   b. Valves NPS 2-1/2 (DN 65) and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
   c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
10. Strainer: Wye pattern type mounted upstream of inlet isolation valve. Bronze for NPS 2 (DN 50) and smaller and cast iron for NPS 2-1/2 (DN 65) and larger.

2.6 AIR CONTROL DEVICES

A. Manual Air Vents:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Bell & Gossett Domestic Pump; a division of ITT Industries.
   d. Taco.
2. Body: Brass or Bronze.
3. Internal Parts: Nonferrous.
4. Operator: Screwdriver or thumbscrew.
5. Inlet Connection: NPS 1/2 (DN 15).
6. Discharge Connection: NPS 1/8 (DN 6).
7. CWP Rating: 150 psig (1035 kPa).
8. Maximum Operating Temperature: 225 deg F (107 deg C).

B. Automatic Air Vent:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Bell & Gossett Domestic Pump; a division of ITT Industries.
   d. Empire.
   e. Hoffman.
   f. Spirax Sarco.
   g. Taco.
2. Body: Brass or Bronze.
3. Internal Parts: Nonferrous.
4. Operation: Automatic float-principle.
5. Inlet Connection: NPS 1/2
6. Discharge Connection: NPS 1/4
7. CWP Rating: 150 psig.
8. Maximum Operating Temperature: 240 degrees F.

C. Bladder Expansion Tanks:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Armstrong Pumps, Inc.
   b. Bell & Gossett Domestic Pump; a division of ITT Industries.
   c. Taco.
2. Tank: Bladder type, welded carbon-steel rated for 125-psig (860-kPa) working pressure and 240 deg F (191 deg C) maximum operating temperature. Factory tested and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
3. Tank taps for system connection, drain and air pressure fitting.

4. Bladder: Replaceable, heavy-duty butyl rubber.
5. Provide lifting rings and floor mounting skirt.

D. Air Separators:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Armstrong Pumps, Inc.
b. Bell & Gossett Domestic Pump; a division of ITT Industries.
c. Spirax Sarco, Inc.
d. Spirotherm, Inc.
e. Taco.
2. Centrifugal Air Separators:
a. Body: Cast-iron or steel with tangential connections. Fabricated and labeled according to ASME Boiler and Pressure Vessel Code Section VIII, Division I.
b. Body diameter shall be not less than three times the nominal inlet/outlet pipe diameter with a body volume for sufficient velocity reduction.
c. Maximum Working Pressure: 125 psig.
d. Maximum Operating Temperature: 250 degrees F.
e. Air Collector Tube: Perforated stainless steel.

2.7 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Armstrong Pumps, Inc.
b. Bell & Gossett ITT; Div. of ITT Fluid Technology Corp.
c. Griswold Controls.
d. Grinnell by Tyco Products, LP.
e. Mueller Steam Specialty.
f. Spirax Sarco Inc.
g. Victaulic
2. Body: Bronze with threaded gasketed cover and bottom drain connection, or ASTM A 126, Class B, cast iron or ductile iron with bolted cover and bottom drain connection.
3. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
4. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
5. CWP Rating: 125 psig (860 kPa).

B. Stainless-Steel Bellow, Flexible Connectors:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Flex-Hose Co., Inc.
b. Flexonics.

c. Metraflex.
d. Twin City Hose.

2. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
3. End Connections: Threaded or flanged to match equipment connected.
4. Performance: Capable of 3/4-inch (20-mm) misalignment.
5. CWP Rating: 150 psig (1035 kPa).
6. Maximum Operating Temperature: 250 deg F (121 deg C).

C. Flexible Pump Connectors:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Mason Industries.
b. Metraflex Co.
c. Proco Products, Inc.
d. Vibration Mountings & Controls, Inc.
2. Body: Flexible, single- or double-sphere of EPDM liner and cover, Kevlar tire cord fractioning with steel ring embedded in raised face of rubber-flanged end. Provide ductile iron, external ring between double-spheres.
3. End Connections: Split ductile-iron or steel flanges with hooked interlocks.
4. Control Rods: Required where recommended by manufacturer or indicated on Drawings.
5. CWP Rating: 150 psig.
6. Maximum Operating Temperature: 250 degrees F.

D. Flexible Hoses: Minimum 400-psig (2758-kPa) working pressure, and operating temperatures from 33 to 211 deg F (0.5 to 99 deg C). Tag hose kits to equipment designations.
1. Hose Material: Reinforced synthetic rubber.
2. Exterior Cover: Braided stainless steel.
3. Couplings: Solid brass or stainless steel.
4. Length: 24 inches (600 mm).
5. Minimum Diameter: Equal to fan-coil-unit connection size.

E. Water Meter:
1. AWWA C700, oscillating-piston or nutating disc, magnetic-drive, totalization meter.
2. Body: Bronze.
3. Maximum Pressure Loss at Design Flow: 3 psig.
4. Registration: Gallons or cubic feet.
5. Controls: Flow-control switch with normally open contacts; rated for maximum 10 A, 250-V ac; and that will close at adjustable increments of total flow.
6. Meter shall match size of adjacent piping.

F. Expansion fittings are specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, NPS 2 (DN 50) and smaller, shall be any of the following:
   1. Type L (B), drawn-temper copper tubing, wrought-copper fittings, and soldered or brazed joints.
   2. Schedule 40 steel pipe; Class 300, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

B. Hot-water heating piping, aboveground, NPS 2-1/2 (DN 65) and larger, shall be any of the following:
   1. Type L (B), drawn-temper copper tubing, wrought-copper fittings, and soldered or brazed joints.
   2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
   3. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

C. Chilled-water piping, aboveground, NPS 2 and smaller, shall be any of the following:
   1. Type L (B), drawn-temper copper tubing, wrought-copper fittings, and soldered or brazed joints.
   2. Schedule 40 steel pipe; Class 300, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

D. Chilled-water piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:
   1. Type L (B), drawn-temper copper tubing, wrought-copper fittings, and soldered or brazed joints.
   2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
   3. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

E. Condenser-water piping, aboveground, NPS 2 (DN 50) and smaller, shall be any of the following:
   1. Type L (B) or M (C), drawn-temper copper tubing, wrought-copper fittings, and soldered or brazed joints.
   2. Schedule 40 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
   3. Steel pipe and fittings installed outside shall be galvanized unless indicated to be painted.

F. Condenser-water piping, aboveground, NPS 2-1/2 (DN 65) and larger, shall be any of the following:
   1. Type L (B), drawn-temper copper tubing, wrought-copper fittings, and soldered or brazed joints.
   2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

3. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
4. Steel pipe and fittings installed outside shall be galvanized unless indicated to be painted.

G. Makeup-water piping installed aboveground: Type L (B), drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

H. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.

I. Air-Vent Piping:
1. Inlet: Same as service where installed.
2. Outlet: Type K (A), annealed-temper copper tubing with soldered or flared joints.

J. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.

3.2 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.

B. Install throttling-duty valves at each branch connection to return main.

C. Install calibrated-orifice, balancing valves and shutoff-duty valves in the return pipe of each heating or cooling terminal.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

G. Install reduced-pressure-principle backflow preventers at the connection between the domestic cold water system and the hydronic systems.

3.3 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Do not install hydronic piping within electrical rooms, elevator equipment rooms, MDF or IDF rooms, or stairwells. Exception: Pipe supplying equipment serving the room. Maintain all required clearances to other equipment.

E. Do not install piping above electrical equipment such as transformers, panels, motor control centers, etc. in other rooms.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Install piping to permit valve servicing.

H. Install piping at indicated slopes.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Install piping to allow application of insulation.

L. Select system components with pressure rating equal to or greater than system operating pressure.

M. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

N. Install drains, consisting of a tee fitting, NPS 3/4 (DN 20) ball valve, and short NPS 3/4 (DN 20) threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

O. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

P. Make branch connections to mains using flow tees where branch size is not less than 1/3 the diameter of the main. Weld-O-Lets and Thread-O-Lets, may be used in other applications. Hot-taps shall only be used to connect branch lines to live mains.

Q. Unless otherwise indicated, install branch connections to mains with the branch connected to the top or side of the main pipe.

R. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."

S. Install unions in piping, NPS 2 (DN 50) and smaller at final connections of equipment, and elsewhere as indicated. Unions may be omitted in piping systems with mechanical joints.

T. Install flanges in piping, NPS 2-1/2 (DN 65) and larger, at final connections of equipment and elsewhere as indicated. Flanges may be omitted in piping systems with mechanical joints.

U. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 (DN 20) nipple and ball valve in blowdown connection of strainers NPS 2 (DN 50) and larger. Match size of strainer blowoff

connection for strainers smaller than NPS 2 (DN 50). Install strainers with strainer basket facing downward to facilitate cleaning and blowdown.

V. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

W. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

X. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."

Y. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."

Z. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Section "Escutcheons for HVAC Piping."

3.4 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.

B. Vibration isolation devices are specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."

C. Install the following pipe attachments:
1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet (6 m) long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet (6 m) or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Wrap copper piping with not less than two layers of 10 mil. thick black plastic tape extending a minimum of 1 inch on each side of clamp for electrolytic protection where hangers or supports are in direct contact with copper piping.

D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4 (DN 20): Maximum span, 7 feet (2.1 m); minimum rod size, 1/4 inch (6.4 mm).
2. NPS 1 (DN 25): Maximum span, 7 feet (2.1 m); minimum rod size, 1/4 inch (6.4 mm).
3. NPS 1-1/2 (DN 40): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).
4. NPS 2 (DN 50): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).
5. NPS 2-1/2 (DN 65): Maximum span, 11 feet (3.4 m); minimum rod size, 3/8 inch (10 mm).
6. NPS 3 (DN 80): Maximum span, 12 feet (3.7 m); minimum rod size, 3/8 inch (10 mm).
7. NPS 4 (DN 100): Maximum span, 12 feet (3.7 m); minimum rod size, 1/2 inch (13 mm).
8. NPS 6 (DN 150): Maximum span, 12 feet (3.7 m); minimum rod size, 1/2 inch (13 mm).

9. NPS 8 (DN 200): Maximum span, 12 feet (3.7 m); minimum rod size, 5/8 inch (16 mm).
10. NPS 10 (DN 250): Maximum span, 12 feet (3.7 m); minimum rod size, 3/4 inch (19 mm).
11. NPS 12 (DN 300): Maximum span, 12 feet (3.7 m); minimum rod size, 7/8 inch (22 mm).
12. NPS 14 (DN 350): Maximum span, 12 feet (3.7 m); minimum rod size, 1 inch (25 mm).
13. NPS 16 (DN 400): Maximum span, 12 feet (3.7 m); minimum rod size, 1 inch (13 mm).
14. NPS 18 (DN 450): Maximum span, 12 feet (3.7 m); minimum rod size, 1-1/4 inch (32 mm).
15. NPS 20 (DN 500): Maximum span, 12 feet (3.7 m); minimum rod size, 1-1/4 inch (32 mm).
16. NPS 24 (DN 600): Maximum span, 12 feet (3.7 m); minimum rod size, 1-1/4 inch (32 mm).

E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4 (DN 20): Maximum span, 5 feet (1.5 m); minimum rod size, 1/4 inch (6.4 mm).
2. NPS 1 (DN 25): Maximum span, 6 feet (1.8 m); minimum rod size, 1/4 inch (6.4 mm).
3. NPS 1-1/4 (DN 45): Maximum span, 6 feet (1.8 m); minimum rod size, 3/8 inch (10 mm).
4. NPS 1-1/2 (DN 40): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
5. NPS 2 (DN 50): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
6. NPS 2-1/2 (DN 65): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).
7. NPS 3 (DN 80): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).
8. NPS 4 (DN 100): Maximum span, 10 feet (3.7 m); minimum rod size, 1/2 inch (13 mm).
9. NPS 6 (DN 150): Maximum span, 10 feet (4.3 m); minimum rod size, 1/2 inch (13 mm).
10. NPS 8 (DN 200): Maximum span, 10 feet (4.9 m); minimum rod size, 5/8 inch (16 mm).
11. NPS 10 (DN 250): Maximum span, 10 feet (5.5 m); minimum rod size, 3/4 inch (19 mm).
12. NPS 12 (DN 300): Maximum span, 10 feet (5.8 m); minimum rod size, 7/8 inch (22 mm).

F. Support vertical runs at roof, at each floor, and at 10-foot (3-m) intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

H. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

I. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints. Inserted tubing must be cut and dimpled.

J. Hot Taps:
   1. Hot taps shall only be made on systems that cannot by isolated or shutdown and are not permitted in new construction.
   2. The hot tap machine shall be provided with a depth gauge to prevent cutting of opposite pipe wall.
   3. The hot tap machine shall be rated for the expected pressures and temperatures of the system being tapped.
   4. Weld-o-lets, split tees, saddles, branch-o-lets, or nozzles shall be used on all hot taps. Full encirclement pads or split tees shall be used if the hot tap diameter is greater than 50% of the run pipe diameter.
   5. Pipe coupons must be removed and not allowed to enter system. Return coupons to Owner.

3.6 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install automatic air vents in mechanical equipment rooms at high points of system piping, at heat transfer coils, at the air outlet on the air separator, and elsewhere as required for system air venting.
   1. Provide shutoff valve on inlet side of each automatic air vent.
   2. Provide drain piping from each automatic air vent outlet to nearest floor sink, mop sink or floor drain.

C. Install piping from boiler air outlet or air separator to expansion tank with a 2 percent upward slope toward air vent.

D. Install in-line air separators in pump suction NPS 1-1/2 and smaller and centrifugal air separators in NPS 2 through NPS 24. Install drain valve on air separators NPS 2 and larger.

E. Install bypass chemical feeders furnished by HVAC Water Treatment Contractor in each hydronic system where indicated, in upright position with top of funnel not more than 48 inches

(1200 mm) above the floor. Install feeder in minimum NPS 3/4 (DN 20) bypass circuit around circulating pumps. Install full-size, full-port, ball valves at inlet and outlet of feeder. Install NPS 3/4 (DN 20) pipe from chemical feeder drain, to nearest equipment drain and include a full-size, full-port, ball valve.

F. Install test-coupon rack assembly by HVAC Water Treatment Contractor in each hydronic system where indicated. Install rack in minimum NPS 3/4 (DN 20) bypass line around circulating pumps. Install full-size, full-port, ball valves at inlet and outlet connections to rack.

G. Install expansion tanks where indicated on Drawings.
   1. Charge tank to initial fill pressure.
   2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.

3.7 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install flexible connectors at the inlet and outlet of all moving equipment, except pumps or as indicated otherwise. Match size of adjacent pipe. Contractor's Option: Install three (3) flexible mechanical couplings in vertical piping drop to pump in lieu of flexible connector.

C. Install flexible pump connectors at the inlet and outlet of all pumps, except in-line pumps. Match size of adjacent pipe. Contractor's Option: Install three (3) flexible mechanical couplings in vertical piping drop to pump in lieu of flexible pump connector.

D. Install flexible hoses at the inlet and outlet of all fan coil units or air terminal unit reheat coils with connection sizes 1-1/2" NPS and smaller. Match size of equipment connection.
   1. Maximum hose bend: Do not exceed 180 degrees.
   2. Maximum pipe offset: Not to exceed 3 inches.
   3. Comply with manufacturer's written limitations and instructions.

E. Install control valves in accessible locations close to connected equipment.

F. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gages for HVAC Piping."

3.8 CLEANING AND CHEMICAL TREATMENT

A. During the cleaning process, maintain a minimum liquid velocity of 3 feet per second through piping systems. All manual, motorized or thermostatically operated valves are to be open during this process. All equipment such as boilers, chillers, etc. shall be off. All dead end runs shall be looped together with piping not less than 1/3 the size of the run. Remove or isolate the end-run piping loop at the completion of the chemical treatment process. When connecting new piping to an existing system the new piping shall be looped together with piping not less than 1/2 the size of the new mains to allow for cleaning before linking the two systems. Remove or isolate the piping loop at the completion of the chemical treatment process.

B. Fill system with fresh water, clean and passivate interior of piping systems using chemicals supplied by HVAC Water Treatment Contractor. Circulate chemicals for a minimum of 24 hours or longer as directed to remove oils, dirt, and other compounds detrimental to the proper operation of the system.

C. Flush piping system with clean water to remove cleaning chemicals and debris. Remove and clean strainer screens, flush mud and debris from drop legs and other low points.

D. Immediately after cleaning and flushing, refill system with fresh water and chemicals supplied by HVAC Water Treatment Contractor to inhibit corrosion. Circulate minimum of 2 hours.

E. Do not repeatedly fill and drain system without proper chemical treatment.

3.9 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:
   1. Leave joints, including welds, uninsulated and exposed for examination during test.
   2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
   3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
   4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
   5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:
   1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
   2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
   3. Isolate expansion tanks and determine that hydronic system is full of water.
   4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
   5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
   6. Prepare written report of testing.

C. Perform the following before operating the system:
   1. Open manual valves fully.
   2. Inspect pumps for proper rotation.
   3. Set makeup pressure-reducing valves for required system pressure.

4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

- END OF SECTION -

- SECTION 23 2115 -

HVAC DRAIN PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes pipe and fitting materials, and joining methods for HVAC drain piping including coil condensate drains.

1.3 PERFORMANCE REQUIREMENTS

A. Drain piping components and installation shall be capable of withstanding 5 psig (34 kPa) at 150 deg F (66 deg C).

1.4 SUBMITTALS

A. Product Data: Include manufacturer's product literature indicating materials of construction, ratings, options and accessories for each type of the following:
   1. Pipe and fittings.

B. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B).

B. DWV Copper Tubing: ASTM B 306, Type DWV.

C. Wrought-Copper Fittings: ASME B16.22.

D. Wrought-Copper Unions: ASME B16.22.

2.2 PLASTIC PIPE AND FITTINGS

A. CPVC Plastic Pipe: ASTM F 441/F 441M, Schedules 40 and 80, plain ends as indicated in Part 3 "Piping Applications" Article.

B. CPVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM F 438 for Schedule 40 pipe; ASTM F 439 for Schedule 80 pipe.

2.3 JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

B. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

C. Solvent Cements for Joining Plastic Piping:

1. CPVC Piping: ASTM F 493.
    a. Use CPVC solvent cement that has a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
    b. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
    c. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings: CPVC one-piece fitting with one threaded brass or copper insert and one Schedule 80 solvent-cement-joint end.

B. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC union. Include brass or copper end, Schedule 80 solvent-cement-joint end, rubber gasket, and threaded union.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).

D. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Drain Piping: Type DWV or Type L (B), drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

B. Drain Piping for Condensing Appliances and Flue Drains: Schedule 80 CPVC plastic pipe and fittings and solvent-welded joints.

3.2 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated piping locations and arrangements if such were used to size pipe. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise. Avoid routing piping on floor across walkways. Provide steel ramps over piping where floor mounted piping crosses walkways.

D. Do not install drain piping within electrical rooms, elevator equipment rooms, MDF or IDF rooms, or stairwells. Exception: Pipe serving equipment serving the room. Maintain all required clearances to other equipment.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping at a uniform grade of 1.0 percent downward towards drain outlet unless otherwise indicated.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install cleanouts fabricated with a tee fitting with a threaded plug at each change of direction to facilitate cleaning of pipe. Cleanout shall allow for cleaning in direction of flow.

J. Install piping to allow application of insulation.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Reduce pipe sizes using concentric reducer fitting or eccentric reducer fitting installed with level side up.

M. Make branch connections to mains using flow tees.

N. Unless otherwise indicated, install branch connections to mains with the branch connected to the top or side of the main pipe.

O. Install unions in piping, NPS 2 (DN 50) and smaller at final connections of equipment, and elsewhere as indicated.

P. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."

R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."

S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Section "Escutcheons for HVAC Piping."

3.3 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.

B. Vibration isolation devices are specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."

C. Install the following pipe attachments:
   1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet (6 m) long.
   2. Wrap copper piping with not less than two layers of 10 mil. thick black plastic tape extending a minimum of 1 inch on each side of clamp for electrolytic protection where hangers or supports are in direct contact with copper piping.
   3. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
   1. NPS 3/4 (DN 20): Maximum span, 5 feet (1.5 m); minimum rod size, 1/4 inch (6.4 mm).
   2. NPS 1 (DN 25): Maximum span, 6 feet (1.8 m); minimum rod size, 1/4 inch (6.4 mm).
   3. NPS 1-1/4 (DN 45): Maximum span, 6 feet (1.8 m); minimum rod size, 3/8 inch (10 mm).
   4. NPS 1-1/2 (DN 40): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
   5. NPS 2 (DN 50): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
   6. NPS 2-1/2 (DN 65): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).
   7. NPS 3 (DN 80): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).
   8. NPS 4 (DN 100): Maximum span, 10 feet (3 m); minimum rod size, 1/2 inch (13 mm).

E. Plastic Piping Hanger Spacing: Space hangers with the following maximum spacing and minimum rod sizes or according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
   1. NPS 3/4 (DN 20): Maximum span, 5 feet (1.5 m); minimum rod size, 1/4 inch (6.4 mm).
   2. NPS 1 (DN 25): Maximum span, 5 feet (1.5 m); minimum rod size, 1/4 inch (6.4 mm).
   3. NPS 1-1/2 (DN 40): Maximum span, 6 feet (1.8 m); minimum rod size, 3/8 inch (10 mm).
   4. NPS 2 (DN 50): Maximum span, 6 feet (1.8 m); minimum rod size, 3/8 inch (10 mm).
   5. NPS 2-1/2 (DN 65): Maximum span, 7 feet (2.1 m); minimum rod size, 3/8 inch (10 mm).
   6. NPS 3 (DN 80): Maximum span, 7 feet (2.1 m); minimum rod size, 3/8 inch (10 mm).
   7. NPS 4 (DN 100): Maximum span, 7 feet (2.1 m); minimum rod size, 1/2 inch (13 mm).

F. Support vertical runs at roof, at each floor, and at 10-foot (3-m) intervals between floors.

3.4 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

F. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

3.5 TERMINAL EQUIPMENT CONNECTIONS

A. Install vented traps at cooling coil condensate pan connections. Size trap and connected piping the same as or larger than equipment connections.

B. Size trap to provide seal against fan static pressure.

3.6 FIELD QUALITY CONTROL

A. Prepare drain piping according to ASME B31.9 and as follows:
   1. Leave joints uninsulated and exposed for examination during test.
   2. Flush drain piping systems with clean water.
   3. Isolate equipment from piping.

B. Perform the following tests on drain piping:
   1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
   2. Subject piping system to hydrostatic test pressure that is equal to 10 feet of water column or maximum that can be obtained based on installed conditions.
   3. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
   4. Prepare written report of testing.

- END OF SECTION -

- SECTION 23 2123 -

HYDRONIC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Vertical Inline Pumps.
2. End-Suction Pumps.

B. Related Sections:
1. Section 01 81 13 - Sustainable Design Requirements
2. Section 23 05 00 - Common Work Results for HVAC.
3. Section 23 05 13 - Common Motor Requirements for HVAC Equipment
4. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment
5. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC
6. Section 23 31 13.51 - Hydronic Piping - Metal

1.3 REFERENCES

A. ASTM International (ASTM) Publications: (Former American Society for Testing and Materials)
1. A36 “Standard Specification for Carbon Structural Steel”
2. B584-09a “Standard Specification for Copper Alloy Sand Castings for General Applications”

B. Hydraulic Institute Publications:
1. ANSI/HI 1.1-1.2 "Centrifugal Pumps for Nomenclature and Definition"

C. National Fire Protection Association (NFPA) Publications:
1. 70 "National Electric Code"

D. Underwriter's Laboratories, Inc. (UL) Standards:
1. 486A “Standard For Wire Connectors and Soldering Lugs for Use With Copper Conductors”
2. 486B “Standard for Wire Connectors for Use With Aluminum Conductors”

3. 778 “Standard for Motor-Operated Water Pumps”

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

1. Product Data: Include certified performance curves and rated capacities; shipping, installed, and operating weights; furnished specialties; final impeller dimensions; and accessories for each type of product indicated. Indicate pump's operating point on curves.
2. Shop Drawings: Show pump layout and connections. Include Setting Drawings with templates for installing foundation and anchor bolts and other anchorages.
   a. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.
3. Maintenance Data: For pumps to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain hydronic pumps through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

B. Store pumps in dry location.

C. Retain protective covers for flanges and protective coatings during storage.

D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.

E. Comply with pump manufacturer's written rigging instructions.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 23 05 00 “Common Work Results for HVAC.”

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Mechanical Seals: One spare mechanical seal for each pump.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved Manufacturers:
   1. Vertical In-Line Pumps:
      a. "Series 4360"; Armstrong Pumps, Inc. (716-693-8813)
      b. "Series 80"; Bell & Gossett ITT; Div. of ITT Fluid Technology Corp. (847-966-3700)
      c. "VIL Series"; Patterson Pump Company (706-886-2101)
      d. "VL Series"; Taco; Fabricated Products Div. (401-942-8000)
   2. End-Suction Pumps:
      a. “Series 4030”; Armstrong Pumps, Inc. (716-693-8813)
      b. “Series 1510” Bell & Gossett ITT; Div. of ITT Fluid Technology Corp. (847-966-3700)
      c. "HVES Series"; Patterson Pump Company (706-886-2101)
      d. “Series FM”; Taco; Fabricated Products Div. (401-942-8000)

2.2 GENERAL PUMP REQUIREMENTS

A. Pump Units: Factory assembled and tested.

B. Motors: Include built-in, thermal-overload protection and grease-lubricated ball bearings. Select each motor to be nonoverloading over full range of pump performance curve.

C. Energy Efficiency: Minimum efficiency complying with EPACT requirements.

2.3 VERTICAL INLINE PUMPS

A. Description: Vertical, in-line, centrifugal, flexible-coupled, single-stage, radially split case design. Include vertical-mounting, bronze-fitted design and mechanical seals rated for 125-psig minimum working pressure and a continuous water temperature of 225 deg F.
   1. Casing: Cast iron, with threaded companion flanges for piping connections smaller than NPS 3, drain plug at low point of volute, and threaded gage tappings at inlet and outlet connections.
   2. Impeller: ASTM B584, cast bronze, statically and dynamically balanced, closed, overhung, single suction, and keyed to shaft.
   3. Wear Rings: Replaceable, bronze casing ring.
   4. Shaft and Sleeve: Ground and polished stainless-steel shaft with bronze sleeve.

5. Shaft: Ground and polished stainless-steel shaft with axially split spacer coupling.
6. Seals: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and flexible bellows and gasket.
7. Pump Bearings: Oil-lubricated, bronze journal and thrust type.
8. Motor Bearings: Oil-lubricated, sleeve type.
9. Motor: Directly mounted to pump casing with lifting and supporting lugs in top of motor enclosure.

2.4 FLEXIBLE-COUPLED, END-SUCTION PUMPS

A. Description: Base-mounted, centrifugal, flexible-coupled, end-suction, single-stage, bronze-fitted, back-pull-out, radially split case design; rated for 150-psig minimum working pressure and a continuous water temperature of 225 deg F.
1. Casing: Cast iron, with flanged piping connections, drain plug at low point of volute, and threaded gage tappings at inlet and outlet connections.
2. Impeller: ASTM B584, cast bronze, statically and dynamically balanced, closed, overhung, single suction, keyed to shaft, and secured by locking cap screw.
3. Wear Rings: Replaceable, bronze casing ring.
4. Shaft and Sleeve: Stainless steel shaft with bronze sleeve.
5. Seals: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and flexible bellows and gasket.
6. Pump Bearings: Grease-lubricated ball bearings contained in cast-iron housing with grease fittings.
7. Coupling: Flexible-spacer type, capable of absorbing torsional vibration and shaft misalignment; with flange and sleeve section that can be disassembled and removed without removing pump or motor.
8. Coupling Guard: Steel, removable, OSHA approved, and attached to mounting frame.
9. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A36 channels and angles. Fabricate for mounting pump casing, coupling guard, and motor. Field-drill motor-mounting holes for field-installed motors.
10. Motor: Secured to mounting frame, with adjustable alignment.

2.5 PUMP SPECIALTY FITTINGS

A. Suction Diffuser: Angle or straight pattern, 300-psig pressure rating, cast-iron body and end cap, pump-inlet fitting; with bronze startup and bronze or stainless-steel permanent strainers; bronze or stainless-steel straightening vanes; drain plug; and factory- or field-fabricated support.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation.
1. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

2. Examine foundations and bases for suitable conditions where pumps are to be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

A. Install pumps according to manufacturer's written instructions.
1. Install pumps according to HI 1.1-1.2, "Centrifugal Pumps for Nomenclature and Definitions."

B. Install pumps to provide access for periodic maintenance, including removing motors, impellers, couplings, and accessories.

C. Support pumps and piping separately so piping is not supported by pumps.

D. Set base-mounted pumps on concrete foundation. Disconnect coupling halves before setting. Do not reconnect couplings until alignment operations have been completed.
1. Support pump baseplate on rectangular metal blocks and shims, or on metal wedges with small taper, at points near foundation bolts to provide a gap of 3/4 to 1-1/2 inches between pump base and foundation for grouting.
2. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges of pump to verify that they are level and plumb.

3.3 ALIGNMENT

A. Align pump and motor shafts and piping connections after setting them on foundations, after grout has been set and foundation bolts have been tightened, and after piping connections have been made.

B. Comply with pump and coupling manufacturers' written instructions.

C. Adjust pump and motor shafts for angular and offset alignment by methods specified in HI 1.1-1.2, "Centrifugal Pumps for Nomenclature, and Definitions."

D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect piping to pumps. Install suction and discharge pipe sizes equal to those shown on the drawings. Install valves and appurtenances at the pumps that are the same size as system piping. If transitions are required, transition at the pump flanges.

D. Install balancing valve, check valve and shutoff valve on discharge side of pumps.

E. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.

F. Install pressure gages on pump suction and discharge. Install at integral pressure-gage tappings where provided. Install compound type gauge on suction side.

G. Install electrical connections for power, controls, and devices.

H. Electrical power and control wiring and connections are specified in Division 26 Sections.

I. Ground equipment.
   1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

A. Verify that pumps are installed and connected according to the Contract Documents.

B. Verify that electrical wiring installation complies with manufacturer's written instructions and the Contract Documents.

C. Perform the following preventive maintenance operations and checks before starting:
   1. Lubricate bearings.
   2. Remove grease-lubricated bearing covers, flush bearings with kerosene, and clean thoroughly. Fill with new lubricant according to manufacturer's written instructions.
   3. Disconnect coupling and check motor for proper rotation that matches direction marked on pump casing.
   4. Verify that pumps are free to rotate by hand and that pumps for handling hot liquids are free to rotate with pumps hot and cold. Do not operate pumps if they are bound or drag, until cause of trouble is determined and corrected.
   5. Check suction piping connections for tightness to avoid drawing air into pumps.
   6. Clean strainers.
   7. Verify that pump controls are correct for required application.

D. Starting procedure for pumps with shutoff power not exceeding safe motor power is as follows:
   1. Prime pumps by opening suction valves and closing drains, and prepare pumps for operation.
   2. Open cooling water-supply valves in cooling water supply to bearings, where applicable.
   3. Open sealing liquid-supply valves if pumps are so fitted.
   4. Open warm-up valves of pumps handling hot liquids if pumps are not normally kept at operating temperature.
   5. Open circulating line valves if pumps should not be operated against dead shutoff.
   6. Start motors.
   7. Open discharge valves slowly.
   8. Check general mechanical operation of pumps and motors.
   9. Close circulating line valves once there is sufficient flow through pumps to prevent overheating.

E. When pumps are to be started against closed check valves with discharge shutoff valves open, steps are the same, except open discharge valves before starting motors.

F. Refer to Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for detailed requirements for testing, adjusting, and balancing hydronic systems.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps as specified below:
1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining pumps.
2. Review data in maintenance manuals.
3. Schedule training with Owner, through Owner’s Representative, with at least seven days' advance notice.

- END OF SECTION -

- SECTION 23 2300 -

REFRIGERANT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Tubes.
2. Fittings.
3. Joining Materials.
4. Specialties.

B. Related Sections:
1. Section 07 92 00 (07920) - Joint Sealants
2. Section 07 84 00 (07840) - Firestopping: Firestopping materials and requirements for penetrations through fire and smoke barriers.
3. Section 23 05 00 (15050) – Common Work Results for HVAC
4. Section 23 05 29 (15060) - Hangers and Supports for HVAC Piping and Equipment: for pipe hanger restraints.
5. Section 23 05 53 (15075) – Identification for HVAC Piping and Equipment
6. Section 22 07 00 (15083) - HVAC Insulation

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
1. Product Data for each valve type and refrigerant piping specialty specified.
2. Refrigerant piping indicated is schematic only. Contractor shall size and design the piping configuration and install the piping, including oil traps, double risers, specialties, and pipe and tube sizes, to ensure proper operation and conformance with warranties of connected equipment.
3. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience.
4. Maintenance data for refrigerant valves and piping specialties to include in the operation and maintenance manual specified in Division 01 Sections.

1.4 QUALITY ASSURANCE

A. ASME Compliance: Qualify brazing and welding processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications."

B. Regulatory Requirements: Comply with provisions of the following codes:
   1. ASME B31.5, "Refrigeration Piping."
   2. ASHRAE 15, "Safety Code for Mechanical Refrigeration."

C. UL Standard: Provide products complying with UL 207, "Refrigerant-Containing Components and Accessories, Non-electrical"; or UL 429, "Electrically Operated Valves."

D. Listing and Labeling: Provide products specified in this Section that are UL listed and labeled.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved Manufacturers:
   1. Refrigerant Valves and Specialties:
      a. Henry Pratt Company, Subsidiary of Mueller Water Products, Inc. (877-436-7966)
      b. Parker-Hannifin Corporation; Refrigeration & Air Conditioning Division (800-272-7537)
      c. Sporlan Valve Company (314-647-2775)

2.2 TUBES

A. Use pre-charged tubing where possible.

B. Soft Copper Tube: ASTM B280, Type ACR, annealed temper.

2.3 TUBE FITTINGS

A. Copper Fittings: ASME B16.22, wrought-copper streamlined pattern.

2.4 JOINING MATERIALS

A. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (Silver).

2.5 REFRIGERANT PIPING SPECIALTIES

A. Moisture/Liquid Indicators: 500-psig operating pressure, 200 deg F operating temperature; forged-brass body, with replaceable, polished, optical viewing window with color-coded moisture indicator, and solder-end connections.

B. Permanent Filter-Dryer: 350-psig maximum operating pressure, 225 deg F maximum operating temperature; steel shell, and wrought-copper fittings for solder-end connections; molded-felt core surrounded by desiccant.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for compliance with requirements for installation tolerances and other conditions affecting performance of refrigerant piping. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Above ground, within Building: Type ACR drawn-copper tubing.

B. Below ground for 2-Inch NPS (DN50) and Smaller: Type L (Type B) annealed-copper tubing installed in schedule 40 PVC sleeve.

3.3 INSTALLATION

A. Install refrigerant piping according to ASHRAE 15.

B. Basic piping installation requirements are specified in Section 21/22/23 95 00 (15050) - "Basic Mechanical Materials and Methods."

C. Install piping in short and direct arrangement, with minimum number of joints, elbows, and fittings.

D. Arrange piping to allow normal inspection and service of compressor and other equipment. Install valves and specialties in accessible locations to allow for service and inspection.

E. Install piping with adequate clearance between pipe and adjacent walls and hangers, or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation. Maximum fill: 40%

F. Below ground, install copper tubing in schedule 40 PVC conduit. Vent conduit outdoors.

G. Insulate suction lines.
   1. Do not install insulation until system testing has been completed and all leaks have been eliminated.

H. Install branch lines to parallel compressors of equal length, and pipe identically and symmetrically.

I. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.

J. Slope refrigerant piping as follows:
   1. Install horizontal suction lines with a uniform slope of 0.4 percent downward to compressor.
   2. Install traps and double risers where indicated and where required to entrain oil in vertical runs.
   3. Liquid lines may be installed level.

K. Use fittings for changes in direction and branch connections.

L. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.

M. Reduce pipe sizes using eccentric reducer fittings installed with level side down.

N. Provide bypass around moisture-liquid indicators in lines larger than 2-inch NPS (DN50).

O. Install unions to allow removal of solenoid valves, pressure-regulating valves, expansion valves, and at connections to compressors and evaporators.

P. Install refrigerant valves according to manufacturer's written instructions.

Q. When brazing, remove solenoid-valve coils; remove sight glasses; and remove stems, seats, and packing of valves, and accessible internal parts of refrigerant specialties. Do not apply heat near bulb of expansion valve.

R. Electrical wiring for solenoid valves is specified in Division 16 Sections. Coordinate electrical requirements and connections.

S. Charge and purge systems, after testing, dispose of refrigerant following ASHRAE 15 procedures.

3.4 HANGERS AND SUPPORTS

A. General: Hangers, supports, and anchors are specified in Section 23 05 29 - "Hangers and Supports for HVAC Piping and Equipment." Provide according to ASME B31.5 and MSS SP-69.

B. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes. Tube sizes are nominal or standard tube sizes as expressed in ASTM B88.
   1. 1/2 Inch: Maximum span, 60 inches; minimum rod size, 1/4 inch.
   2. 5/8 Inch: Maximum span, 60 inches; minimum rod size, 1/4 inch.
   3. 1 Inch: Maximum span, 60 inches; minimum rod size, 1/4 inch.
   4. 1-1/4 Inches: Maximum span, 72 inches; minimum rod size, 1/4 inch.
   5. 1-1/2 Inches: Maximum span, 96 inches; minimum rod size, 3/8 inch.

3.5 PIPE INSULATION

A. Piping insulation is specified in Section 23 07 00 “HVAC Insulation”.

3.6 SPECIALTIES APPLICATION AND INSTALLATION

A. Install permanent filter dryers in low-temperature systems using hermetic compressors, and before each solenoid valve.

3.7 PIPE JOINT CONSTRUCTION

A. Basic pipe and tube joint construction is specified in Section 23 05 00 - "Common Work Results for HVAC."

B. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide) during brazing to prevent formation of scale.

3.8 VALVE INSTALLATIONS

A. Install refrigerant valves according to manufacturer's written instructions.

3.9 CONNECTIONS

A. Electrical: Conform to applicable requirements of Division 26 Sections for electrical connections.

3.10 FIELD QUALITY CONTROL

A. Inspect and test refrigerant piping according to ASME B31.5, Chapter VI.
   1. Pressure test with nitrogen to 200 psig. Perform final tests at 27-psig vacuum and 200 psig using halide torch or electronic leak detector. Test to no leakage.

B. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

C. Repair leaks using new materials; retest.

3.11 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat requirements.

3.12 CLEANING

A. Before installation of copper tubing other than Type ACR, clean tubing and fittings with trichloroethylene.

3.13 COMMISSIONING

A. Charge system using the following procedures:
   1. Install core in filter dryer after leak test, but before evacuation.
   2. Evacuate refrigerant system with vacuum pump until temperature of 35 deg is indicated on vacuum dehydration indicator.

3. During evacuation, apply heat to pockets, elbows, and low spots in piping.
4. Maintain vacuum on system for minimum of 5 hours after closing valve between vacuum pump and system.
5. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
6. Complete charging of system, using new filter-dryer core in charging line. Provide full-operating charge.

- END OF SECTION -

- SECTION 23 2500 -

HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following HVAC water-treatment systems:
   1. Closed-loop chemical feed systems.
   2. Open-loop chemical feed systems.
   3. HVAC water-treatment chemicals.

1.3 PERFORMANCE REQUIREMENTS

A. Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or the environment.

B. Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, and requirements and guidelines of authorities having jurisdiction.

C. Closed-loop hydronic systems shall have the following water qualities:
   1. pH: Maintain a value within 8.3 to 9.5.
   2. "P" Alkalinity: Maintain a value within 100 to 500 ppm.
   3. Boron: Maintain a value within 100 to 200 ppm.
   4. Chemical Oxygen Demand for Non-Glycol Systems: Maintain a maximum value of 100 ppm.
   5. Soluble Copper: Maintain a maximum value of 0.20 ppm.
   6. TDS: Maintain a maximum value of 1500 ppm.
   7. Ammonia: Maintain a maximum value of 20 ppm.
   8. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.
   9. Microbiological Limits:
      a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/ml.
      b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/ml.
      c. Nitrate Reducers: Maintain a maximum value of 100 organisms/ml.

d. Sulfate Reducers: Maintain a maximum value of 0 organisms/ml.
e. Iron Bacteria: Maintain a maximum value of 0 organisms/ml.

D. Open-loop hydronic systems, including condenser or fluid-cooler spray water, shall have the following water qualities:
1. pH: Maintain a value within 8.0 to 9.1.
2. "P" Alkalinity: Maintain a maximum value of 500 ppm.
3. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.
4. Soluble Copper: Maintain a maximum value of 0.20 ppm.
5. TDS: Maintain a maximum value of 2000 ppm.
6. Ammonia: Maintain a maximum value of 20 ppm.
7. Free "OH" Alkalinity: Maintain a maximum value of 0 ppm.
8. Microbiological Limits:
a. Total Aerobic Plate Count: Maintain a maximum value of 10,000 organisms/ml.
b. Total Anaerobic Plate Count: Maintain a maximum value of 1000 organisms/ml.
c. Nitrate Reducers: Maintain a maximum value of 100 organisms/ml.
d. Sulfate Reducers: Maintain a maximum value of 0 organisms/ml.
e. Iron Bacteria: Maintain a maximum value of 0 organisms/ml.

E. Passivation for Galvanized Steel: For the first 60 days of operation.
1. pH: Maintain a value within 7 to 8.
2. Calcium Carbonate Hardness: Maintain a value within 100 to 300 ppm.
3. Calcium Carbonate Alkalinity: Maintain a value within 100 to 300 ppm.

1.4 SUBMITTALS

A. Product Data: For each type of product or chemical indicated. Include pretreatment and chemical treatment equipment showing tanks, maintenance space required, electrical requirements, and piping connections to HVAC systems.
1. Wiring Diagrams: Power and control wiring.

B. Material Safety Data Sheets for all chemicals.

C. Field quality-control test reports.

D. Other Informational Submittals:
1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in the "Performance Requirements" Article above.
2. Water Analysis: Illustrate water quality available at Project site.
3. Loop Cleaning confirmation Report: Verify proper cleaning of the hydronic loops and confirm this observation in a letter to the Engineer.
4. Passivation Confirmation Report: Verify passivation of galvanized-steel surfaces on cooling towers or fluid coolers, and confirm this observation in a letter to Engineer.

1.5 QUALITY ASSURANCE

A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 WARRANTY

A. Special Guarantee: Provide a guarantee that the treated systems will remain scale and algae free for a period of one year when the provided chemicals are used as directed. If scaling or fouling occurs when the provided chemicals are used as directed the Water Treatment Firm shall clean the system(s) at no cost to the Owner.

B. Provide all parts, chemicals, and labor required to maintain the chemical treatment systems in good working order during the warranty period.

PART 2 - PRODUCTS

2.1 PROVIDERS

A. Approved Providers: Engage the services of one of the following:
1. Aqua-Serve.
2. Ecolab.
3. Garrett Calahan.
4. GE Water.
5. H-O-H Water Technology.
6. Nalco.
7. Pro Chem Tech.
8. Pro Services.
9. Water Energy Systems Technology (WEST).
10. Water Engineering Services (WES).

2.2 CLOSED-LOOP CHEMICAL TREATMENT

A. Bypass Feeders: Steel, with corrosion-resistant exterior coating, minimum 3-1/2-inch (89-mm) fill opening in the top, and NPS 3/4 (DN 20) bottom inlet and top side outlet. Quarter turn or threaded fill cap with gasket seal and diaphragm to lock the top on the feeder when exposed to system pressure in the vessel.
1. Capacity: 5 gal. (19 L).
2. Minimum Working Pressure: 125 psig (860 kPa).

B. Test Kit: Manufacturer-recommended equipment and chemicals in a wall-mounting cabinet for testing pH and inhibitor concentrations.

C. Corrosion Test-Coupon Assembly: Constructed of corrosive-resistant material, complete with piping, valves, and coupons. Locate copper coupon downstream from mild steel coupon in the test-coupon assembly.
   1. Two-station rack for closed-loop systems.
   2. Provide 8, pre-weighed C1010 mild steel coupons and 8, pre-weighed CDA 110 copper coupons.

D. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment, and that can attain water quality specified in Part 1 "Performance Requirements" Article.
   1. Cleaner: Alkaline based cleaner designed for the removal of oil, corrosion and other contaminants from closed loop piping systems and equipment, and to form passivating film to protect against corrosion. The clean shall contain the following as a minimum:
      a. Polyphosphonate: Mild Steel Corrosion Inhibitor
      b. Tolyltriazole (TT): Yellow Metal Corrosion Inhibitor
      c. Polymer: Dispersant & Oil Emulsifier
   2. Corrosion Inhibitor: Designed to prevent corrosion in closed loop piping and containing the following:
      a. Nitrite: Mild Steel Corrosion Inhibitor
      b. Molybdate: Mild Steel Corrosion Inhibitor
      c. Tolyltriazole (TT): Yellow Metal Corrosion Inhibitor
      d. Polymer Control: General Dispersant & Deposition
      e. Inert Chemical Tracer: Testing, Monitoring & Online Control
   3. Closed Loop Biocide: Provide a non-oxidizing biocide for quarterly treatment of each closed loop system. This biocide shall be Glutaraldehyde.

2.3 OPEN-LOOP CHEMICAL-FEED EQUIPMENT

A. Water Meter:
   1. AWWA C700, oscillating-piston, magnetic-drive, totalization meter.
   2. Body: Bronze.
   3. Maximum Pressure Loss at Design Flow: 3 psig (20 kPa).
   4. Registration: Gallons (Liters) or cubic feet (cubic meters).
   5. Controls: Flow-control switch with normally open contacts; rated for maximum 10 A, 250-V ac; and that will close at adjustable increments of total flow.
   6. Meter shall match size of adjacent piping.

B. Chemical Controller: Microprocessor-based controller, with solid-state integrated circuits, digital LCD display, interface for Building Automation System and touchpad for input.
   1. Acceptable Manufacturers: Subject to compliance with requirements, provide a product by the following:
      a. Lakewood Instruments.
      b. Approved Equal.
   2. TDS Control: Control dissolved solids, based on conductivity, and include the following:
      a. Sensor: Temperature compensated, 4 electrode, 1 percent accuracy in a range from zero to 5000 microhms.

b. Sensor probe adaptable to sample stream manifold.
c. High, low, and normal conductance indication.
d. High or low conductance alarm light, trip points field adjustable; with silence switch.
e. Hand-off-auto switch for solenoid bleed-off valve.
f. Bleed-off valve activated indication.
g. Internal adjustable hysteresis or deadband.

3. Inhibitor Injection Timers: Control inhibitor feeding, based on makeup volume, and include the following:
   a. Solid-state reset counter (accumulator), with selections from 1 to 15.
   b. Solid-state timer, adjustable from 15 to 300 seconds.
   c. Test switch.
   d. Hand-off-auto switch for chemical pump.
   e. Illuminated legend to indicate feed when pump is activated.
   f. Programmable lockout timer with indicator light. Lockout timer to deactivate the pump and activate alarm circuits.
   g. LCD makeup totalizer to measure amount of makeup and bleed-off water from two water meter inputs.
4. Biocide Feeder Timer: Control biocide with an adjustable time programmer and include the following:
   a. 24-hour timer with 14-day skip feature to permit activation any hour of day.
   b. Precision, solid-state, bleed-off lockout timer and clock-controlled biocide pump timer. Prebleed and bleed lockout timers.
   c. Solid-state alternator to enable use of two different formulations.
   d. 24-hour display of time of day.
   e. 14-day display of day of week.
   f. Battery backup so clock is not disturbed by power outages.
   g. Hand-off-auto switches for biocide pumps.
   h. Biocide A and Biocide B pump running indication.
5. Relay control and/or chemical feed methods available
   a. Relay one:
      1) Blowdown dedicated.
      2) By percent of blowdown time after blowdown.
      3) By setpoint.
      4) By makeup totalized gallons.
      5) By percent of time.
   b. All other relays:
      1) By setpoint.
      2) By blowdown totalized gallons.
      3) By makeup totalized gallons.
      4) By percent of time.
      5) B schedule (time and date)
6. Setpoints and calibration shall be retained in the event of loss of power.

7. Alarms – A relay contact shall be selectable to either feed biocide or to use alarm on the following conditions:
   a. High/low conductivity
   b. Clean sensor alarm
   c. Blowdown time exceeded
   d. No flow
   e. Temperature compensation not working
8. Inputs:
   a. Conductivity, one
   b. Water meter, two
   c. Flow switch, one
9. Outputs
   a. Four relays rated at 120AC.
   b. Relay ratings, 3 amp per relay, 10 amps total for the set of four relays. 1/5 HP motor max. The set of relays is fused by a common 10 amp fuse.
   c. 4-20mA signal that tracks conductivity.
10. Power ratings 120 VAC, 60 Hz.
11. The controller will have a three security levels to prevent unauthorized program changes.
12. Provide NEMA 4X enclosure with gasketed and lockable door when controller is mounted outdoors.

C. Bleed Valves: Two-piece, full port ball valve with electrically driven operator.

D. Chemical Solution Tanks:
1. Chemical-resistant reservoirs fabricated from high-density opaque polyethylene with minimum 110 percent containment vessel.
2. Molded cover with recess for mounting pump.
3. Capacity: 50 gal.

E. Chemical Solution Injection Pumps: Electronic metering pump.
1. Products: Subject to compliance with requirements provide one of the following:
   a. IWAKI EZ series.
   b. LMI Model 151.
   c. Pulsafeeder Model C Plus.
2. Self-priming, positive-displacement; rated for intended chemical with minimum 25 percent safety factor for design pressure and temperature.
3. Adjustable flow rate.
4. Metal and thermoplastic construction.
5. Built-in relief valve.
6. Fully enclosed, continuous-duty, single-phase motor. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

F. Chemical Solution Tubing: Polyethylene tubing with compression fittings and joints.

G. Injection Assembly:
   1. Quill: Minimum NPS 1/2 with insertion length sufficient to discharge into at least 25 percent of pipe diameter.
   2. Ball Valve: Two-piece, stainless steel; selected to fit quill.
   3. Packing Gland: Mechanical seal on quill of sufficient length to allow quill removal during system operation.
   4. Assembly Pressure/Temperature Rating: Minimum 600 psig at 200 deg F.

H. Test Kit: Manufacturer-recommended equipment and chemicals in a wall-mounting cabinet for testing pH, TDS, inhibitor, chloride, alkalinity, and hardness; and oxidizing biocide test.

I. Corrosion Test-Coupon Assembly: Constructed of corrosive-resistant material, complete with piping, valves, and coupons. Locate copper coupon downstream from mild steel coupon in the test-coupon assembly.
   1. Four-station rack for open systems.
   2. Provide 16, pre-weighed C1010 mild steel coupons and 16, pre-weighed CDA 110 copper coupons.

J. Chemicals: As recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment, and that can attain water quality specified in Part 1 "Performance Requirements" Article.
   1. Cleaner: Alkaline based cleaner designed for the removal of oil, corrosion and other contaminants from closed loop piping systems and equipment, and to form passivating film to protect against corrosion. The clean shall contain the following as a minimum:
      a. Polyphosphonate: Mild Steel Corrosion Inhibitor
      b. Tolyltriazole (TT): Yellow Metal Corrosion Inhibitor
      c. Polymer: Dispersant & Oil Emulsifier
   2. Scale Inhibitor: Liquid organo-phosphate maintained between 8 and 10 ppm concentration and Benzyltriazole.
   3. Oxidizing Biocide: EPA registered, stabilized liquid bromine, maintained at sufficient concentrations to prevent formation of slime and growth of algae.
   4. Non-Oxidizing Biocide: EPA registered, non-chlorine type, maintained at sufficient concentrations to prevent formation of slime and growth of algae. Do not use Isothiazolin.

PART 3 - EXECUTION

3.1 WATER ANALYSIS

A. Perform an analysis of supply water to determine quality of water available at Project site.

3.2 INSTALLATION

A. Furnish to and coordinate with Mechanical Contractor all items specified herein that are installed in piping systems.

B. Install water testing equipment on wall near water chemical application equipment.

C. Install test equipment and provide test-kit to Owner. Install test-coupon assembly in bypass circuit around circulating pumps, unless otherwise indicated on Drawings.

D. Install chemical storage tanks on concrete base, level and plumb. Maintain manufacturer's recommended clearances. Anchor chemical tanks to wall or support to prevent tipping.

E. Arrange units so controls and devices that require servicing are accessible.

F. Install interconnecting control wiring for chemical treatment controls and sensors. See Division 23 Sections for wiring and conduit requirements.

G. Mount sensors in piping circuits.

H. Mount blow-down valve between 36 inches and 60 inches above finished floor. Provide with throttling valve to regulate flow and equally sized by-pass for manual blow-down.

I. Mount quill injectors in condenser water return piping to tower. Provide one quill per chemical. Install injector downstream of blow-down valve connection.

J. Install automatic chemical-feed equipment for condenser or fluid-cooler spray water and include the following:
   1. Install water meter in makeup water supply.
   2. Install chemical controller with sensor(s) in bypass circuit around pumps.
      a. Install bleed valves. Bleed valves shall cycle to maintain maximum TDS concentration.
      b. Injection pumps shall operate to feed biocide on an alternating basis.
      c. Injection pumps shall operate to feed inhibitor based on make-up water flow.
      d. Injection pumps shall operate to feed acid to maintain proper water pH.
   3. Install chemical pumps on chemical tanks.
      a. Provide inlet tubing with foot valve from tank to pump.
      b. Provide outlet tubing from chemical pump discharge to quill assembly. Install chemical tubing in minimum NPS 2 inch, Schedule 40, CPVC conduit for protection of tubing and secondary chemical containment.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings.

D. Unless otherwise indicated, connect piping with unions and shut-off valves to allow equipment to be disconnected without draining piping.

E. Install shutoff valves on HVAC water-treatment equipment inlet and outlet.

F. Interconnect flow switch dry contactors in controller with condenser water pump starter. Open loop system bleed and chemical pump to be disabled when condenser pumps are not operating.

G. Confirm applicable electrical requirements in Division 26 Sections for connecting electrical equipment.

H. Ground equipment according to Division 26.

I. Connect wiring according to Division 26.

3.4 CLEANING

A. Provide cleaner to Mechanical Contractor as required to maintain the manufacturer's recommended concentration for cleaning of the hydronic systems.

B. Supervise cleaning of the hydronic systems to ensure the following:
   1. The cleaning solution is circulated a minimum of 24 hours or longer as required to thoroughly clean the interior of the piping systems.
   2. The system is drain and flushed until all cleaning chemicals and suspended materials have been removed from the system.

3.5 CHEMICAL ADDITION

A. Closed Loop Systems:
   1. Immediately after system testing, cleaning and flushing, add the required amount of corrosion inhibitor to reach the manufacturer's recommended concentration or the following.
      a. Chilled Loop Molybdate 62 – 125 ppm as MoO_4
      b. Chilled Loop Nitrite 250 – 500 ppm as NO_2
      c. Hot Loop Molybdate 125 – 187 ppm as MoO_4
      d. Hot Loop Nitrite 500 – 750 ppm as NO_2
      e. Heat Pump Loop Molybdate 125 – 187 ppm as MoO_4
      f. Heat Pump Loop Nitrite 500 – 750 ppm as NO_2
   2. Install the corrosion coupons in the coupon rack after the initial chemical addition.

B. Open Loop Systems:
   1. Add the required amount of scale inhibitor to reach an initial concentration of 8-10 ppm.
   2. Add the required amount of biocide to reach the manufacturer's recommended concentration to prevent the formation of slime and the growth of algae.
   3. Add the required amount of acid to set the pH between 8.4 and 9.0.
   4. Install the corrosion coupons in the coupon rack after the initial chemical addition.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:
   1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
   2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
   3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of HVAC systems' startup procedures.
   4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
   5. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   6. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
   7. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
   8. Repair leaks and defects with new materials and retest piping until no leaks exist.

C. Operational Test: After the systems have been filled with water and the condenser pump(s) are operating, measure chemical treatment levels and verify proper operation of controller, chemical pumps and automatic bleed valve. Set the bleed and chemical feed rates to maintain the appropriate chemical levels.

D. Remove and replace malfunctioning units and retest as specified above.

E. At one-week intervals during the warranty period, perform separate water analyses on hydronic systems to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section. Submit written reports of water analysis advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article.

F. Corrosion Coupons:
   1. Remove and replace the corrosion coupons at 90 day intervals during the warranty period.
   2. Deliver the removed coupons to a certified laboratory for testing.
   3. Return the coupons and certified analysis to the Owner’s representative.
   4. If the coupons from the closed loop system(s) show any noticeable metal loss the system water shall be tested and the appropriate action taken to prevent additional metal loss.

5. If the coupons from the open loop system show a metal loss of greater the 3.0 mils per year for steel and/or 0.5 mils per year for copper the system water shall be tested and the appropriate action taken to reduce the metal loss below those values.

G. Comply with ASTM D 3370 and with the following standards:
1. Silica: ASTM D 859.
2. Acidity and Alkalinity: ASTM D 1067.
3. Iron: ASTM D 1068.
4. Water Hardness: ASTM D 1126.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment. Refer to Division 01 Section "Demonstration and Training."

B. Review manufacturer's safety data sheets for handling of chemicals.

C. Train Owner’s maintenance personnel in performing on-site testing of water samples.

3.8 SUPPLIES

A. Provide all chemicals, testing supplies, log sheets, laboratory analysis, and other consumables required to maintain the proper chemical balance in the system(s) during the warranty period.

- END OF SECTION -

- SECTION 23 3113 -

METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Rectangular rigid ducts and fittings.
2. Round rigid ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.

1.3 PERFORMANCE REQUIREMENTS

A. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Provide the following for each duct application and pressure classification: metal gauge, construction methods, reinforcement details and spacing, hangers and support details, seam and joint types. Include manufacturer, description of material, locations for use, R-value, and thickness for duct liner.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

PART 2 - PRODUCTS

2.1 RECTANGULAR RIGID DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Duct sizes shown on drawings are clear, inside dimensions. Adjust sizes of sheet metal ductwork to account for duct lining.

C. Transverse Joints: Fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," or manufacturer's instructions for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." Select joint types from the following:
   1. Flat Drive Slip.
   2. Standing Drive Split.
   3. Companion, Angle-Van Stone Type.
   4. Flanged, formed or one of the following manufactured products:
      a. Ductmate or WDCI by Ductmate Industries, Inc.
      b. Elgen- or J-Flange by Elgen Manufacturing.
      c. FLG J or H by Ward Industries; a division of Hart & Cooley, Inc.
      d. J Flange by CL Ward & Family, Inc.
      e. J Flange by Nexus PDQ; Division of Shilco Holdings Inc.

D. Longitudinal Seams: Fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." Select seam type based on the following:
   1. Duct with Static Pressure 2-Inch wg and Less: Pittsburg lock hammered flat or button punch snap lock. Do not use button punch snap lock on aluminum duct.
   2. Duct with Static Pressure Greater Than 2-Inch wg: Pittsburg lock hammered flat.

E. Elbows: Fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2 "Rectangular Elbows." Comply with requirements for indicated static-pressure class, sealing requirements, support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." Select elbows from the following types:
   1. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
   2. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
   3. Mitered Type RE 2 with turning vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

F. Branches: Fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-5 “Divided Flow Branches" and Figure 2-6 “Branch Connections.” Comply with requirements for indicated static-pressure class, sealing requirements, support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." Select branch connections from the following types:

1. Rectangular Main to Rectangular Branch: 45-degree entry.
2. Rectangular Main to Round Branch: Conical or 45-degree lead in.

G. Transitions, Offsets, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 ROUND RIGID DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

B. Duct sizes shown on drawings are clear, inside dimensions. Adjust sizes of sheet metal ductwork to account for duct lining.

C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches (1524 mm) in Diameter: Flanged or one of the following manufactured products:
   a. SpiralFlange by CL Ward & Family, Inc.

D. Longitudinal Seams: Select a snaplock seam type for straight seam ductwork and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.

E. Elbows: Fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3 “Round Duct Elbows." Comply with requirements for indicated static-pressure class, sealing requirements, support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Minimum Radius-to-Diameter Ratio shall be 1.5.
2. Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
3. Round Elbows, 12 Inches (305 mm) and Smaller in Diameter: Stamped or pleated.
4. Round Elbows, 14 Inches (356 mm) and Larger in Diameter: Welded.

F. Tees and Laterals: Fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Comply with requirements for indicated static-pressure class, sealing requirements, support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." Select tees and laterals based on the following:
   1. Velocity Up to 1500 fpm (Up to 7.6 m/s): Conical tap.
   2. Velocity 1500 fpm (7.6 m/s) or Higher: 45-degree lateral.
   3. Saddle taps may be used in existing duct.

2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   1. Galvanized Coating Designation: G90 (Z275).
   2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

D. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M) Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

E. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
   1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

F. Tie Rods: Galvanized steel, stainless steel, or aluminum to match duct material, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.4 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. CertainTeed Corporation; Insulation Group.
      b. Johns Manville.
      c. Knauf Insulation.
      d. Owens Corning.

2. Maximum Thermal Conductivity:
   a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F (0.039 W/m x K) at 75 deg F (24 deg C) mean temperature.
   b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F (0.033 W/m x K) at 75 deg F (24 deg C) mean temperature.
3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
4. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
   a. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Mechanical Fasteners:
1. Metal, Capacitor-Discharge-Weld Pin, Insulation Hangers: Copper-coated, low carbon steel, or stainless steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated. May be provided with base.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm) thick, galvanized or stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
3. Metal, Cupped-Head, Capacitor-Discharge-Weld Pins:
   a. Head: Galvanized, carbon-steel or stainless steel sheet, minimum of 0.016-inch- (0.41-mm) thick with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
   b. Spindle: Copper- or zinc-coated, low carbon steel, or stainless steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.

C. Shop Application of Fibrous-Glass Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."
1. Duct sizes shown on drawings are clear, inside dimensions. Adjust sizes of sheet metal ductwork to account for duct lining.
2. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
3. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
4. Butt transverse joints without gaps, and coat joint with adhesive.
5. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
6. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
7. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm (12.7 m/s).
8. Secure liner with mechanical fasteners 4 inches (100 mm) from corners and at intervals not exceeding 12 inches (300 mm) transversely; at 3 inches (75 mm) from transverse joints and at intervals not exceeding 18 inches (450 mm) longitudinally.

9. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
   a. Fan discharges.
   b. Intervals of lined duct preceding unlined duct.
   c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm (12.7 m/s) or where indicated.
10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.5 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Water-Based Joint and Seam Sealant:
   1. Application Method: Brush on.
   2. Solids Content: Minimum 65 percent.
   3. Shore A Hardness: Minimum 20.
   4. Water resistant.
   5. Mold and mildew resistant.
   6. VOC: Maximum 75 g/L (less water).
   7. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
   8. Service: Indoor or outdoor.
   9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

C. Flanged Joint Sealant: Comply with ASTM C 920.
   1. General: Single-component, acid-curing, silicone, elastomeric.
   2. Type: S.
   3. Grade: NS.
   4. Class: 25.
   5. Use: O.
   6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

E. Round Duct Joint O-Ring Seals:
   1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m at 250 Pa) and shall be rated for 10-inch wg (2500-Pa) static-pressure class, positive or negative.
   2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.

3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1 (Table 4-1M), "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches (38 mm).

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

A. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
   1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   2. All Ductwork: Seal Class A.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
   1. Where practical, install concrete inserts before placing concrete.
   2. Install powder-actuated concrete fasteners after concrete is placed and completely cured and as directed by structural engineer.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1 (Table 4-1M), "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet (5 m).

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.7 DUCT SCHEDULE

A. Fabricate rigid ducts with galvanized sheet steel except as otherwise indicated.

B. Supply Ducts:
   1. Ducts Connected to Fan Coil Units, Furnaces, Air-Conditioners, Heat Pumps, and Terminal Units.
      a. Pressure Class: Positive 2-inch wg (500 Pa).
      b. Minimum SMACNA Seal Class: See Article 3.4 “Duct Sealing”.
      c. SMACNA Leakage Class for Rectangular: 24.
      d. SMACNA Leakage Class for Round and Flat Oval: 12.
   2. Ducts Connected to Constant-Volume Air-Handling Units:
      a. Pressure Class: Positive 2-inch wg (500 Pa).

b. Minimum SMACNA Seal Class: See Article 3.4 “Duct Sealing” SMACNA Leakage Class for Rectangular: 12.
c. SMACNA Leakage Class for Round and Flat Oval: 6.

3. Ducts Connected to Variable-Air-Volume Air-Handling Units:
   a. Pressure Class: Positive 3-inch wg (750 Pa).
   b. Minimum SMACNA Seal Class: See Article 3.4 “Duct Sealing”.
   c. SMACNA Leakage Class for Rectangular: 6.
   d. SMACNA Leakage Class for Round and Flat Oval: 3
4. Ducts Connected to Equipment Not Listed Above:
   a. Pressure Class: Positive 2-inch wg (500 Pa).
   b. Minimum SMACNA Seal Class: See Article 3.4 “Duct Sealing”.
   c. SMACNA Leakage Class for Rectangular: 12.
   d. SMACNA Leakage Class for Round and Flat Oval: 6.
5. Ducts Connected to Pool or Pool Equipment Room Equipment
   a. Aluminum.
   b. Pressure Class: Positive 2-inch wg (500 Pa).
   c. Minimum SMACNA Seal Class: See Article 3.4 “Duct Sealing” SMACNA Leakage Class for Rectangular: 12.
   d. SMACNA Leakage Class for Round and Flat Oval: 6.

C. Return Ducts:
1. Ducts Connected to Fan Coil Units, Furnaces, Air-Conditioners, Heat Pumps, and Terminal Units:
   a. Pressure Class: Positive or negative 1-inch wg (250 Pa).
   b. Minimum SMACNA Seal Class: See Article 3.4 “Duct Sealing”.
   c. SMACNA Leakage Class for Rectangular: 24.
   d. SMACNA Leakage Class for Round and Flat Oval: 12.
2. Ducts Connected to Air-Handling Units:
   a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
   b. Minimum SMACNA Seal Class: See Article 3.4 “Duct Sealing”.
   c. SMACNA Leakage Class for Rectangular: 12.
   d. SMACNA Leakage Class for Round and Flat Oval: 6.
3. Ducts Connected to Equipment Not Listed Above:
   a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
   b. Minimum SMACNA Seal Class: See Article 3.4 “Duct Sealing”.
   c. SMACNA Leakage Class for Rectangular: 12.
   d. SMACNA Leakage Class for Round and Flat Oval: 6.

D. Exhaust Ducts:
1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
   a. Pressure Class: Negative 2-inch wg (500 Pa).
   b. Minimum SMACNA Seal Class: See Article 3.4 “Duct Sealing”.
   c. SMACNA Leakage Class for Rectangular: 12.
   d. SMACNA Leakage Class for Round and Flat Oval: 6.

2. Ducts Connected to Air-Handling Units:
   a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
   b. Minimum SMACNA Seal Class: See Article 3.4 “Duct Sealing” if negative pressure, and A if positive pressure.
   c. SMACNA Leakage Class for Rectangular: 12.
   d. SMACNA Leakage Class for Round and Flat Oval: 6.
3. Ducts Connected to Dishwasher Hoods:
   a. Type 304, stainless-steel sheet.
   b. Exposed to View: No. 4 finish.
   c. Concealed: No. 2D finish.
   d. Welded seams and flanged joints with watertight EPDM gaskets.
   e. Pressure Class: Positive or negative 2-inch wg (500 Pa).
   f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
   g. SMACNA Leakage Class: 3.

E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
   a. Pressure Class: Positive or negative 1-inch wg (250 Pa).
   b. Minimum SMACNA Seal Class: See Article 3.4 “Duct Sealing”.
   c. SMACNA Leakage Class for Rectangular: 24.
   d. SMACNA Leakage Class for Round and Flat Oval: 12.
2. Ducts Connected to Air-Handling Units:
   a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
   b. Minimum SMACNA Seal Class: See Article 3.4 “Duct Sealing”.
   c. SMACNA Leakage Class for Rectangular: 12.
   d. SMACNA Leakage Class for Round and Flat Oval: 6.
3. Ducts Connected to Equipment Not Listed Above:
   a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
   b. Minimum SMACNA Seal Class: See Article 3.4 “Duct Sealing”.
   c. SMACNA Leakage Class for Rectangular: 12.
   d. SMACNA Leakage Class for Round and Flat Oval: 6.

F. Intermediate Reinforcement:
1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.
2. Stainless-Steel Ducts:
   a. Exposed to Airstream: Match duct material.
   b. Not Exposed to Airstream: Match duct material.
3. Aluminum Ducts: Aluminum.

G. Duct Liner: Furnish ducts with duct liner for the following applications unless noted otherwise on the drawings:
1. Rectangular Supply and Return Air Ducts Within the Building Envelope: Fibrous glass, Type I, 1-1/2 inches (38 mm) thick with a minimum R-value of 5.

2. Rectangular Supply and Return Air Ducts Outside the Building Envelope: Fibrous glass, Type I, 2 inches (51 mm) thick with a minimum R-value of 8.
3. Rectangular Exhaust Air Ducts Within the Building Envelope Within 10 Lineal Feet of an Exhaust Grille (Excluding Guestroom Exhaust Registers): Fibrous glass, Type I, 1/2 inch (13 mm) thick.
4. Rectangular Exhaust Air Ducts Within 20 Lineal Feet of the Exhaust Fan: Fibrous glass, Type I, 1/2 inch (13 mm) thick.
5. Supply and Return Fan Plenums Within the Building Envelope: Fibrous glass, Type II, 1-1/2 inches (38 mm) thick with a minimum R-value of 5.
6. Supply and Return Fan Plenums Outside the Building Envelope: Fibrous glass, Type II, 2 inches (51 mm) thick with a minimum R-value of 8.
7. Transfer Ducts or Boots: Fibrous glass, Type I, 1/2 inch (13 mm) thick.
8. Exception: Do not line ductwork connected to evaporative coolers, ductwork connected to kitchen hoods, outside air intakes, ductwork serving shower areas, or combustion air ducts.

- END OF SECTION -

- SECTION 23 3115 -

TYPE I KITCHEN HOOD EXHAUST DUCT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Shop fabricated grease ductwork.
   2. Listed and factory manufactured grease ductwork.

1.3 SUBMITTALS

A. Product Data: For the following:
   1. Fabricated grease ductwork.
   2. Listed and manufactured grease ductwork.
   3. Include plans, elevations, sections, details, and attachments to other work.

B. Welding certificates.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
   2. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

PART 2 - PRODUCTS

2.1 LISTED MANUFACTURED GREASE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. American Metal Products.
   2. Industrial Chimney Company.

3. Metal-Fab, Inc.
4. Selkirk Inc.
5. Van-Packer Company, Inc.

B. Description: Double-wall metal vents tested according to UL 1978 and rated for 500 deg F continuously, or 2000 deg F for 30 minutes; with positive or negative duct pressure and complying with NFPA 211, UL1978.

C. Construction: Inner shell and outer jacket separated by at least a 3-inch annular space filled with high-temperature, ceramic-fiber insulation.

D. Inner Shell: ASTM A 666, Type 304 or Type 316 stainless steel.

E. Outer Jacket: Aluminized or stainless steel where concealed. Stainless steel where exposed.

F. Accessories: Tees, elbows, increasers, hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly. Include unique components required to comply with NFPA 96 including cleanouts, transitions, adapters and drain fittings.

2.2 HANGERS AND SUPPORTS

A. Hanger Rods: Cadmium-plated steel rods and nuts.

B. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

C. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

D. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

E. Trapeze and Riser Supports:
1. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for fan sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved.

B. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

C. Install ducts with a clearance as required by local code requirements and the manufacturer's listed information.

D. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

E. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

C. Repair or replace damaged sections and finished work that does not comply with these requirements.

D. Install ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.

E. Install fire-rated access panel assemblies as required by the local code authority and at each change in direction and at maximum intervals of 20 feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1-1/2 inches from bottom of duct.

F. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.3 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured and as directed by the structural engineer.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.4 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.5 DUCT SCHEDULE

A. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.
   1. Listed and manufactured duct may be used in both exposed and concealed applications. Provide stainless steel jacket where exposed.
   2. Pressure Class: Positive or negative 3-inch wg.

- END OF SECTION -

- SECTION 23 3300 -

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Control dampers.
4. Fire dampers.
5. Smoke dampers.
6. Combination fire/smoke dampers.
7. Flange connectors.
8. Turning vanes.
9. Duct-mounted access doors.
10. Flexible connectors.
11. Flexible ducts.
12. Domestic clothes dryer connection box.

1.3 SUBMITTALS

A. Product Data: Provide manufacturer's product data for each duct accessory intended for use on this project. Data to be specific to the items proposed for the project with all options and accessories indicated. Include the following as a minimum:
1. Manufacturer and model number.
2. Dimensions.
3. Electrical data for damper motor operators including voltage and motor ampacity.
4. Materials of construction.
5. Accessories and options.
6. Installation details for fire, smoke, and combination fire/smoke dampers for each application intended for this project.

B. Test reports for smoke and combination fire/smoke dampers.

C. Warranty information.

D. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   1. Galvanized Coating Designation: G90 (Z275).
   2. Exposed-Surface Finish: Mill phosphatized.

C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and No. 4 finish for exposed ducts.

D. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

E. Extruded Aluminum: Comply with ASTM B 221 (ASTM B 221M), Alloy 6063, Temper T6.

F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

G. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.2 DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Air Balance Inc.
   2. Elgen Manufacturing.
   3. Greenheck Fan Corporation.
   4. McGill Airflow LLC.
   5. Metal Form.
   6. National Controlled Air.

7. Nailor Industries Inc.
8. Pottorff.
9. Ruskin Company.
10. Safe-Air-Dowco.
11. Vent Products Company, Inc.
12. Young Regulator Company.

B. Backdraft and Pressure Relief Dampers:
1. Description: Counterbalanced.
2. Maximum Air Velocity: 2000 fpm (10 m/s).
3. Static Pressure Range: 0.01 to 0.10-inch wg.
4. Frame: Hat-shaped, minimum 0.052-inch- (1.3-mm-) thick, galvanized sheet steel, 0.063-inch- (1.6-mm-) thick extruded aluminum or 0.052-inch- (1.3-mm-) thick stainless steel, with welded corners and mounting flange.
5. Blades: Multiple single-piece blades, maximum 6-inch (150-mm) width, 0.025-inch- (0.6-mm-) thick, roll-formed aluminum or 0.050-inch- (1.2-mm-) thick aluminum sheet with sealed edges. Blade material shall match frame material.
6. Blade Action: Parallel.
7. Blade Seals: Extruded vinyl or neoprene mechanically locked.
8. Blade Axles:
   a. Material: Galvanized steel, stainless steel or aluminum to match frame and blades.
   b. Diameter: Minimum 0.20 inch (5 mm).
9. Tie Bars and Brackets: Aluminum or galvanized steel to match axles.
10. Bearings: Steel ball or synthetic pivot bushings.
11. Counterweights: Adjustable for varying differential static pressure as well as horizontal and vertical airflow.

C. Manual Volume Dampers:
1. Rectangular:
   a. Factory fabricated for shut-off or balancing duty in branch ducts:
      1) Standard leakage rating, with linkage outside airstream.
      2) Suitable for horizontal or vertical applications.
      3) Frames:
         a) Hat-shaped, galvanized-steel or aluminum channels.
         b) Mitered and welded corners.
         c) Flanges for attaching to walls and flangeless frames for installing in ducts.
      4) Blades:
         a) Multiple with maximum blade width of 8 inches (200 mm).
         b) Opposed-blade design.
         c) Stiffen damper blades for stability.
         d) Galvanized-steel, 0.064 inch (1.62 mm) thick or aluminum 0.10 inch (2.5 mm) thick to match frame.
      5) Blade Axles: Galvanized steel or aluminum to match frame and blades.

6) Bearings:
   a) Oil-impregnated bronze or molded synthetic.
   b) Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
7) Tie Bars and Brackets: Galvanized steel or aluminum to match frame and blades.
8) Jackshaft:
   a) Size: 1-inch (25-mm) diameter.
   b) Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
   c) Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
9) Damper Hardware:
   a) Zinc-plated, die-cast core with dial and handle made of 3/32-inch-(2.4-mm-) thick zinc-plated steel, and a 3/4-inch (19-mm) hexagon locking nut.
   b) Include center hole to suit damper operating-rod size.
   c) Include elevated platform for insulated duct mounting.

b. Shop and field fabricated for balancing duty in duct run-outs serving a single diffuser, grille or register:
   1) Blade: Single blade volume damper constructed per SMACNA standards.
   2) Handle: Stamped or cast metal configured to indicate damper position in duct. Provide extension to raise handle above duct insulation and locking device such as wing nut to secure extension device to side of damper bearing and duct, or standoff with locking quadrant to secure damper in position.

2. Round:
   a. Factory fabricated for shut-off or balancing duty in branch ducts:
      1) Standard leakage rating.
      2) Suitable for horizontal or vertical applications.
      3) Frames: Galvanized-steel channel.
      4) Blades: Galvanized steel, minimum 16 gauge.
      5) Blade Axles: Plated steel extending minimum 6 inches beyond frame.
      6) Bearings: Nylon sleeve with stainless steel thrust washers.
      7) Stops: Plated screw for both open and closed positions.
      8) Damper Hardware:
         a) Zinc-plated, die-cast core with dial and handle made of 3/32-inch-(2.4-mm-) thick zinc-plated steel, and a 3/4-inch (19-mm) hexagon locking nut.
         b) Include center hole to suit damper operating-rod size.
         c) Include elevated platform for insulated duct mounting.
         d) Include locking quadrant to secure damper in position.

b. Shop and field fabricated for balancing duty in duct run-outs serving a single diffuser, grille or register:
   1) Blade: Single blade volume damper constructed per SMACNA standards.
   2) Handle: Stamped or cast metal configured to indicate damper position in duct. Provide extension to raise handle above duct insulation and locking device such as wing nut to secure extension device to side of damper bearing and duct, or standoff with locking quadrant to secure damper in position.

3. Remote Damper Operators:
   a. Damper operator for remote operation of manual balancing dampers located above hard ceilings or other inaccessible locations.
   b. Electrically Activated: Greenheck RBD-10
      1) Electrically actuated motor for field mounting on manual balancing damper shaft.
      2) Plenum-rated, interconnect cable in length suitable to reach remote- wall, ceiling, or diffuser plate.
      3) Handheld, battery powered controller for actuation of motor.
   c. Manually Activated: Young 270-315
      1) Galvanized steel rack and pinion controller for attachment to the balancing damper shaft.
      2) Bowden cable with galvanized steel outer casing and stainless steel inner wire in length as required but no more than 50 feet.
      3) Ceiling mounted, die cast mounting cup, with adjustable threaded cover.
   d. Provide all accessories required for the intended application.

D. Control Dampers:
1. Rectangular:
   a. Frames:
      1) Hat or U-channel.
      2) Galvanized-steel, minimum 0.064 inch (1.62 mm) thick.
      3) Mitered and welded corners.
   b. Blades:
      1) Airfoil shape.
      2) Multiple blade with maximum blade width of 8 inches (200 mm).
      3) Opposed-blade design.
      4) Galvanized steel.
      5) 0.080 inch (2.0 mm) thick.
      6) Blade Edge Seals: Closed-cell neoprene.
      7) Blade Jamb Seals: Flexible metal compression seal.
   c. Blade Axles: 1/2-inch- (13-mm-) diameter; plated or galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
      1) Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).

d. Bearings:
   1) Oil-impregnated bronze, stainless steel, or molded synthetic.
   2) Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
   3) Thrust bearings at each end of every blade.
e. Leakage: Maximum of 3 cfm/sf at 1 inch water gauge.

2. Round:
   a. Frames: Galvanized-steel, minimum 0.040 inch (1.0 mm) thick.
   b. Blade: Two layers of galvanized steel each a minimum 0.080 inch (2.0 mm) thick.
   c. Blade Seal: Neoprene sandwiched between blade layers extending beyond blades all around.
   d. Blade Axle: 1/2-inch- (13-mm-) diameter extended full length of blade; plated or galvanized steel extending beyond frame as required for operator mounting.
      1) Maximum Operating Temperature: 200 deg F (93 deg C).
   e. Bearings:
      1) Oil-impregnated bronze, stainless steel, or molded synthetic.
   f. Leakage: Maximum of 0.15 cfm per inch of blade circumference at 4 inch water gauge.

2.3 FIRE DAMPERS, SMOKE DAMPERS, COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Greenheck Fan Corporation.
   2. Pottorff; a division of PCI Industries, Inc.
   3. Ruskin Company.

B. Fire Dampers:
   1. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.
   2. Closing rating in ducts up to 4-inch wg (1-kPa) static pressure class and minimum 4000-fpm (20-m/s) velocity.
   3. Fire Rating: 1-1/2 hours or longer as required or noted on drawings.
   4. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch- (0.85-mm) thick galvanized steel; with mitered and interlocking corners.
   5. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
      a. Minimum Thickness: 0.052 or 0.138 inch (1.3 or 3.5 mm) thick, as indicated, and of length to suit application.
      b. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
   6. Mounting Orientation: Vertical or horizontal as indicated.
   7. Blades: Roll-formed, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.

8. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
9. Heat-Responsive Device: Replaceable, 165 deg F (74 deg C) rated, fusible links.

C. Smoke Dampers:
1. General Requirements: Label according to UL 555S by an NRTL.
2. Smoke Detector: Integral, factory wired for single-point connection where indicated.
3. Frame: Multiple-blade type fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.
4. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.
5. Leakage: Class I.
6. Rated pressure and velocity to exceed design airflow conditions.
7. Mounting Sleeve: Factory-installed, galvanized sheet steel; length to suit wall or floor application.
8. Damper Motors: Two-position action, externally mounted.
9. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
   a. Motor Sizes: Provide motor large enough so driven load will not require motor to operate in service factor range above 1.0.
   b. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
   c. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
   d. Spring-Return Motors: Equip with an integral spiral-spring mechanism. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).
   e. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).
   f. Electrical Connection: 115 V, single phase, 60 Hz.
10. Accessories:
    a. Auxiliary switches for signaling or position indication where indicated.
    b. Momentary test switch, and test and reset switches damper or remote mounted as indicated.

D. Combination Fire and Smoke Dampers:
1. General Requirements: Label according to UL 555 and UL 555S by an NRTL.
2. Closing rating in ducts up to 4 inch wp (kPa) static pressure and maximum air flow through the open damper of 2000 FPM (10 m/s).
3. Smoke Detector: Integral, factory wired for single-point connection where indicated.
4. Fire rating: 1-1/2 hours or longer as required or noted on drawings.
5. Frame: Hat-shaped, minimum 0.094-inch- (2.4-mm-) thick, galvanized sheet steel, with welded or interlocking, gusseted corners and mounting flange.
6. Leakage: Class 1.

7. Blades: Horizontal, airfoil shaped, minimum 0.063-inch- (1.6-mm) thick, galvanized sheet steel.
8. Mounting Sleeve: Factory-installed, galvanized sheet steel; length to suit wall or floor application.
9. Heat Response Device: Electric fuse link 165 deg F (74 deg C) rated with re-openability for use in smoke control systems.
10. Damper Motors: Two-position action, externally mounted unless indicated otherwise.
11. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
    a. Motor Sizes: Provide motor large enough so driven load will not require motor to operate in service factor range above 1.0.
    b. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
    c. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
    d. Spring-Return Motors: Equip with an integral spiral-spring mechanism. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).
    e. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).
    f. Electrical Connection: 115 V, single phase, 60 Hz.
12. Accessories:
    a. Auxiliary switches for signaling or position indication where indicated.
    b. Momentary test switch, and test and reset switches damper or remote mounted as indicated.

2.4

A. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades; set into vane runners suitable for duct mounting.

B. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."

C. Vane Construction: Single thickness with 3/4 inch trailing edge spaced at 1.5 inch centers.

2.5 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. American Warming and Ventilating.
2. CL Ward & Family, Inc.
3. Ductmate Industries, Inc.
4. Flexmaster U.S.A., Inc.
5. Greenheck.

6. McGill AirFlow Corporation.
7. Nailor Industries Inc.
8. Ventfabrics, Inc.
9. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Rectangular Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 2-10, "Duct Access Doors and Panels."
   1. Door:
      a. Double wall, rectangular.
      b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Where used in product conveying ducts, match duct material.
      c. Hinges and Latches: 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.
      d. Fabricate doors airtight and suitable for duct pressure class.
   2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets. Where used in product conveying ducts, match duct material.
   3. Number of Hinges and Locks:
      a. Access Doors Less Than 8 Inches (300 mm) Square: No hinges and two sash locks.
      b. Access Doors up to 18 Inches (460 mm) Square: Two hinges and two sash locks.
      c. Access Doors up to 24 by 48 Inches (600 by 1200 mm): Three hinges and two compression latches.
      d. Access Doors Larger Than 24 by 48 Inches (600 by 1200 mm): Four hinges and two compression latches with outside and inside handles.

C. Round Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 2-11, "Access Panels - Round Duct."
   1. Door:
      a. Double wall, rectangular or oval.
      b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Where used in product conveying ducts, match duct material.
      c. Hinges and Latches: 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.
      d. Fabricate doors airtight and suitable for duct pressure class.
   2. Number of Hinges and Locks:
      a. Access Doors Less Than 12 Inches (300 mm) Square: No hinges and two sash locks.
      b. Access Doors up to 18 Inches (460 mm) Square: Two hinges and two sash locks.
      c. Access Doors up to 24 by 48 Inches (600 by 1200 mm): Three hinges and two compression latches.

D. Pressure Relief Access Door:
   1. Door and Frame Material: Galvanized sheet steel.
   2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.

3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
4. Factory set at 10-inch wg (2500 Pa) or an indicated.
5. Doors close when pressures are within set-point range.
6. Hinge: Continuous piano.
7. Latches: Cam.
8. Seal: Neoprene or foam rubber.
9. Insulation Fill: 1-inch- (25-mm-) thick, fibrous-glass or polystyrene-foam board.

2.6 DUCT ACCESS PANEL ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Ductmate Industries, Inc.
2. Flame Gard, Inc.
3. 3M.

B. Labeled according to UL 1978 by an NRTL.

C. Panel and Frame: Minimum thickness 0.0528-inch (1.3-mm) carbon steel.

D. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.

E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F (1093 deg C).

F. Minimum Pressure Rating: 10-inch wg (2500 Pa), positive or negative.

2.7 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. CL Ward & Family, Inc.
2. Ductmate Industries, Inc.
3. Duro Dyne Inc.
4. Elgen.
5. Ventfabrics, Inc.
6. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches (89 mm) wide attached to 2 strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized sheet steel or 0.032-inch- (0.8-mm-) thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
   1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
   2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.
   3. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).

F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
   1. Minimum Weight: 24 oz./sq. yd. (810 g/sq. m).
   2. Minimum Tensile Strength: 500 lbf/inch (88 N/mm) in the warp and 440 lbf/inch (77 N/mm) in the filling.
   3. Service Temperature: Minus 50 to plus 250 deg F (Minus 45 to plus 121 deg C).

2.8 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Atco Flex.
   2. Elgen.
   3. Flexmaster U.S.A., Inc.
   4. Genflex.
   5. Manville.
   6. Owens-Corning.
   7. Therma Flex.
   8. Wiremold.

B. Insulated, Flexible Duct: UL 181, Class 1, polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized vapor-barrier film.
   1. Pressure Rating:
      a. Low Pressure: 4-inch wg (1000 Pa) positive and 0.5-inch wg (125 Pa) negative.
      b. High Pressure: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative in applications over 2-inch wg (500 Pa).
   2. Maximum Air Velocity: 4000 fpm (20 m/s).
   3. Temperature Range: Minus 20 to plus 175 deg F (Minus 29 to plus 79 deg C).
   4. Insulation R-Value: Comply with the latest addition of ASHRAE/IESNA 90.1.

C. Flexible Duct Connectors:
   1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches (75 through 460 mm), to suit duct size.

2.9 DOMESTIC CLOTHES DRYER CONNECTION BOX

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. In-O-Vate Technologies.

B. Description: 22 gauge aluminized steel recessed box with 4-inch cut-out for dryer vent.

C. Size: Minimum 9 inch wide, 18 inch tall, 4 inch deep inside recess for final dryer connection.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Select duct accessories suitable for the pressure class of the ductwork to which it is attached.

B. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.

C. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

D. Install turning vanes in all rectangular duct elbows having a 45-degree or greater bend as indicated.

E. Install dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

F. Install volume dampers at points on supply, return, and exhaust systems where branches serving diffusers and grilles extend from larger ducts. Install dampers where accessible and as close to mains as possible. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
   1. Install steel volume dampers in steel ducts.
   2. Install aluminum volume dampers in aluminum ducts.

G. Install volume dampers in outside air systems at the connection to the equipment served.
   1. Install steel volume dampers in steel ducts.
   2. Install aluminum volume dampers in aluminum ducts.

H. Remote Damper Operators:
   1. Install remote damper operators for all dampers located above hard ceilings or for dampers that will otherwise be inaccessible at the completion of construction.
   2. Install remote damper operator in accordance with the manufacturer's written instructions.
   3. Locate operator interface as indicated on the drawings or as instructed by the Architect/Engineer.
   4. Finish cover to match adjacent ceiling.

I. Set dampers to fully open position before testing, adjusting, and balancing.

J. Install fire and smoke dampers according to UL listing at all duct penetrations of rated assemblies as required to maintain the rating as designated on the drawings.

K. Mount duct smoke detectors in strict conformance with manufacturer's recommendations. Duct smoke detectors to be furnished and wired in Division 21, 26 or 28.

L. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment. Locate on side of duct with greatest clearance. Install at the following locations:
   1. On both sides of duct coils. (Minimum head and hand access.)
   2. Upstream and downstream from duct filters. (Minimum head and hand access.)
   3. At outdoor-air intakes and mixed-air plenums. (Minimum head and hand access.)
   4. At drain pans and seals. (Minimum head and hand access.)
   5. Downstream from control dampers, backdraft dampers, and other duct-mounted equipment. (Minimum head and hand access.)
   6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors; and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers. (Minimum two hand access.)
   7. Elsewhere as indicated.

M. Install access doors with swing against duct static pressure.

N. Minimum Access Door Sizes:
   1. One-Hand or Inspection Access: 8 by 8 inches (200 by 200 mm).
   2. Two-Hand Access: 12 by 8 inches (300 by 200 mm).
   3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
   4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).
   5. Body Access: 25 by 14 inches (635 by 355 mm).
   6. Body plus Ladder Access: 25 by 17 inches (635 by 430 mm).

O. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

P. Install flexible connectors to connect ducts to equipment. Provide sheet metal sunshields on flexible connectors exposed to weather.

Q. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

R. Flexible duct may only be used in the following locations with the following limitations:
   1. Connect terminal units to supply ducts with maximum 12-inch lengths of high pressure flexible duct. Do not use flexible ducts to change directions.
   2. Connect diffusers, grilles, or registers located in lay-in ceilings to ducts with maximum 60-inch lengths of low pressure flexible duct secured in place with stainless steel clamps.
   3. Install flexible ducts stretched and supported without kinks or sags.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. Operate dampers to verify full range of movement.
   2. Inspect locations of access doors and verify that purpose of access door can be performed.

3. Operate fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.

- END OF SECTION -

- SECTION 23 3416 -

CENTRIFUGAL HVAC FANS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following utility sets:
   1. Backward-inclined centrifugal fans.

1.3 SUBMITTALS

A. Product Data: Provide manufacturer's product data for each unit indicated on the drawings. Data to be specific to the equipment proposed for the project with all options and accessories indicated. Include the following as a minimum:
   1. Manufacturer and model number.
   2. Rated capacity based on scheduled conditions and project elevation.
   3. Equipment dimensions.
   4. Required clearances.
   5. Electrical data.
      a. Motor horsepower
      b. Voltage/Phase/Hz
      c. Full load ampacity, minimum circuit ampacity and maximum overcurrent protection device requirements.
      d. Electrical service point(s) of connection.
      e. AIC rating of the equipment.
   6. Materials of construction.
   7. Accessories and options.
   8. Controls.

B. Warranty information.

C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA 1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
   1. Greenheck.
   2. Loren Cook Company.
   3. Penn Barry

2.2 BACKWARD-INCLINED CENTRIFUGAL FANS

A. Description: Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and support structure.

B. Housings: Formed panels to make curved-scroll housings with shaped cutoff; with doors or panels to allow access to internal parts and components.
   1. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
   2. Spun inlet cone with flange.
   3. Fan housing to have continuously welded seams and shall be field rotatable to any one of eight discharge positions.
   4. Outlet flange.

C. Fan Wheel: Aluminum or steel, as scheduled, backward inclined, non-overloading, single-width-single-inlet with blades welded or riveted to back plate and wheel cone; aluminum, cast-iron, or cast-steel hub fastened to shaft; wheels to be statically and dynamically balanced.

D. Shafts: Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
   1. Turned, ground, and polished hot-rolled steel or stainless steel with keyway. Ship with a protective coating of lubricating oil.
   2. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

E. Prelubricated and Sealed Shaft Bearings: Self-aligning, pillow-block-type ball bearings.
   1. Ball or Roller Bearing Rating Life: ABMA 9, Ll0 at 50,000 hours.

F. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.
   1. Service Factor Based on Fan Motor Size: 1.5.
   2. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
   3. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
   4. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
   5. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
   6. Motor Mount: Adjustable for belt tensioning.

G. Finish: All steel portions of the fan except the shaft shall have a baked powder coated finish which will exceed 1,000 hour salt spray under ASTM B117 test method unless alternate coating is specified on the Drawings.

H. Accessories: Provide the following accessories as scheduled.
   1. Scroll Access Doors: Shaped to conform to scroll, with quick-opening latches and gaskets.
   2. Scroll Drain Connection: NPS 1 (DN 25) steel pipe coupling welded to low point of fan scroll.
   3. Companion Flanges: Rolled flanges for duct connections of same material as housing.
   4. Discharge Dampers: Assembly with parallel blades constructed of two plates formed around and to shaft, channel frame, and sealed ball bearings; with blades linked outside of airstream to single control lever of same material as housing.
   5. Inlet Screens: Grid screen of same material as housing.
   6. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
   7. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing with extended lubrication lines.

I. Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

2.3 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install centrifugal fans level and plumb.

B. Support floor-mounting units using spring isolators having a static deflection of 2 inch. Vibration- and seismic-control devices are specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."
   1. Secure vibration controls to concrete bases using anchor bolts cast in concrete base.

C. Install floor-mounting units on concrete bases.

D. Support suspended units from structure using threaded steel rods and spring hangers having a static deflection of 2 inch. Vibration-control devices are specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."

E. Install units with clearances for service and maintenance.

F. Label fans according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."

B. Install ducts adjacent to fans to allow service and maintenance.

C. Install line-sized piping from scroll drain connection, on fans provided with drains, with trap with seal equal to 1.5 times specified static pressure, to nearest floor drain.

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
   1. Verify that shipping, blocking, and bracing are removed.
   2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
   3. Verify that cleaning and adjusting are complete.
   4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
   5. Adjust belt tension.
   6. Adjust damper linkages for proper damper operation.
   7. Verify lubrication for bearings and other moving parts.

8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
10. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

- END OF SECTION -

- SECTION 23 3423 -

HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Centrifugal Roof Ventilators.
2. Up-blast Propeller Roof Exhaust Fans (Kitchen Hood Exhaust).
3. Ceiling-Mounted Ventilators.
4. In-Line Centrifugal Fans.
5. Attic Ventilators
6. Motors
7. Factory Finishes
8. Quality Control

B. Related Sections:
1. Section 23 05 00 (15050) – Common Work Results for HVAC
2. Section 23 05 48 (15070) - Mechanical Sound, Vibration and Seismic Control.
3. Section 23 08 00 – Commissioning of HVAC
4. Section 23 05 53 (15075) – Identification for HVAC Piping and Equipment
5. Section 23 05 13 (15090) – Common Motor Requirements for HVAC Equipment
6. Section 23 05 93 (15950) - Testing, Adjusting, and Balancing for HVAC
7. Section 26 29 13 (16420) - Enclosed Controllers: For motor starters.
8. Section 26 51 00 (16510) – Interior Lighting: Light Fixture Matrix For Guestroom Toilet Ceiling Mounted Ventilators.

C. Products Supplied But Not Installed Under This Section:
1. Roof curbs for roof-mounted exhaust fans.

1.3 REFERENCES

A. Air Movement & Control Association International, Inc. (AMCA) Publications:
   1. 99 "Standards Handbook" (Revised 2003)
   2. 210 "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating"
   3. 300 "Reverberant Room Method for Sound Testing of Fans"
   4. 301 "Methods for Calculating Fan Sound Ratings from Laboratory Test Data"

B. Home Ventilating Institute (HVI) Publications:
   1. 915 “Procedure for Loudness Rating of Residential Fan Products”

C. National Electrical Manufacturer’s Association (NEMA) Standards Publications:
   1. MG 1 “Motors and Generators”

D. National Fire Protection Association (NFPA) Publications:
   1. 70 "National Electric Code"

E. Underwriter's Laboratories, Inc. (UL) Publications:
   1. 486A “Standard For Wire Connectors and Soldering Lugs for Use With Copper Conductors”
   2. 486B “Standard for Wire Connectors for Use With Aluminum Conductors”
   3. 705 “Standard for Power Ventilators”

1.4 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base air ratings on actual site elevations.

B. Operating Limits: Classify according to AMCA 99.

C. Fan Schedule: The following information is described in an equipment schedule on the Drawings.
   1. Fan performance data including capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
   2. Fan arrangement including wheel configuration, inlet and discharge configurations, and required accessories.

1.5 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
   1. Product Data including rated capacities of each unit, weights (shipping, installed, and operating), furnished specialties, accessories, and the following:
      a. Certified fan performance curves with system operating conditions indicated.
      b. Certified fan sound power ratings.
      c. Motor ratings and electrical characteristics plus motor and electrical accessories.

d. Material gages and finishes, including color charts.

e. Dampers, including housings, linkages, and operators.

2. Shop Drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.

3. Wiring diagrams detailing wiring for power and control systems and differentiating clearly between manufacturer-installed and field-installed wiring.

4. Maintenance data for power ventilators to include in the operation and maintenance manual specified in Division 01 and in Section 23 05 00 "Common Work Results for HVAC."

1.6 QUALITY ASSURANCE

A. Electrical Component Standard: Provide components that comply with NFPA 70 and that are listed and labeled by UL where available.

B. Listing and Labeling: Provide electrically operated fixtures specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.

C. AMCA Compliance: Provide products that meet performance requirements and are licensed to use the AMCA Seal.

D. NEMA Compliance: Provide components required as part of fans that comply with applicable NEMA standards.

E. UL Standard: Provide power ventilators that comply with UL 705.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions by field measurements. Verify clearances.

B. Do not operate fans until ductwork is clean, filters are in place, bearings are lubricated, and fans have been commissioned.

1.8 COORDINATION AND SCHEDULING

A. Coordinate the size and location of structural steel support members.

B. Coordinate the installation of roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 07 Sections.

1.9 EXTRA MATERIALS

A. Furnish extra materials described in Section 01 78 43 (01790) “Spare Parts and Materials” that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved Manufacturers:
   1. In-Line Centrifugal Fans:
      a. Carnes Co. (608-845-6411)
      b. Loren Cook Company (417-869-6474)
      c. Greenheck Fan Corporation (715-359-6171)
      d. PennBarry (972-234-3202)

2.2 IN-LINE CENTRIFUGAL FANS

A. Description: In-line, belt-driven, or direct-drive centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, drive assembly, motor and disconnect switch, mounting brackets, and accessories.

B. Housing: Split, spun-aluminum housing, with aluminum straightening vanes; inlet and outlet flanges; and support bracket adaptable to floor, side wall, or ceiling mounting.

C. Direct-Drive Units: Motor encased in housing out of air stream, factory wired to disconnect located on outside of fan housing.

D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

E. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

F. Accessories: The following accessories are required as indicated:
   1. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
   2. Companion Flanges: For inlet and outlet duct connections.
   3. Fan Guards: Expanded metal in removable frame. Provide fan guards for units not connected to ductwork.

2.3 MOTORS

A. Refer to Section 23 05 13 - "Common Motor Requirements for HVAC Equipment" for general requirements for factory-installed motors.

B. Motor Construction: NEMA MG 1, general purpose, continuous duty, Design B.

C. Enclosure Type: The following features are required as indicated:
   1. Open dripproof motors where satisfactorily housed or remotely located during operation.

2.4 FACTORY FINISHES

A. Sheet Metal Parts: Prime coat before final assembly.

B. Exterior Surfaces: Baked-enamel finish coat after assembly.

C. Aluminum Parts: No finish required.

2.5 SOURCE QUALITY CONTROL

A. Testing Requirements: The following factory tests are required as indicated:

1. Sound Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings From Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA Seal.
2. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements of installation tolerances and other conditions affecting performance of the power ventilators. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install power ventilators according to manufacturer's written instructions.

B. Support units using the vibration-control devices indicated. Vibration-control devices are specified in Section 23 05 48 - "Vibration, and Seismic Control for HVAC Piping and Equipment."

1. Suspend units from structural steel support frame using threaded steel rods and vibration isolation springs.

C. Install units with clearances for service and maintenance.

D. Label units according to requirements specified in Section 23 05 53 "Identification for HVAC Piping and Equipment."

3.3 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 15 Sections. Drawings indicate the general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors.

B. Electrical: Conform to applicable requirements in Division 16 Sections.

C. Grounding: Ground equipment. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Provide services of a factory-authorized service representative to supervise the field assembly of components and installation of fans, including duct and electrical connections, and to report results in writing.

3.5 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Lubricate bearings.

3.6 CLEANING

A. After completing installation, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.

B. Clean fan interiors to remove foreign material and construction debris. Vacuum clean fan wheel and cabinet.

3.7 COMMISSIONING

A. Final Checks before Startup: Perform the following operations and checks before startup:
   1. Verify that shipping, blocking, and bracing are removed.
   2. Verify that unit is secure on mountings and supporting devices and that connections for piping, ducts, and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnects.
   3. Perform cleaning and adjusting specified in this Section.
   4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
   5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
   6. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in the fully open position.
   7. Disable automatic temperature-control operators.

B. Starting procedures for fans are as follows:
   1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.

2. Measure and record motor voltage and amperage.

C. Shut unit down and reconnect automatic temperature-control operators.

D. Refer to Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for procedures for air-handling-system testing, adjusting, and balancing.

E. Replace fan and motor pulleys as required to achieve design conditions.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.
1. Conduct training as specified in Section 01 79 00 (01820) "Training".
2. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive.

- END OF SECTION -

- SECTION 23 3600 -

AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Single-duct air terminal units.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports shall withstand the effects of gravity and loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

1.4 SUBMITTALS

A. Product Data: Provide manufacturer's product data for each unit indicated on the drawings. Data to be specific to the equipment proposed for the project with all options and accessories indicated. Include the following as a minimum:
   1. Manufacturer and model number.
   2. Rated capacity.
   3. Equipment dimensions.
   4. Required clearances.
   5. Materials of construction.
   6. Accessories and options.
   7. Controls.

B. Warranty information.

C. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance: Applicable requirements in the latest addition of ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Carrier Corporation.
   2. Environmental Technologies, Inc.
   3. Krueger.
   4. Nailor Industries, Inc.
   5. Price Industries
   6. Titus.
   7. Trane; a business of American Standard Companies.

2.2 SINGLE-DUCT AIR TERMINAL UNITS

A. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.

B. Casing: 0.034-inch steel, single wall.
   1. Casing Lining: Adhesive attached, 1/2-inch-thick, coated, fibrous-glass duct liner complying with ASTM C 1071, UL181, NNPA 90-A and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
   2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in the latest addition of ASHRAE 62.1.

C. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
   1. Maximum Damper Leakage: ARI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.
   2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in the latest addition of ASHRAE 62.1.

D. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.

E. Control Panel Enclosure: NEMA 250, Type 1, with access panel sealed from airflow and mounted on side of unit.

1. Provide multi-point, averaging, airflow measuring sensor in air inlet. Connect sensor tubing to unit controller.

F. Direct Digital Controls: Unit controller to be provided by Control Contractor and installed by terminal unit manufacturer.

2.3 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Steel Cables: Galvanized steel complying with ASTM A 603 or Stainless steel complying with ASTM A 492.

D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

2.4 SOURCE QUALITY CONTROL

A. Factory Tests: Test assembled air terminal units according to ARI 880.
1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

3.2 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
1. Where practical, install concrete inserts before placing concrete.

2. Install powder-actuated concrete fasteners after concrete is placed and completely cured and as directed by the structural engineer.

C. Hangers Exposed to View: Threaded rod and angle or channel supports.

D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.3 CONNECTIONS

A. Install piping adjacent to air terminal unit to allow service and maintenance.

B. Hot-Water Piping: In addition to requirements in Division 23 Section "Hydronic Piping," connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.

C. Connect ducts to air terminal units according to Division 23 Section "Metal Ducts."

D. Make connections to air terminal units with flexible connectors complying with requirements in Division 23 Section "Air Duct Accessories."

3.4 IDENTIFICATION

A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. On units with heaters include heating capacity (BTUH), GPM, or KW. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Perform startup service.
1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.

3. Verify that controls and control enclosure are accessible.
4. Verify that control connections are complete.
5. Verify that nameplate and identification tag are visible.
6. Verify that controls respond to inputs as specified. (Damper modulates from minimum to maximum position, heat modulates, fan cycles, etc.)
7. Verify that recommended and required service clearances have been provided.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

- END OF SECTION -

- SECTION 23 3700 -

AIR OUTLETS & INLETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Diffusers
   2. Registers
   3. Grilles
   4. Louvers

B. Related Sections:
   1. Section 23 33 00 (15820) – Air Duct Accessories.
   2. Section 23 05 93 (15950) - Testing, Adjusting, and Balancing for HVAC.

1.3 DEFINITIONS

A. Diffuser: Circular, square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air.

B. Grille: A louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.

C. Register: A combination grille and damper assembly over an air opening.

1.4 SUBMITTALS

A. Submit “Letter of Conformance” in accordance with Section 01 33 00 (01330) indicating specified items selected for use in Project with the following supporting data:
   1. Product Data: For each model indicated, include the following:
      a. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.
      b. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.

c. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size, and accessories furnished.

d. Assembly Drawing: For each type of air outlet and inlet: indicate materials and methods of assembly of components.

1.5 QUALITY ASSURANCE

A. Product Options: Drawings and schedules indicate specific requirements of diffusers, registers, and grilles and are based on the specific requirements of the systems indicated.

B. NFPA Compliance: Install diffusers, registers, and grilles according to NFPA 90A, "Standard for the Installation of air-conditioning and Ventilating Systems."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved Manufacturers:
1. Diffusers, Registers, and Grilles:
   a. Titus (972-699-1030)
   b. Carnes (608-845-6411)
   c. Krueger (972-680-9136)
2. Exterior Louvers:
   a. Ruskin Company (816-761-7476)
   b. American Warming & Ventilating Co., A Division of Mestek, Inc. (419-865-5000)
   c. Arrow United Industries, A Division of Mestek, Inc. (570-746-1888)

2.2 MANUFACTURED UNITS

A. Diffusers, Registers, and Grilles:
1. As scheduled on Drawings

B. Exterior Louvers:
1. Provide storm proof exterior wall louvers; size as indicated on Drawings.
2. Louvers shall be AMCA certified for zero water penetration and maximum 1/8-inch pressure drop at a free area velocity of 900 fpm.
3. Louvers shall be 4” deep constructed of 0.081” thick 6063-TS extruded aluminum complete with ½” aluminum screen in removable frame.
4. Frames shall be box type for masonry construction and flange type for frame construction.
5. Louver shall have a factory baked enamel prime finish ready to accept full paint to match adjacent surfaces.
6. Louvers shall be minimum 4” deep, storm proof, extruded aluminum, drainable, with ½” square mesh aluminum screen on interior face.

2.3 SOURCE QUALITY CONTROL

A. Testing: Test performance according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb, according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of the panel. Where architectural features or other item conflict with installation notify Owner’s Representative for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connection to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

3.4 CLEANING

A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

- END OF SECTION -

- SECTION 23 3723 -

HVAC GRAVITY VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Louvered-penthouse ventilators.
   2. Roof hoods.

1.3 SUBMITTALS

A. Product Data: Provide manufacturer's product data for each product indicated on the drawings. Data to be specific to the product proposed for the project with all options and accessories indicated. Include the following as a minimum:
   1. Manufacturer and model number.
   2. Rated capacity based on scheduled conditions and project elevation.
   3. Dimensions.
   4. Required clearances.
   5. Materials of construction.
   6. Accessories and options.

1.4 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Carnes.
2. Greenheck Fan Corporation.
3. Loren Cook Company.
4. PennBarry.

2.2 MATERIALS

A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5 or T-52.

B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming or as otherwise recommended by metal producer for required finish.

C. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 zinc coating, mill phosphatized.

D. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel unless otherwise indicated. Do not use metals that are incompatible with joined materials.
   1. Use types and sizes to suit unit installation conditions.
   2. Use hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.

E. Post-Installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors made from stainless-steel components, with capability to sustain without failure a load equal to 4 times the loads imposed for concrete, or 6 times the load imposed for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.3 FABRICATION, GENERAL

A. Factory fabricate gravity ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.

B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.

D. Fabricate supports, anchorages, and accessories required for complete assembly.

2.4 ROOF HOODS

A. Factory fabricated according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figures 5-6 and 5-7.

B. Materials: Galvanized-steel sheet, minimum 0.064-inch-thick base and 0.040-inch-thick hood or aluminum sheet, minimum 0.063-inch-thick base and 0.050-inch-thick hood; suitably reinforced.

C. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch-thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening and ventilator base.
   1. Configuration: Self-flashing without a cant strip, with mounting flange.
   2. Overall Height: 9-1/2 inches.

D. Bird Screening: Galvanized-steel, 1/2-inch-square mesh, 0.041-inch wire or Aluminum, 1/2-inch-square mesh, 0.063-inch wire.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install gravity ventilators level, plumb, and at indicated alignment with adjacent work.

B. Secure gravity ventilators to roof curbs with cadmium-plated hardware. Use concealed anchorages where possible. Refer to Division 07.

C. Install gravity ventilators with clearances for service and maintenance.

D. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Division 07 for sealants applied during installation.

F. Label gravity ventilators according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

G. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.

H. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

- END OF SECTION -

- SECTION 23 4100 -

PARTICULATE AIR FILTRATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Disposable Panel Filters
   2. Extended Surface Filters

B. Related Sections:
   1. Section 23 37 00 - Air Outlets and Inlets
   2. Section 23 73 13 - Indoor Air Handling Units
   3. Section 23 82 19 - Fan Coil Units

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
   1. Product Data: Include dimensions; shipping, installed, and operating weights; required clearances and access; rated flow capacity, including initial and final pressure drop at rated airflow; efficiency and test method; fire classification; furnished specialties; and accessories for each model indicated.
   2. Maintenance Data: For each type of filter and rack to include in maintenance manuals specified in Division 01. Reference Section 01 78 23 (01830) “Operation and Maintenance Data” for additional requirements.

1.4 QUALITY ASSURANCE

A. Product Options: Drawings indicate requirements of air filters and are based on the specific system indicated.

B. Comply with NFPA 90A and NFPA 90B.

C. ASHRAE Compliance: Comply with provisions of ASHRAE 52.1 for method of testing and rating efficiency, arrestance, and dust holding capacity.

D. Underwriters Laboratories, Inc. (UL): Comply with UL Standards pertaining to safety and performance of air filter units including UL 900 “Test Performance of Air Filter Units.”

1.5 EXTRA MATERIALS

A. Furnish extra materials described in Section 01 78 43 (01790) “Spare Parts and Materials” that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved Manufacturers:
   1. Air Filters, Electrostatic Air Cleaners, and Filter-Holding Systems:
      a. AAF International (800-477-1214)
      b. Camfil Farr (973-616-7300)
      c. International Air Filter, Inc. (800-797-1000)

2.2 DISPOSABLE PANEL FILTERS

A. Description: Factory-fabricated, viscous-coated, flat-panel type, disposable air filters with holding frames.

B. Media: Interlaced glass fibers sprayed with nonflammable adhesive.

C. Frame: Cardboard frame with perforated metal retainer.

D. Duct-Mounting Frames: Welded, galvanized steel with gaskets and fasteners and suitable for bolting together into built-up filter banks.

2.3 EXTENDED-SURFACE, DISPOSABLE PANEL FILTERS

A. Description: Factory-fabricated, dry, one 4-inch extended-surface filters with holding frames.

B. Media: Fibrous material formed into deep-V-shaped pleats and held by self-supporting wire grid.

C. Media and Media-Grid Frame: Nonflammable rigid drip board frame with expanded metal support cross braced on both sides of filter media.

D. Media and Media-Grid Frame: Galvanized steel.

E. Duct-Mounting Frames: Welded, galvanized steel with gaskets and fasteners, and suitable for bolting together into built-up filter banks.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install filter frames according to manufacturer's written instructions.

B. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.

C. Install filters in position to prevent passage of unfiltered air. Joints between filter frames and enclosing ductwork shall be gasketed and sealed against air leakages.

D. Coordinate filter installations with duct and air-handling unit installations.

3.2 CLEANING

A. After completing system installation and testing, adjusting, and balancing air-handling and air-distribution systems, clean filter housings and install new filter media.

- END OF SECTION -

- SECTION 23 5100 -

BREECHINGS, CHIMNEYS & STACKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Listed double-wall vents.

1.3 SUBMITTALS

A. Product Data: Provide manufacturer's product data for each system indicated on the drawings. Data to be specific to the system and components proposed for the project with all options and accessories indicated. Include the following as a minimum:
   1. Installation drawings with plans, elevations, sections, and details. Include required clearances, support methods, and attachments to other work.
   2. Materials of construction.
   3. Accessories and options.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Subject to compliance with requirements, provide products by one of the following:
   1. American Metal Products.
   2. Industrial Chimney Company.
   3. Metal-Fab, Inc.
   4. The Schebler Company.
   5. Selkirk Inc.
   6. Van-Packer Company.

2.2 TYPE BH, LISTED SPECIAL GAS VENTS

A. Description: Double-wall metal vents tested according to UL 1738 and rated for 480 deg F (248 deg C) continuously, with positive or negative flue pressure complying with NFPA 211.

B. Construction: Inner shell and outer jacket separated by at least a 1/2-inch (13-mm) airspace.

C. Inner Shell: Type 316 stainless steel.

D. Outer Jacket: Aluminized steel.

E. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.

1. Termination: Round chimney top designed to exclude minimum 98 percent of rainfall.

2.3 LISTED BUILDING-HEATING-APPLIANCE CHIMNEYS

A. Description: Double-wall metal vents tested according to UL 103 and rated for 1000 deg F (538 deg C) continuously, or 1700 deg F (926 deg C) for 10 minutes; with neutral or negative flue pressure complying with NFPA 211.

B. Construction: Inner shell and outer jacket separated by at least a 1-inch (50-mm) annular space filled with high-temperature, ceramic-fiber insulation.

C. Inner Shell: ASTM A 666, Type 316 stainless steel.

D. Description: Double-wall metal vents tested according to UL 103 and UL 959 and rated for 1400 deg F (760 deg C) continuously, or 1800 deg F (982 deg C) for 10 minutes; with positive or negative flue pressure complying with NFPA 211.

E. Construction: Inner shell and outer jacket separated by at least a 2-inch (50-mm) annular space filled with high-temperature, ceramic-fiber insulation.

F. Inner Shell: ASTM A 666, Type 316 stainless steel.

PART 3 - EXECUTION

3.1 APPLICATION

A. Listed Special Gas Vents: Condensing gas appliances.

B. Listed Building-Heating-Appliance Chimneys: Exhaust for engines.

3.2 INSTALLATION OF LISTED VENTS AND CHIMNEYS

A. Locate to comply with minimum clearances from combustibles and minimum termination heights according to product listing, local code, or NFPA 211, whichever is most stringent.

B. Seal between sections of positive-pressure vents according to manufacturer's written installation instructions, using sealants recommended by manufacturer.

C. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.

D. Slope breechings down in direction of condensing appliance, with condensate drain connection at lowest point piped to nearest drain.

E. Lap joints in direction of flow.

F. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

G. Clean breechings internally, during and after installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth and apply touchup finish to match factory or shop finish.

H. Provide temporary closures at ends of breechings, chimneys, and stacks that are not completed or connected to equipment.

- END OF SECTION -

- SECTION 23 5233.13 -

COPPER FIN TUBE BOILERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes packaged, factory-fabricated and -assembled, non-condensing, copper fin tube boilers, trim, and accessories for generating hot water.

1.3 SUBMITTALS

A. Product Data: Provide manufacturer's product data for each unit indicated on the drawings. Data to be specific to the equipment proposed for the project with all options and accessories indicated. Include the following as a minimum:
   1. Manufacturer and model number.
   2. Rated capacity based on scheduled conditions and project elevation.
   3. Equipment dimensions.
   4. Required clearances.
   5. Electrical data.
      a. Motor horsepower
      b. Voltage/Phase/Hz
      c. Full load ampacity, minimum circuit ampacity and maximum overcurrent protection device requirements.
      d. Electrical service point(s) of connection.
      e. AIC rating of the equipment.
   6. Materials of construction.
   7. Accessories and options.
   8. Controls.

B. Operation and maintenance data.

C. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.

C. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."

D. DOE Compliance: Minimum efficiency shall comply with 10 CFR 430, Subpart B, Appendix N, "Uniform Test Method for Measuring the Energy Consumption of Furnaces and Boilers."

E. I=B=R Compliance: Boilers shall be tested and rated according to HI's "Rating Procedure for Heating Boilers" and "Testing Standard for Commercial Boilers," with I=B=R emblem on a nameplate affixed to boiler.

F. UL Compliance: Test boilers for compliance with UL 795, "Commercial-Industrial Gas Heating Equipment." Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace heat exchangers, headers, cabinets, atmospheric gas burners, and vent dampers that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Tubes, Headers, Cabinets, Vent Damper and Atmospheric Gas Burner: Five years from date of Substantial Completion, pro rata.
   2. Warranty Period for Heat Exchangers: 10 years from date of Substantial Completion, for thermal shock.

PART 2 - PRODUCTS

2.1 HIGH EFFICIENCY FINNED COPPER TUBE BOILERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Aerco International, Inc.
   2. Camus Hydronics Ltd.
   3. Laars Heating Systems.
   4. Lochinvar, LLC
   5. Thermal Solutions LLC.
   6. Raypak.

B. Description: Factory-fabricated, -assembled, and -tested boiler with vertical tubes sealed into headers pressure tight, and set on a steel base; including insulated jacket, flue-gas vent,

combustion-air intake, water supply and return connections, and controls. Boiler shall be ASME rated for a working pressure of 160 psig (1104 kPA) with ASME “H” stamp.

C. Heat Exchanger:
1. Finned copper, copper-nickel, or stainless steel tubing with stainless-steel baffles arranged around the central burner.
2. Stainless steel header.
3. Tubes shall be sealed in header by mechanically rolling tubes in header.

D. Casing:
1. Jacket: Sheet metal, with snap-in or interlocking closures.
2. Control Compartment Enclosure: NEMA 250, Type 1A.
3. Finish: Baked enamel over primer, baked enamel over galvanizing, or powder coated.
4. Insulation: Minimum 1-inch- (25-mm-) thick, mineral-fiber insulation surrounding the heat exchanger.
5. Mounting base to secure boiler.
6. Boilers shall have 0-inch clearance to combustibles requirement.

E. Burner:
1. Radiant non-corroding ceramic burner, with full 360 degree firing pattern and no moving parts. Provide a viewing port for visual observation of burner performance
2. Burner shall be capable of infinite modulation with minimum 3:1 turn down utilizing a variable frequency drive and air-fuel ratio control gas valve.

F. Blower:
1. Blower shall be non-sparking with a cast aluminum housing.
2. Blower shall be equipped with a 99 percent efficient to one micron, replaceable combustion air filter. Provide a differential pressure switch across filter to monitor filter status.
3. A combustion airflow switch shall be provided
4. Fans shall be factory mounted to supply combustion air to the burner and shall be controlled to prepurge and postpurge the combustion chamber before and after firing.
5. Combustion Connection: Inlet duct collar and sheet metal closure with replaceable filter over burner compartment.
6. Vent: Boiler venting shall be Category III material.
7. Motors: Comply with requirements specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

G. Gas Train: Control devices for modulating control sequence as scheduled on the drawings shall comply with requirements in IRI. In addition to these requirements, include shutoff cock, pressure regulator, and control valve.
1. Pressure: Gas train shall be designed for use with up to 5 psi incoming gas pressure.
2. Pilot: Intermittent-electric-spark or hot-surface pilot ignition with 100 percent main-valve and pilot-safety shutoff with electronic supervision of burner flame.
3. NOx emissions shall be less than 9 ppm and 50 ppm CO.

H. Trim:
1. Aquastat Controllers: Operating**,** firing rate, and high limit.

2. Safety Relief Valve: ASME rated.
3. Pressure and Temperature Gage: Minimum 3-1/2-inch-diameter, combination water-pressure and -temperature gage. Gages shall have operating-pressure and -temperature ranges so normal operating range is about 50 percent of full range.
4. Boiler Air Vent: Automatic.
5. Drain Valve: Minimum NPS 3/4 (DN 20) hose-end gate valve.

I. Controls:
1. Boiler operating controls shall include the following devices and features:
   a. Control transformer.
   b. Set-Point Adjust: Set points shall be adjustable.
   c. Include automatic, alternating-firing sequence for multiple boilers to ensure maximum system efficiency throughout the load range and to provide equal runtime for boilers.
2. Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation.
   a. High Cutoff: Automatic reset stops burner if operating conditions rise above maximum boiler design temperature.
   b. Water Flow Switch: Automatic-reset paddle-switch shall prevent burner operation on low water flow.
3. Building Automation System Interface: Factory install hardware and software to enable Bacnet automation system to monitor, control, and display boiler status and alarms.
   a. A communication interface with building automation system shall enable building automation system operator to remotely control and monitor the boiler from an operator workstation. Control features available, and monitoring points displayed, locally at boiler control panel shall be available through building automation system.

2.2 ELECTRICAL POWER

A. Single-Point Field Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.
1. House in NEMA 250, Type 1 enclosure.
2. Wiring shall be numbered and color-coded to match wiring diagram.
3. Install factory wiring outside of an enclosure in a metal raceway.
4. Field power interface shall be to wire lugs.
5. Provide branch power circuit to each motor and to controls with disconnect switch or circuit breaker.
6. Provide each motor with overcurrent protection.

2.3 SOURCE QUALITY CONTROL

A. Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code.

PART 3 - EXECUTION

3.1 BOILER INSTALLATION

A. Install boilers level on concrete base. Concrete base is specified in Division 23 Section "Common Work Results for HVAC," and concrete materials and installation requirements are specified in Division 03.

B. Install gas-fired boilers according to NFPA 54.

C. Assemble and install boiler trim.

D. Install electrical devices furnished with boiler but not specified to be factory mounted.

E. Install control wiring to field-mounted electrical devices.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to boiler to allow service and maintenance.

C. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas train connection. Provide a reducer if required.

D. Connect hot-water piping to supply- and return-boiler tappings with shutoff valve and union or flange at each connection.

E. Install piping from safety relief valves to nearest floor drain.

F. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.

G. Boiler Flue Venting:
   1. Install venting kit and combustion-air intake.
   2. Connect full size to boiler connections. Comply with requirements in Division 23 Section "Breechings, Chimneys, and Stacks."

H. Ground equipment according to Division 26.

I. Connect wiring according to Division 23 Section "Instrumentation and Control wiring for HVAC."

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:
   1. Perform installation and startup checks according to manufacturer's written instructions.
   2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
   3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
      a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level, and water temperature.
      b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
      c. Provide services of a manufacturer's authorized representative to perform combustion test including boiler firing rate, gas flow rate, heat input, burner manifold gas pressure, percent carbon monoxide, percent oxygen, percent excess air, flue gas temperature at outlet, ambient temperature, net stack temperature, percent stack loss, percent combustion efficiency, and heat output. Perform test at minimum, mid-range, and high fire.

C. Remove and replace malfunctioning units and retest as specified above.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain boilers.

- END OF SECTION -

- SECTION 23 5700 -

HEAT EXCHANGERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Plate-and-Frame Heat Exchangers For HVAC Applications.

B. Related Sections:
   1. Section 01 81 13 - Sustainable Design Requirements
   2. Section 23 05 00 - Common Work Results for HVAC.

1.3 REFERENCES

A. The American Society of Mechanical Engineers (ASME) Publications:

B. “Boiler and Pressure Vessel Code”

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
   1. Product Data: Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories for each type of product indicated. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Maintenance Data: For heat exchangers to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. ASME Compliance: Fabricate and label boilers to comply with the ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved Manufacturers:
   1. Plate-and-Frame Heat Exchangers:
      a. Alfa Laval Thermal, Inc. (804-222-5300)
      b. Mueller: Paul Mueller Co. (800-683-5537)
      c. Polaris Plate Heat Exchangers. (732-345-7188)
      d. Sondex, Inc. (502-933-9991)
      e. Taco, Inc. (401-942-8000)
      f. Tranter, Inc.; Texas Div. (800-414-6908)

2.2 PLATE-AND-FRAME HEAT EXCHANGERS

A. Configuration: Freestanding assembly consisting of frame support, fixed and movable end plates, tie rods, plates, and one-piece gaskets. Constructed to 150 psig working pressure unless noted otherwise.
   1. Piping Connections: ANSI Class 150 or Class 300, flanged as required.

B. Fabrication shall be in accordance with the ASME Code, Section VIII, Div. 1, Unfired Pressure Vessels, current edition. Units shall bear an ASME Code Stamp. The maximum velocity through exchanger inlet and outlet ports with stainless steel nozzles shall be 20 feet per second. The flow port area shall be such that the entrance and exit pressure drops are not more than 25 percent of the total calculated pressure drop. The maximum allowable pressure drop shall be 15 psi unless otherwise indicated.

C. Plate material shall be Type 316 stainless steel. The minimum thickness of plates before pressing shall be 0.024 in. nominal. Port holes not feeding passes between plates shall be fully gasketed and vented to the atmosphere. Plates shall be of one piece design with metal-to-metal contact between adjacent plates. Plates shall be fully supported from the top stainless steel carrying bar and guided by only the bottom stainless steel bar with reinforced slots integral with the plate. Gasket groove shall be designed so that full gasket support is provided by metal-to-metal plate contact both inboard and outboard of the gasket groove. Plates shall have a positioning system which will prevent them from shifting during operation and tightening of the plate pack.

D. Nozzle/flange connections shall be located in the fixed end frame. Slotted holes for compression bolts shall be uniformly distributed around the periphery of the end frame. Compression Bolts shall be low alloy steel SA-193-B7. Nozzles shall be of the elastomer lined type, of the same type material as the plates, or lined with another alloy compatible with the service.

E. Captive nuts shall be provided at the stationary end frame. A threaded nut shall be provided at the movable end frame. Nuts shall be low alloy steel SA-194-2H. Washers shall be provided at each end of the compression bolts.

F. A smooth surface shall be provided for the roller bearing carrying groove for the whole length of the carrying bar. The carrying bar shall be fabricated of Type 304 stainless steel, designed to

support 1.5 times the weight of a flooded exchanger, movable cover, compression bolts, nuts and nozzle.

G. Supports shall be furnished at the fixed end frame and at the end support. A minimum of two support plates shall be provided at the fixed end frame with anchor bolt holes in each plate. The frame material shall be carbon steel. SA515 or SA516 Grade 70 material.

H. Connections shall be suitable for the installation of 90 deg long radius flanged elbows to facilitate opening of the plate pack without disturbing piping. Materials shall be compatible with fluid requirements.

I. Gaskets shall be positioned in a groove around the heat transfer surface and around the port holes of the plate as required. Gasket and gasket groove detail shall be designed to facilitate positioning of plates. Gaskets shall be compressed to achieve a metal-to-metal contact between plates. An adhesive compound compatible with the gasket material and having a thickness to insure bond strength between plate and gasket shall be applied to the plate gasket grove surface. Gasket plate surface shall be thoroughly cleaned by means of solvent cleaning and dried before the application of the adhesive. Relieving grooves shall be provided in the outside gasket in those locations where an internal gasket also is used. The relieving grooves should be located such that no gasket caused cross contamination of liquids can occur without external evidence. Gasket materials shall be selected by the manufacturer based on fluid and temperature compatibility.

J. OSHA approved shrouds, constructed of Type 304 stainless steel, shall be provided.

K. Suitable lifting means shall be included on the frame to facilitate installation and maintenance of the exchangers and designed to support twice the exchanger maximum dry weight.

L. After complete assembly and before shipment, each heat exchanger shall be hydrostatic tested in accordance with the requirements of ASME Section VIII, Division 1. After hydrostatic testing, the units shall be drained of the test fluid and blown dry with air.

M. Each exchanger shall have a permanently attached stainless steel nameplate with the following information:
   1. Customer Equipment Number.
   2. Manufacturer and Serial Number.
   3. Year Built.
   4. Hot and Cold Side Design Temperatures and Pressures.
   5. Hot and Cold Side Test Pressures.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas for compliance with requirements for installation tolerances and for structural rigidity, strength, anchors, and other conditions affecting performance of heat exchangers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 HEAT EXCHANGER INSTALLATION

A. Install heat exchangers according to manufacturer's written instructions.

B. Install plate-frame heat exchangers on 4-inch high concrete pads.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Maintain manufacturer's recommended clearances for service and maintenance. Install piping connections to allow service and maintenance of heat exchangers.

C. Install piping with threaded or flanged connections at heat exchangers.

D. Install shutoff valves at heat exchanger inlet and outlet connections.

E. Install relief valves on heat exchanger secondary-fluid connection.

3.4 CLEANING

A. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

3.5 FIELD QUALITY CONTROL

A. Verify that heat exchangers are installed and connected according to the Contract Documents.

B. Adjust flows and controls to deliver specified performance.

C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain heat exchangers as specified below:
   1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining heat exchangers.
   2. Review data in maintenance manuals.
   3. Schedule training with Owner, through Architect, with at least seven days' advance notice.
   4. Schedule training with the Owner, through the Owner’s Representative with at least 7 days' advance notice.

- END OF SECTION -

- SECTION 23 6410 -

REFRIGERANT DETECTION & ALARM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes refrigerant monitors and notification appliances.

1.3 SUBMITTALS

A. For each type of monitor, include refrigerant sensing range in ppm, temperature and humidity range, alarm outputs, display range, furnished specialties, installation requirements, and electric power requirement.

B. Shop Drawings:
   1. Sensor Locations: Location and mounting heights for passive monitors.
   2. Wiring Diagrams: Power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 PASSIVE INFRARED REFRIGERANT MONITOR

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Chillgard Refrigerant Monitors; MSA; Instrument Division.
   2. Davis Instruments Manufacturing Co., Inc.
   3. Foxboro Company (The).
   4. General Analysis Corp.
   5. Genesis International Inc.
   6. Thermal Gas Systems, Inc.; Haloguard Monitors.

7. Trane Co. (The).
8. Vulcain Alarm, Inc.

B. Description: Compound-specific sensor shall be factory tested, calibrated, and certified to continuously measure and display the specific gas concentration and shall be capable of indicating, alarming and automatically activating ventilation system.

C. ASHRAE: Monitoring system shall comply with ASHRAE 15.

D. Exposure Limits: Use the following exposure limits for setting the alarm limits mentioned below:

Refrigerant	TVL-TWA	PEL
R-22	1,000	1,000
R-123	50	30
R-134a	1,000	1,000

E. Performance:
1. Refrigerant to Be Monitored: Coordinate with installed equipment in refrigeration machinery room.
2. Range: 0 to 1000 ppm.
3. Sensitivity for Passive Monitors:
   a. Minimum Detectability: 1 ppm.
   b. Accuracy: 0 to 100 ppm; plus or minus 1 ppm, 100 to 1000 ppm; plus or minus 10 percent of reading.
   c. Repeatability: Plus or minus 1 percent of full scale.
   d. Response: 50 percent of a step change in 60 seconds.
   e. Detection Level Set Points:
      1) Detection Level 1: 25 percent of permissible exposure limit (PEL) or time weighted average (TWA), whichever is lower.
      2) Detection Level 2: 50 percent of permissible exposure limit (PEL) or time weighted average (TWA), whichever is lower.
4. Operating Temperature: 32 to 104 deg F.
5. Relative Humidity: 20 to 95 percent, noncondensing over the operating temperature range. Compensate sensor for relative humidity.
6. Site Elevation: Maximum 6560 feet.

F. Input/Output Features:
1. Maximum Power Input: 120-V ac, 60 Hz, 75 W.
2. Number of Air-Sampling Points: As recommended by sensor manufacturer to provide complete coverage of room.
3. Alarm Relays: Minimum required to achieve specified sequence of control, at a minimum of 5-A resistive load each.
4. Alarm Set Points: Displayed and adjustable through keypad on front of meter.
5. Alarm Silence Switch: Mount in the front panel of the monitor to stop audible and visual notification appliances, but alarm LED remains illuminated.

6. Alarm Manual Reset: Momentary-contact push button in the front panel of the monitor stops audible and visual notification appliances, extinguishes alarm LED, and returns monitor to detection mode at current detection levels.
7. Display: Alphanumeric LCD, LED indicating lights for each detection level; acknowledge switch and test switch mounted on front panel; alarm status LEDs and service fault/trouble LEDs.
8. Audible Output: Minimum 75 dB at 10 feet.
9. Visible Output: Strobe light.
10. Sensor Analog Output: 0- to 10-V dc into 2k ohms, or 4- to 20-mA into 1k ohms.
11. Serial Output: RS-232 or RS-485 compatible with HVAC controls.
12. Enclosure: NEMA 250, type as required by application , with locking quarter-turn latch and key.

2.2 MONITOR ALARM SEQUENCE

A. Detection Level 1: Notify the BAS control workstation of the detection of a refrigerant leak in the refrigeration equipment room. Cycle amber strobe lights.

B. Detection Level 2: Notify the BAS control workstation of the detection of a critical level of refrigerant in the refrigeration equipment room. Sound alarm horns, cycle red strobe lights inside and outside refrigeration equipment room, de-energize any combustion equipment in the room, and energize purge fan. Provide manual reset for this detection level. Purge fan shall operate for a minimum of 30 minutes after reset.

C. Sensor Fault/Trouble: Notify BAS control workstation of fault/trouble detection in monitor.

2.3 NOTIFICATION APPLIANCES

A. Horns: Comply with UL 464; electric-vibrating-polarized type, listed by a qualified testing agency with provision for housing the operating mechanism behind a grille. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn.

B. Visible Alarm Devices: Comply with UL 1971; xenon strobe light, with colored polycarbonate lens mounted on an aluminum faceplate. The words "REFRIGERANT DETECTION" printed in minimum 1/2-inch-high letters on the lens. Rated light output is 110 candela with clear lens.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with ASHRAE 15.

B. Install air-sampling inlets, or diffusion type monitors in pits, tunnels, or trenches in machinery room that are accessible to personnel.

C. Floor mount diffusion-type monitor, sensor/transmitters, or air-sampling inlets on slotted channel frame 12 to 18 inches above the floor in a location near the refrigerant source or between the refrigerant source and the ventilation duct inlet.

D. Install warning signs, labels, and nameplates to identify detection devices according to Division 15 Section "Identification for HVAC Piping and Equipment."

E. Place warning signs inside and outside each door to the refrigeration equipment room. Sample wording: "AUDIBLE AND VISUAL ALARM SOUNDING INDICATES REFRIGERANT DETECTION - ENTRY REQUIRES SELF-CONTAINED BREATHING APPARATUS."

F. Audible Alarm-Indicating Devices: Install at each entry door to refrigeration equipment room, and position not less than 6 inches below the ceiling. Install horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

G. Visible Alarm-Indicating Devices: Install adjacent to each alarm horn at each entry door to refrigeration equipment room, and position at least 6 inches below the ceiling.

3.2 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Tests and Inspections:
   1. Inspect field-assembled components, equipment installation, and electrical connections for compliance with requirements.
   2. Test and adjust controls and safeties.
   3. Operational Test: Test monitor alarm levels and functions using factory supplied gasses in the specified concentrations. Operational test to be witnessed by the Test and Balance Contractor and Owner.
   4. Test Reports: Prepare a written report to record the following:
      a. Test procedures used.
      b. Test results that comply with requirements.
      c. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

C. Repair or replace malfunctioning units and retest as specified above.

- END OF SECTION -

- SECTION 23 6426 -

ROTARY-SCREW WATER CHILLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Packaged, water-cooled, single-compressor chillers.

B. Related Section:
   1. Division 28 Section "Refrigerant Detection and Alarm" for refrigerant monitors, alarms, supplemental breathing apparatus, and ventilation equipment interlocks.

1.3 PERFORMANCE REQUIREMENTS

A. Delete if unit is air-cooled.

B. Condenser-Fluid Temperature Performance:
   1. Startup Condenser-Fluid Temperature: Chiller shall be capable of starting with an entering condenser-fluid temperature of 60 deg F and providing stable operation until the system temperature is elevated to the minimum operating entering condenser-fluid temperature.
   2. Minimum Operating Condenser-Fluid Temperature: Chiller manufacturer shall provide wire and control a condenser water control valve. The valve shall be installed by the mechanical contractor.
   3. Make factory modifications to standard chiller design if necessary to comply with performance indicated.

C. Site Altitude: Chiller shall be suitable for altitude in which installed without affecting performance indicated. Make adjustments to affected chiller components to account for site altitude.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include refrigerant, rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Certificates: For certification required in "Quality Assurance" Article.

D. Startup service reports.

E. Operation and maintenance data.

F. Warranty.

1.5 QUALITY ASSURANCE

A. ARI Rating: Rate chiller performance according to requirements in ARI 550/590.

B. ASHRAE Compliance:
1. ASHRAE 15 for safety code for mechanical refrigeration.
2. ASHRAE 147 for refrigerant leaks, recovery, and handling and storage requirements.

C. ASHRAE/IESNA Compliance: Applicable requirements in the latest addition of ASHRAE/IESNA 90.1.

D. ASME Compliance: Fabricate and label chiller to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, and include an ASME U-stamp and nameplate certifying compliance.

E. Comply with NFPA 70.

F. Comply with requirements of UL and UL Canada and include label by a qualified testing agency showing compliance.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of chillers that fail in materials or workmanship within specified warranty period.
1. Extended warranties include, but are not limited to, the following:
   a. Complete chiller including refrigerant and oil charge.
   b. Parts and labor.
   c. Shaft seal (for open compressors).
2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PACKAGED, WATER-COOLED CHILLERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Carrier Corporation; a United Technologies company.
2. YORK International Corporation.

B. Description: Factory-assembled and-tested chiller with compressor(s), compressor motor(s), compressor motor controller, lubrication system, evaporator, condenser, controls, interconnecting unit piping and wiring, and indicated accessories.

C. Compressor(s): York is the only manufacturer with open drive.
1. Description: Semi-Hermetic or open, positive displacement, and oil lubricated.
2. Casing: Cast iron, precision machined for minimum clearance about periphery of rotors.
3. Rotors: Manufacturer's standard one-, two-, or three-rotor design.
4. Drive Coupling: For chillers with open drives, provide flexible disc with all-metal construction and no wearing parts to ensure long life without the need for lubrication.
5. Seals: Seal drive assembly to prevent refrigerant leakage.

D. Compressor Motor:
1. Continuous-duty, squirrel-cage, induction-type motor with energy efficiency required to suit chiller energy efficiency indicated.
2. Factory mounted, aligned, and balanced as part of compressor assembly before shipping.
3. Motor shall be of sufficient capacity to drive compressor throughout entire operating range without overload and with sufficient capacity to start and accelerate compressor without damage.
4. For chillers with open drives, provide motor with open-dripproof enclosure. Increase chiller capacity in an amount equal to the motor heat rejection.
5. Provide motor with thermistor or RTD in each motor winding to monitor temperature and report information to chiller control panel.
6. Provide motor with thermistor or RTD to monitor bearing temperature and report information to chiller control panel.

E. Vibration Balance: Balance chiller compressor and drive assembly to provide a precision balance that is free of noticeable vibration over the entire operating range.
1. Overspeed Test: 25 percent above design operating speed.

F. Service: Easily accessible for inspection and service.

G. Capacity Control: Modulating slide-valve assembly or port unloaders combined with a variable frequency controller and hot-gas bypass, if necessary, to achieve performance indicated.
1. Maintain stable operation throughout range of operation. Configure to achieve most energy-efficient operation possible.
2. Operating Range: From 100 to 20 percent of design capacity.

H. Oil Lubrication System: Consisting of pump if required, filtration, heater, cooler, factory-wired power connection, and controls.
1. Provide lubrication to bearings, gears, and other rotating surfaces at all operating, startup, shutdown, and standby conditions including power failure.
2. Thermostatically controlled oil heater properly sized to remove refrigerant from oil.
3. Oil filter shall be a replaceable cartridge type, minimum 0.5-micron efficiency, with means of positive isolation while servicing.

4. Refrigerant- or water-cooled oil cooler.
5. Factory-installed and pressure-tested piping with isolation valves and accessories.
6. Oil compatible with refrigerant and chiller components.
7. Positive visual indication of oil level.

I. Refrigerant Circuit:
1. Refrigerant Type: R-134a. Classified as Safety Group A1 according to ASHRAE 34.
2. Refrigerant Compatibility: Chiller parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.
3. Refrigerant Flow Control: Manufacturer's standard refrigerant flow-control device satisfying performance requirements indicated.
4. Pressure Relief Device:
   a. Comply with requirements in ASHRAE 15 and in applicable portions of ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
   b. ASME-rated, spring-loaded pressure relief valve; single- or multiple-reseating type. Pressure relief valve(s) shall be provided for each heat exchanger. Condenser shall have dual valves with one being redundant and configured to allow either valve to be replaced without loss of refrigerant.
5. Refrigeration Transfer: Provide service valves and other factory-installed accessories required to facilitate transfer of refrigerant from chiller to a remote refrigerant storage and recycling system. Comply with requirements in ASHRAE 15 and ASHRAE 147.

J. Evaporator:
1. Description: Shell-and-tube design with water in tubes and refrigerant surrounding tubes within shell. Shell is separate from condenser.
2. Shell Material: Carbon-steel rolled plates with continuously welded seams or seamless pipe.
3. Designed to prevent liquid refrigerant carryover from entering compressor.
4. Provide evaporator with sight glass or other form of positive visual verification of liquid-refrigerant level.
5. Tubes:
   a. Mechanically expanded into end sheets and physically attached to intermediate tube sheets.
   b. Material: Copper or copper-nickel alloy.
   c. Nominal OD: Manufacturer's choice.
6. End Tube Sheets: Continuously welded to each end of shell; drilled and reamed to accommodate tubes with positive seal between fluid in tubes and refrigerant in shell.
7. Intermediate Tube Sheets: Installed in shell and spaced along length of tube at intervals required to eliminate vibration and to avoid contact of tubes resulting in abrasion and wear.
8. Water Box:
   a. Cast-iron or carbon-steel construction; arranged to provide visual inspection and cleaning of tubes from either end without disturbing refrigerant in shell.
   b. Standard type for water box with piping connections. Standard type for water box without piping connections.
   c. Provide water boxes with lifting lugs or eyebolts.
   d. Nozzle Pipe Connections: Grooved for mechanical-joint coupling or flanged.

e. Thermistor or RTD temperature sensor factory installed in each nozzle.

f. Fit each water box with 3/4- or 1-inch drain connection at low point and vent connection at high point, each with threaded plug.

K. Condenser:

1. Description: Shell-and-tube design with water in tubes and refrigerant surrounding tubes within shell. Shell is separate from evaporator.
2. Shell Material: Carbon-steel rolled plates with continuously welded seams or seamless pipe.
3. Designed to prevent direct impingement of high-velocity hot gas from compressor discharge on tubes.
4. Tubes:
   a. Mechanically expanded into end sheets and physically attached to intermediate tube sheets.
   b. Material: Copper or copper-nickel alloy.
   c. Nominal OD: Manufacturer's choice.
   d. Minimum Wall Thickness: 0.028 inch.
   e. External Finish: Manufacturer's standard.
   f. Internal Finish: Enhanced or smooth.
5. End Tube Sheets: Continuously welded to each end of shell; drilled and reamed to accommodate tubes with positive seal between fluid in tubes and refrigerant in shell.
6. Intermediate Tube Sheets: Installed in shell and spaced along length of tube at intervals required to eliminate vibration and to avoid contact of tubes resulting in abrasion and wear.
7. Water Box:
   a. Cast-iron or carbon-steel construction; arranged to provide visual inspection and cleaning of tubes from either end without disturbing refrigerant in shell.
   b. Standard type for water box with piping connections. Standard type for water box without piping connections.
   c. Provide water boxes with lifting lugs or eyebolts.
   d. Nozzle Pipe Connections: Grooved for mechanical-joint coupling or flanged.
   e. Thermistor or RTD temperature sensor factory installed in each nozzle.
   f. Fit each water box with 3/4- or 1-inch drain connection at low point and vent connection at high point, each with threaded plug.

L. Electrical Power:

1. Factory installed and wired, and functionally tested at factory before shipment.
2. Single-point, field-power connection to nonfused disconnect switch. Minimum withstand rating shall be as required by electrical power distribution system, but not less than 42,000A.
   a. Provide branch power circuit to each motor, electric heater, dedicated electrical load, and controls with disconnect switch or circuit breaker.
   b. NEMA- and ICS 2-rated motor controller for auxiliary motors, hand-off-auto switch, and overcurrent protection for each motor. Provide variable frequency controller for each variable-speed motor furnished.
   c. Control-circuit transformer with primary and secondary side fuses.

3. Terminal blocks with numbered wiring to match wiring diagram. Spare wiring terminal block for connection to external controls or equipment.

M. Motor Controller:
1. Enclosure: Factory installed, unit mounted, NEMA 250, Type 1, with hinged full-front access door.
2. Control Circuit: Obtained from integral control power transformer with a control power of enough capacity to operate connected control devices.
3. Accessories: Devices shall be factory installed in controller enclosure unless otherwise indicated.

N. Variable Frequency Controller:
1. Motor controller shall be factory mounted and wired on the chiller to provide a single-point, field-power termination to the chiller and its auxiliaries.
2. Description: NEMA ICS 2; listed and labeled as a complete unit and arranged to provide variable speed by adjusting output voltage and frequency.
3. Enclosure: Unit mounted, NEMA 250, Type 1, with hinged full-front access door with lock and key.
4. Cooling: Provide cooling of the variable frequency controller using one of the following:
   a. Refrigerant cooled, factory piped.
   b. Chilled water cooled, factory piped with copper tubing across evaporator with modulating valve to prevent condensation.
5. Integral Disconnecting Means: NEMA AB 1, instantaneous-trip circuit breaker with lockable handle. Minimum withstand rating shall be as required by electrical power distribution system, but not less than 42,000A.
6. Technology: Pulse width modulated (PWM) output suitable for constant or variable torque loads.
7. Output Rating: Three phase; with voltage proportional to frequency throughout voltage range.
8. Operating Requirements:
   a. Input AC Voltage Tolerance: 460-V ac, plus 10 percent or 506 V maximum.
   b. Input frequency tolerance of 60 Hz, plus or minus 2 Hz.
   c. Capable of driving full load, without derating, under the following conditions:
      1) Ambient Temperature: 0 to 40 deg C.
      2) Relative Humidity: Up to 90 percent (noncondensing).
      3) Altitude: 3300 feet.
   d. Minimum Efficiency: 96 percent at 60 Hz, full load.
   e. Minimum Displacement Primary-Side Power Factor: 98 percent.
   f. Overload Capability: 1.05 times the full-load current for 7 seconds.
   g. Starting Torque: As required by compressor-drive assembly.
   h. Speed Regulation: Plus or minus 1 percent.
   i. Isolated control interface to allow controller to follow control signal over a 10:1 speed range.
   j. To avoid equipment resonant vibrations, provide critical speed lockout circuitry to allow bands of operating frequency at which controller shall not operate continuously.

k. Capable of being restarted into a motor coasting in either the forward or reverse direction without tripping.

9. Internal Adjustability Capabilities:
   a. Minimum Output Frequency: 6 Hz.
   b. Maximum Output Frequency: 60 Hz.
   c. Acceleration: 2 seconds to 60 seconds.
   d. Deceleration: Zero seconds to 60 seconds.
   e. Current Limit: 30 to a minimum of 100 percent of maximum rating.
10. Self-Protection and Reliability Features: Subjecting the controller to any of the following conditions shall not result in component failure or the need for replacement:
   a. Overtemperature.
   b. Short circuit at controller output.
   c. Ground fault at controller output. Variable frequency controller shall be able to start a grounded motor.
   d. Open circuit at controller output.
   e. Input undervoltage.
   f. Input overvoltage.
   g. Loss of input-phase.
   h. Reverse phase.
   i. AC line switching transients.
   j. Instantaneous overload, line to line or line to ground.
   k. Sustained overload exceeding 100 percent of controller rated current.
   l. Starting a rotating motor.
11. Motor Protection: Controller shall protect motor against overvoltage and undervoltage, phase loss, reverse phase, overcurrent, overtemperature, and ground fault.
12. Automatic Reset and Restart: Capable of three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Controller shall be capable of automatic restart on phase-loss, and overvoltage and undervoltage trips.
13. Visual Indication: On face of controller enclosure or chiller control enclosure; indicating the following conditions:
   a. Power on.
   b. Run.
   c. Overvoltage.
   d. Line fault.
   e. Overcurrent.
   f. External fault.
   g. Motor speed (percent).
   h. Fault or alarm status (code).
   i. Motor output voltage.
   j. Input kilovolt amperes.
   k. Total power factor.
   l. Input kilowatts.
   m. Input kilowatt-hours.

n. Three-phase input voltage.
o. Three-phase output voltage.
p. Three-phase input current.
q. Three-phase output current.
r. Output frequency (Hertz).
s. Elapsed operating time (hours).
t. Diagnostic and service parameters.

14. Operator Interface: At controller or chiller control panel; with start-stop and auto-manual selector with manual-speed-control potentiometer.
15. Harmonic Distortion Filter: Factory mounted and wired to limit total voltage and current distortion to 5 percent.

O. Controls:

1. Standalone and microprocessor based with all memory stored in nonvolatile memory so that reprogramming is not required on loss of electrical power.
2. Enclosure: Unit mounted, NEMA 250, Type 1, hinged or lockable; factory wired with a single-point, field-power connection and a separate control circuit.
3. Operator Interface: Multiple-character digital or graphic display with dynamic update of information and with keypad or touch-sensitive display located on front of control enclosure. In either imperial or metric units, display the following information:
   a. Date and time.
   b. Operating or alarm status.
   c. Fault history with not less than last 10 faults displayed.
   d. Set points of controllable parameters.
   e. Trend data.
   f. Operating hours.
   g. Number of chiller starts.
   h. Outdoor-air temperature or space temperature if required for chilled-water reset.
   i. Temperature and pressure of operating set points.
   j. Entering- and leaving-fluid temperatures of evaporator and condenser.
   k. Difference in fluid temperatures of evaporator and condenser.
   l. Fluid flow of evaporator and condenser.
   m. Fluid pressure drop of evaporator and condenser.
   n. Refrigerant pressures in evaporator and condenser.
   o. Refrigerant saturation temperature in evaporator and condenser.
   p. Pump status.
   q. Antirecycling timer status.
   r. Percent of maximum motor amperage.
   s. Current-limit set point.
   t. Compressor bearing temperature.
   u. Motor bearing temperature.
   v. Motor winding temperature.
   w. Oil temperature.
   x. Oil discharge pressure.

y. Phase current.
z. Percent of motor rated load amperes.
aa. Phase voltage.
bb. Demand power (kilowatts).
cc. Energy use (kilowatt-hours).
dd. Power factor.

4. Manually Reset Safety Controls: The following conditions shall shut down chiller and require manual reset:
   a. Low evaporator pressure or temperature; high condenser pressure.
   b. Low evaporator fluid temperature.
   c. Low oil differential pressure.
   d. High or low oil pressure.
   e. High oil temperature.
   f. High compressor-discharge temperature.
   g. Loss of condenser-fluid flow.
   h. Loss of evaporator-fluid flow.
   i. Motor overcurrent.
   j. Motor overvoltage.
   k. Motor undervoltage.
   l. Motor phase reversal.
   m. Motor phase failure.
   n. Sensor- or detection-circuit fault.
   o. Processor communication loss.
   p. Motor controller fault.
   q. Extended compressor surge.
5. BAS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display chiller status and alarms.
   a. ASHRAE 135 (BACnet) communication interface with the BAS shall enable the BAS operator to remotely control and monitor the chiller from an operator workstation. Control features and monitoring points displayed locally at chiller control panel shall be available through the BAS.

P. Insulation:
1. Material: Closed-cell, flexible elastomeric, thermal insulation complying with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
2. Thickness: 3/4 inch.
3. Adhesive: As recommended by insulation manufacturer and applied to 100 percent of insulation contact surface. Seal seams and joints.
4. Factory-applied insulation over cold surfaces of chiller capable of forming condensation. Components shall include, but not be limited to, evaporator shell and end tube sheets, evaporator water boxes including nozzles, refrigerant suction pipe from evaporator to compressor, cold surfaces of compressor, refrigerant-cooled motor, and auxiliary piping.
   a. Before insulating steel surfaces, prepare surfaces for paint, and prime and paint as indicated for other painted components. Do not insulate unpainted steel surfaces.
   b. Seal seams and joints to provide a vapor barrier.

c. After adhesive has fully cured, paint exposed surfaces of insulation to match other painted parts.

Q. Finish:
1. Paint chiller, using manufacturer's standard procedures, except comply with the following minimum requirements:
a. Paint surfaces that are to be insulated before applying the insulation.
b. Paint installed insulation to match adjacent uninsulated surfaces.
c. Color of finish coat to be manufacturer's standard.
2. Provide Owner with quart container of paint used in application of topcoat to use in touchup applications after Project Closeout.

R. Accessories:
1. Flow Switches:
a. If required and not factory installed, chiller manufacturer shall furnish a switch for each evaporator and condenser and verify field-mounting location before installation.
b. Pressure Differential Switches:
1) Construction: Wetted parts of body and trim constructed of Type 316 stainless steel.
2) Performance: Switch shall withstand, without damage, the full-pressure rating of the heat exchanger applied to either port and exhibit zero set-point shift due to variation in working pressure.
3) Set Point: Screw type, field adjustable.
4) Electrical Connections: Internally mounted screw-type terminal blocks.
5) Switch Enclosure: NEMA 250, Type 4.
6) Switch Action: Double-pole, double-throw switch with one pole field wired to the chiller control panel and the other pole field wired to the BAS.
2. Vibration Isolation:
a. Chiller manufacturer shall furnish vibration isolation for each chiller.
b. Neoprene Pad:
1) Two layers of 0.375-inch- thick, ribbed- or waffle-pattern neoprene pads separated by a 16-gage, stainless-steel plate.
2) Fabricate pads from 40- to 50-durometer neoprene.
3) Provide stainless-steel square bearing plate to load the pad uniformly between 20 and 40 psig with a 0.12- to 0.16-inch deflection.
3. Noise Rating: 85 sound power level when measured according to ARI 575. Provide sound treatment if necessary to achieve the performance indicated.

2.2 SOURCE QUALITY CONTROL

A. Perform functional tests of chillers before shipping.

B. Factory run test each air-cooled chiller with water flowing through evaporator.

C. Factory test and inspect evaporator according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. For chillers located outdoors, rate sound power level according to ARI 370.

PART 3 - EXECUTION

3.1 CHILLER INSTALLATION

A. Equipment Mounting: Install chiller on concrete bases using spring isolators. Comply with requirements for concrete bases specified in Division 03 Section "Cast-in-Place Concrete."
   1. Minimum Deflection: 1/4 inch.
   2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
   3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Maintain manufacturer's recommended clearances for service and maintenance.

C. Charge chiller with refrigerant and fill with oil if not factory installed.

D. Install separate devices furnished by manufacturer and not factory installed.

3.2 CONNECTIONS

A. Install piping adjacent to chiller to allow service and maintenance.

B. Evaporator Fluid Connections: Connect to evaporator inlet with shutoff valve, flexible connector, thermometer, and plugged tee with pressure gage. Connect to evaporator outlet with shutoff valve, balancing valve, flexible connector, flow switch, thermometer, plugged tee with shutoff valve and pressure gage, flow meter, and drain connection with valve. Make connections to chiller with a flange or mechanical coupling.

C. Connect each chiller drain connection with a union and drain pipe, and extend pipe, full size of connection, to floor drain. Provide a shutoff valve at each connection.

3.3 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. Verify that refrigerant charge is sufficient and chiller has been leak tested.
   3. Verify that pumps are installed and functional.
   4. Verify that thermometers and gages are installed.
   5. Operate chiller for run-in period.
   6. Check bearing lubrication and oil levels.

7. For chillers installed indoors, verify that refrigerant pressure relief device is vented outdoors.
8. Verify proper motor rotation.
9. Verify static deflection of vibration isolators, including deflection during chiller startup and shutdown.
10. Verify and record performance of fluid flow and low-temperature interlocks for evaporator and condenser.
11. Verify and record performance of chiller protection devices.
12. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assembly, installation, and connection.

C. Prepare test and inspection startup reports.

- END OF SECTION -

- SECTION 23 6501 -

COOLING TOWERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Open-circuit, induced-draft, cooling towers.

1.3 SUBMITTALS

A. Product Data: Provide manufacturer's product data for each unit indicated on the drawings. Data to be specific to the equipment proposed for the project with all options and accessories indicated. Include the following as a minimum:
   1. Manufacturer and model number.
   2. Rated capacity based on scheduled conditions and project elevation.
   3. Equipment dimensions.
   4. Required clearances.
   5. Electrical data.
      a. Motor horsepower
      b. Voltage/Phase/Hz
      c. Electrical service point(s) of connection.
   6. Materials of construction.
   7. Accessories and options.
   8. Controls.

B. Certificates: For certification required in "Quality Assurance" Article.

C. Source quality-control reports.

D. Startup service reports.

E. Operation and maintenance data.

F. Warranty.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in the latest addition of ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

C. ASME Compliance: Fabricate and label heat-exchanger coils to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. CTI Certification: Cooling tower thermal performance according to CTI STD 201, "Certification Standard for Commercial Water-Cooling Towers Thermal Performance."

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace the following components of cooling towers that fail in materials or workmanship within specified warranty period:
   1. Fan assembly including fan, drive, and motor.
   2. All components of cooling tower.
   3. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 OPEN-CIRCUIT, INDUCED-DRAFT, COOLING TOWERS

A. Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Baltimore Aircoil Company.
   2. Marley Cooling Technologies.
   3. Evapco.

B. Cooling tower designed to resist wind load of 30 lbf/sq. ft. (1.44 kPa).

C. Casing and Frame:
   1. Casing Material: Type 304 stainless steel.
   2. Frame Material: Type 304 stainless steel.
   3. Joints and Seams: Sealed watertight.
   4. Welded Connections: Continuous and watertight.

D. Collection Basin:
   1. Material: Type 304 stainless steel.
   2. Removable stainless-steel strainer with openings smaller than nozzle orifices.
   3. Overflow and drain connections.
   4. Makeup water connection.

5. Outlet Connection: ASME B16.5, Class 150 flange.
6. Removable equalization flume plate between adjacent cells of multiple-cell towers.
7. Equalizer connection for field-installed equalizer piping.
8. Sweeper Piping: PVC sump and basin sweeper piping with plastic nozzles for connection to filter system.

E. Mechanically Operated, Collection Basin Water-Level Control: Manufacturer's standard adjustable, mechanical float assembly and valve.

F. Water Distribution System:
1. Gravity Water Distribution Basin: Non-pressurized design with head of water level in basin adequate to overcome spray nozzle losses and designed to evenly distribute water over fill throughout the flow range indicated.
   a. Material: Stainless steel.
   b. Location: Over each bank of fill with easily replaceable spray nozzles mounted in bottom of basin.
   c. Inlet Connection: ASME B16.5, Class 150 flange.
   d. Joints and Seams: Sealed watertight.
   e. Removable Panels: Same material as basin to completely cover top of basin. Secure panels to basin with removable corrosion-resistant hardware.
   f. Valves: Manufacturer's standard valve installed at each inlet connection and arranged to balance or shut off flow to each gravity distribution basin.
2. Pressurized Water Distribution Piping: Main header and lateral branch piping designed for even distribution over heat-exchanger coil or fill throughout the flow range without the need for balancing valves and for connecting individual, removable, non-clogging spray nozzles.
   a. Pipe Material: PVC.
   b. Spray Nozzle Material: Plastic or PVC.
   c. Piping Supports: Corrosion-resistant hangers and supports to resist movement during operation and shipment.

G. Fill:
1. Materials: PVC, with maximum flame-spread index of 25 according to ASTM E 84.
2. Fabrication: Fill-type sheets, fabricated, formed, and bonded together after forming into removable assemblies that are factory installed by manufacturer.
3. Fill Material Operating Temperature: Suitable for entering-water temperatures up through 120 deg F (49 deg C).

H. Drift Eliminator:
1. Material: FRP or PVC; with maximum flame-spread index of 25 according to ASTM E 84.
2. UV Treatment: Inhibitors to protect against damage caused by UV radiation.
3. Configuration: Multipass, designed and tested to reduce water carryover to achieve performance indicated.

I. Air-Intake Louvers:
1. Material: FRP or PVC.
2. UV Treatment: Inhibitors to protect against damage caused by UV radiation.

3. Louver Blades: Arranged to uniformly direct air into cooling tower, to minimize air resistance, and to prevent water from splashing out of tower during all modes of operation including operation with fans off.

J. Removable Air-Intake Screens: Stainless-steel wire mesh.

K. Axial Fan: Balanced at the factory after assembly.
1. Blade Material: Aluminum.
2. Hub Material: Aluminum or Galvanized steel.
3. Blade Pitch: Field adjustable.
4. Fan Shaft Bearings: Self-aligning ball or roller bearings with moisture-proof seals and premium, moisture-resistant grease suitable for temperatures between minus 20 and plus 300 deg F (minus 29 and plus 149 deg C). Bearings designed for an L-10 life of 40,000 hours.
5. Bearings Grease Fittings: Extended lubrication lines to an easily accessible location.

L. Drive System:
1. Belt Drive:
a. Service Factor: 1.5 based on motor nameplate horsepower.
b. Sheaves: Fan and motor shafts shall have taper-lock sheaves fabricated from corrosion-resistant materials.
c. Belt: Multiple V-belt design with a matched set of belts or one-piece, multigrooved, solid-back belt.
d. Belt Material: Oil resistant, nonstatic conducting, and constructed of neoprene polyester cord.
e. Belt-Drive Guard: Comply with OSHA regulations.

M. Fan Motor:
1. General Requirements for Fan Motors: Comply with NEMA designation and temperature-rating requirements specified in Division 23 Section "Common Motor Requirements for HVAC Equipment" and not indicated below.
2. Motor Enclosure: Totally enclosed.
3. Energy Efficiency: Comply with ASHRAE/IESNA 90.1.
4. Service Factor: 1.15.
5. Insulation: Class F.
6. Variable-Speed Motors: Inverter-duty rated per NEMA MG-1, Section IV, "Performance Standard Applying to All Machines," Part 31, "Definite-Purpose, Inverter-Fed, Polyphase Motors."
7. Motor Base: Adjustable, or other suitable provision for adjusting belt tension.

N. Fan Discharge Stack: Material shall match casing, manufacturer's standard design.
1. Stack Termination: Wire-mesh, galvanized-steel screens; complying with OSHA regulations.

O. Vibration Switch: For each fan drive.
1. Enclosure: NEMA 250, Type 4X.

2. Vibration Detection: Sensor with a field-adjustable, acceleration-sensitivity set point in a range of 0 to 1 g and frequency range of 0 to 3000 cycles per minute. Cooling tower manufacturer shall recommend switch set point for proper operation and protection.
3. Provide switch with manual-reset button for field connection to a BAS and hardwired connection to fan motor electrical circuit.
4. Switch shall, on sensing excessive vibration, signal an alarm through the BAS and shut down the fan.

P. Personnel Access Components:
1. Doors: Large enough for personnel to access cooling tower internal components from both cooling tower end walls. Doors shall be operable from both sides of the door.
2. External Ladders with Safety Cages: Aluminum, galvanized- or stainless-steel, fixed ladders with ladder extensions to access external platforms and top of cooling tower from adjacent grade without the need for portable ladders. Comply with 29 CFR 1910.27.
3. External Platforms with Handrails: Aluminum, FRP, or galvanized-steel bar grating at cooling tower access doors when cooling towers are elevated and not accessible from grade.
4. Handrail: Aluminum, galvanized steel, or stainless steel complete with knee-rail and toe-board, around top of cooling tower to safeguard personnel while accessing components located on top of cooling tower. Comply with 29 CFR 1910.23.
5. Internal Platforms: Aluminum, FRP, or galvanized-steel bar grating.
   a. Spanning the collection basin from one end of cooling tower to the other and positioned to form a path between the access doors. Platform shall be elevated so that all parts are above the high water level of the collection basin.
   b. Elevated internal platforms with handrails accessible from fixed vertical ladders to access the fan drive assembly when out of reach from collection basin platform.

2.2 SOURCE QUALITY CONTROL

A. Verification of Performance: Test and certify cooling tower performance according to CTI STD 201, "Certification Standard for Commercial Water-Cooling Towers Thermal Performance."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cooling towers on support structure indicated.

B. Install anchor bolts to elevations required for proper attachment to supported equipment.

C. Maintain manufacturer's recommended clearances for service and maintenance.

D. Loose Components: Install electrical components, devices, and accessories that are not factory mounted.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to cooling towers to allow service and maintenance.

C. Provide drain piping with valve at cooling tower drain connections and at low points in piping.

D. Route cooling tower overflows and drains, and piping drains.

E. Make-up Water Piping: Comply with applicable requirements in Division 23 Section "Hydronic Piping." Connect to water-level control with shutoff valve and union, flange, or mechanical coupling at each connection.

F. Supply and Return Piping: Comply with applicable requirements in Division 23 Section "Hydronic Piping." Connect to entering cooling tower connections with shutoff valve, balancing valve, thermometer, plugged tee with pressure gage, water meter, and drain connection with valve. Connect to leaving cooling tower connection with shutoff valve. Make connections to cooling tower with a union, flange, or mechanical coupling.

G. Equalizer Piping: Connect an equalizer pipe between tower cells. Connect to cooling tower with shutoff valve.

H. Connect vibration switch to building automation system and to tower fan drive for fan shutdown.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections: Comply with CTI ATC 105, "Acceptance Test Code for Water Cooling Towers."

C. Cooling towers will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.

C. Obtain performance data from manufacturer.
   1. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
      a. Clean entire unit including basins.

b. Verify that accessories are properly installed.
c. Verify clearances for airflow and for cooling tower servicing.
d. Check for vibration isolation and structural support.
e. Lubricate bearings.
f. Verify fan rotation for correct direction and for vibration or binding and correct problems.
g. Adjust belts to proper alignment and tension.
h. Verify proper oil level in gear-drive housing. Fill with oil to proper level.
i. Operate variable-speed fans through entire operating range and check for harmonic vibration imbalance. Set motor controller to skip speeds resulting in abnormal vibration.
j. Check vibration switch setting. Verify operation.
k. Verify water level in tower basin. Fill to proper startup level. Check makeup water-level control and valve.
l. Verify that cooling tower air discharge is not recirculating air into tower or HVAC air intakes. Recommend corrective action.
m. Replace defective and malfunctioning units.

D. Start cooling tower and associated water pumps. Follow manufacturer's written starting procedures.

E. Prepare a written startup report that records the results of tests and inspections.

3.5 ADJUSTING

A. Set and balance water flow to each tower inlet.

B. Adjust water-level control for proper operating level.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cooling towers.

- END OF SECTION -

- SECTION 23 7313 -

INDOOR AIR HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Constant-air-volume, single-zone air-handling units.
   2. Variable volume air-handling units.

1.3 SUBMITTALS

A. Product Data: Provide manufacturer's product data for each unit indicated on the drawings. Data to be specific to the equipment proposed for the project with all options and accessories indicated. Include the following as a minimum:
   1. Manufacturer and model number.
   2. Rated capacity based on scheduled conditions and project elevation.
   3. Fans:
      a. Certified fan-performance curves with system operating conditions indicated.
      b. Certified fan-sound power ratings.
      c. Fan construction and accessories.
      d. Motor ratings, electrical characteristics, and motor accessories.
   4. Certified coil-performance ratings with system operating conditions indicated.
   5. Filters with performance characteristics.
   6. Equipment dimensions and weights.
   7. Required clearances.
   8. Electrical data.
      a. Motor horsepower.
      b. Voltage/Phase/Hz.
      c. Full load ampacity, minimum circuit ampacity and maximum overcurrent protection device requirements.
      d. Electrical service point(s) of connection.
      e. AIC rating of the equipment.
   9. Materials of construction, metal thickness, finishes, insulation, etc.

10. Accessories and options.
11. Controls.
12. Dampers, including housings, linkages, and operators.
13. Sound power ratings for the unit.

B. Source quality-control reports.

C. Start-up procedures.

D. Warranty information.

E. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

C. ARI Certification: Air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.

D. ASHRAE Compliance: Applicable requirements in the latest addition of ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

E. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in the latest addition of ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

F. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Alliance.
2. Carrier Corporation.
3. Daikin.
4. Energy Labs.
5. Governair.
6. Haakon.
7. Huntair.
8. McQuay International.
9. Pace.

10. Temtrol.
11. Trane; American Standard Inc.
12. York International Corporation.
13. United Metal Products.

2.2 UNIT CASINGS

A. General Fabrication Requirements for Casings:
1. Outside Casing: Galvanized steel, minimum 16 GA thick.
2. Inside Casing: Galvanized steel, solid, minimum 20 GA (1.0 mm) thick.
3. Floor Plate: Galvanized steel, minimum 14 GA thick with integral safety tread.
4. Insulation Thickness: 2 inches.
5. Casing Leakage Rating: Less than 1% of rated unit airflow at 6 inches of wg.
6. Factory Finish for Steel and Galvanized-Steel Casings: Apply manufacturer's standard primer immediately after cleaning and pretreating.
7. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in the latest addition of ASHRAE 62.1.
8. Casing panels shall be double-wall, thermally broken, with minimum R-12 foam-type insulation between inner and outer panels.
9. Casing panels shall be sealed to unit frame with a neoprene full-perimeter gasket.

B. Inspection and Access Panels and Access Doors:
1. Panel and Door Fabrication: Construction and thickness shall be similar to casing panels.
2. Inspection and Access Panels:
   a. Fasteners: Two or more camlock type for panel lift-out operation. Arrangement shall allow panels to be opened against air-pressure differential.
   b. Gasket: Neoprene, applied around entire perimeter of panel frames.
   c. Size: Large enough to allow inspection and maintenance of air-handling unit's internal components.
3. Access Doors:
   a. Hinges: A minimum of two hinges or stainless-steel piano hinge and two latches, operable from inside and outside. Arrange doors to be opened against air-pressure differential. Hinges and latches shall be adjustable.
   b. Gasket: Neoprene, applied around entire perimeters of panel frames.
4. Locations and Applications:
   a. Fan Section: Doors.
   b. Access Section: Doors.
   c. Coil Section: Inspection and access panel.
   d. Damper Section: Doors.
   e. Filter Section: Doors large enough to allow removal and installation of filters.
   f. Mixing Section: Doors.

C. Condensate Drain Pans:
   1. Double-wall, insulated, fabricated with slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and to direct water toward drain connection.
      a. Length: Extend drain pan downstream from leaving face to comply with the latest addition of ASHRAE 62.1.
   2. Materials: Stainless steel sheet.
   3. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple.
   4. Insulation: Closed cell foam of sufficient thickness to prevent condensation from forming on exterior surfaces of pan and casing.
   5. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

D. Air-Handling-Unit Mounting Frame: Formed galvanized-steel channel or structural channel supports, designed for low deflection, welded with integral lifting lugs.

2.3 SUPPLY FAN, DRIVE, AND MOTOR SECTION

A. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.
   1. Shafts: Designed for continuous operation at maximum-rated fan speed and motor horsepower, and with field-adjustable alignment.
      a. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
      b. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

B. Single and Multiple Fan Units:
   1. Centrifugal Fan Housings: Formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.
      a. Bracing: Steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.
      b. Housing for Supply Fan: Attach housing to fan-section casing with metal-edged flexible duct connector.
      c. Flexible Connector: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized-steel sheet or 0.032-inch- thick aluminum sheets; select metal compatible with casing.
         1) Flexible Connector Fabric: Glass fabric, double coated with neoprene. Fabrics, coatings, and adhesives shall comply with UL 181, Class 1.
            a) Fabric Minimum Weight: 26 oz./sq. yd..
            b) Fabric Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
            c) Fabric Service Temperature: Minus 40 to plus 200 deg F.
   2. Plenum Fan Housings: Steel frame and panel; fabricated without fan scroll and volute housing.

3. Centrifugal Fan Wheels: Forward curved, backward inclined, airfoil plenum, or multi-blade double-width-double-inlet construction with curved inlet flange, backplate, welded or riveted to flange and backplate; cast-iron or cast-steel hub mechanically fastened to backplate and fastened to shaft with set screws.
4. Fan Shaft Bearings: Grease-lubricated, self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing with grease lines extended to outside unit and a rated L-50 life of 200,000 hours.
5. Belt Drives: Factory mounted, with adjustable alignment and belt tensioning, and with 1.5 service factor based on fan motor.
   a. Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
   b. Motor Pulleys: Adjustable pitch for use with 5-hp motors and smaller; fixed pitch for use with motors larger than 5 hp. Select pulley size so pitch adjustment is at the middle of adjustment range at fan design conditions.
   c. Belts: Oil resistant, nonsparking, and nonstatic; in matched sets for multiple-belt drives.
   d. Belt Guards(for motors mounted outside the casing): Comply with requirements specified by OSHA and fabricate according to SMACNA's "HVAC Duct Construction Standards"; 0.1046-inch- thick, 3/4-inch diamond-mesh wire screen, welded to steel angle frame; prime coated.
6. Internal Vibration Isolation: Fans shall be factory mounted with manufacturer's standard vibration isolation mounting devices having a minimum static deflection of 2 inches.

C. Motors: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
1. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
2. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
3. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 23.
4. Mount unit-mounted IEC starter-disconnect on exterior of unit. Units shall be factory wired, include a circuit breaker, control transformer, hand-off-auto switch with NEMA Type 1 enclosure.

2.4 COIL SECTION

A. General Requirements for Coil Section:
1. Comply with ARI 410.
2. Fabricate coil section to allow removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).
3. Coils shall not act as structural component of unit.

B. Water Coils:
1. Tube Material: Copper or as indicated on the drawings.
2. Tube Thickness: 0.020 inches (0.5 mm) minimum or as indicated on the drawings.
3. Fin Type: Plate or spiral.
4. Fin Material: Aluminum or as indicated on the drawings.

5. Fin Spacing: 12 fins per inch (0.47 fins per mm) maximum or as indicated on the drawings.
6. Fin and Tube Joint: Mechanical bond.
7. Headers:
   a. Cast iron or copper with cleaning plugs and drain and air vent tappings.
   b. Seamless copper tube with brazed joints, prime coated.
   c. Fabricated steel, with brazed joints, prime coated.
   d. Provide insulated cover to conceal headers exposed outside casings.
8. Frames: Channel frame, 18 GA thick galvanized steel minimum.
9. Coil Working-Pressure Ratings: 175 psig, 325 deg F.

2.5 AIR FILTRATION SECTION

A. General Requirements for Air Filtration Section:
   1. Comply with NFPA 90A.
   2. Provide minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
   3. Provide filter holding frames arranged for flat or angular orientation as noted, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum where indicated.
   4. Comply with requirements of Division 23 Sections.
   5. Provide filters as indicated on drawings.

B. Filter Gage:
   1. 3-1/2-inch- diameter, diaphragm-actuated dial in metal case.
   2. Vent valves.
   3. Black figures on white background.
   4. Front recalibration adjustment.
   5. 2 percent of full-scale accuracy.
   6. Accessories: Static-pressure tips with integral compression fittings, 1/4-inch tubing, and 2- or 3-way vent valves.

2.6 DAMPERS

A. General Requirements for Dampers: Leakage rate, according to AMCA 500, "Laboratory Methods for Testing Dampers for Rating," shall not exceed 2 percent of air quantity at 2000-fpm face velocity through damper and 4-inch wg pressure differential.

B. Damper Operators: Comply with requirements in Division 23 Section "Instrumentation and Control for HVAC."

C. Outdoor- and Return-Air Dampers: Doubleskin airfoil parallel-blade or opposed blade, galvanized-steel or aluminum dampers mechanically fastened to cadmium-plated steel operating rod in reinforced cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.

2.7 ELECTRICAL

A. Fused Disconnects: Provide individual fused disconnects for each piece of electrically driven equipment such as fans, electric heaters, etc. Locate disconnect outside of unit adjacent to the door where component is located.

B. Variable Frequency Drive: Factory mount and wire a variable frequency drive at each fan section. Comply with requirements in Division 23 Section “Variable Frequency Motor Drives.” Wiring shall be complete between local disconnect, drive, and fan motor.

C. Service Light: 100-W vaporproof fixture or magnetically attached LED light with switched junction box located outside adjacent door.
   1. Locations: Minimum of one light per section.
   2. Lights may be controlled via a common switch if switch is provided with a pilot light.
   3. Wire all lights to a single junction box for connection to building power.

2.8 SOURCE QUALITY CONTROL

A. Fan Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.

B. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."

C. Water Coils: Factory tested to 300 psig according to ARI 410 and ASHRAE 33.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment Mounting: Install air-handling units on concrete bases without vibration isolation devices. Secure units to anchor bolts installed in concrete bases. Comply with requirements for concrete bases specified in Division 03.
   1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
   2. Install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   4. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Arrange installation of units to provide access space around air-handling units for service and maintenance.

C. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.

D. Install filter-gage, static-pressure taps upstream and downstream of filters. Mount filter gages on outside of filter housing or filter plenum in accessible position. Provide filter gages on filter banks, installed with separate static-pressure taps upstream and downstream of filters.

E. Comply with requirements for piping specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

F. Install piping adjacent to air-handling unit to allow service and maintenance.

G. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.

H. Condensate Drain Piping: Comply with applicable requirements in Division 23 Section "HVAC Drain Piping." Connect condensate drain pans, extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

I. Coil-Water Piping: Comply with applicable requirements in Division 23 Section "Hydronic Piping." Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.

J. Connect duct to air-handling units with flexible connections. Comply with requirements in Division 23 Section "Air Duct Accessories."

- END OF SECTION -

- SECTION 23 7413 -

PACKAGED, OUTDOOR ELECTRIC-ELECTRIC AIR CONDITIONING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes packaged, outdoor, central-station air-handling units (rooftop units) with the following components and accessories:
   1. Direct-expansion cooling.
   2. Economizer outdoor- and return-air damper section.
   3. Integral, space temperature controls.
   4. Roof curbs.

1.3 DEFINITIONS

A. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

B. Outdoor-Air Refrigerant-Coil Fan: The outdoor-air refrigerant-coil fan in RTUs. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

C. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air-handling units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.

D. Supply-Air Fan: The fan providing supply-air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

E. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

1.4 SUBMITTALS

A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.

B. Operation and maintenance data.

C. Warranty.

1.5 QUALITY ASSURANCE

A. ARI Compliance:
   1. Comply with ARI 210/240 and ARI 340/360 for testing and rating energy efficiencies for RTUs.
   2. Comply with ARI 270 for testing and rating sound performance for RTUs.

B. ASHRAE Compliance:
   1. Comply with ASHRAE 15 for refrigerant system safety.
   2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
   3. Comply with applicable requirements in the latest addition of ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in the latest addition of ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of RTUs that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
   2. Warranty Period for Gas Furnace Heat Exchangers: Manufacturer's standard, but not less than 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
   1. AAON, Inc.
   2. Carrier Corporation.

3. Lennox Industries Inc.
4. Trane; American Standard Companies, Inc.
5. YORK International Corporation.

2.2 CASING

A. General Fabrication Requirements for Casings: Formed and reinforced double-wall or single-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.

B. Exterior Casing Material: Galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.

C. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
1. Materials: ASTM C 1071, Type I.
2. Thickness: 1/2 inch (13 mm).
3. Liner materials shall have air-stream surface coated with an erosion- and temperature-resistant coating or faced with a plain or coated fibrous mat or fabric.
4. Liner Adhesive: Comply with ASTM C 916, Type I.

D. Condensate Drain Pans: Formed sections of plastic, galvanized or stainless-steel sheet.
1. Pan-Top Surface Coating: Corrosion-resistant compound (unless the pan is stainless steel).

E. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in the latest addition of ASHRAE 62.1.

2.3 FANS

A. Belt-Driven Supply-Air Fans: Double width, forward curved, centrifugal; with permanently lubricated, single-speed motor installed on an adjustable fan base resiliently mounted in the casing. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.

B. Condenser-Coil Fan: Propeller, mounted on shaft of permanently lubricated motor.

C. Relief-Air Fan: Forward curved, shaft mounted on permanently lubricated motor.

D. Fan Motor: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

2.4 COILS

A. Supply-Air Refrigerant Coil:
1. Aluminum-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
2. Coil Split: Interlaced.
3. Condensate Drain Pan: Galvanized steel with corrosion-resistant coating or Stainless steel formed with pitch and drain connections complying with the latest addition of ASHRAE 62.1.

B. Outdoor-Air Refrigerant Coil: Aluminum-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.

2.5 REFRIGERANT CIRCUIT COMPONENTS

A. Compressor: Hermetic, scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief, and crankcase heater.

B. Refrigeration Specialties:
1. Refrigerant: R-407C or R-410A.
2. Expansion valve with replaceable thermostatic element.
3. Refrigerant filter/dryer.
4. Manual-reset high-pressure safety switch.
5. Automatic-reset low-pressure safety switch.
6. Minimum off-time relay.
7. Automatic-reset compressor motor thermal overload.
8. Brass service valves installed in compressor suction and liquid lines.

2.6 AIR FILTRATION

A. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

2.7 DAMPERS

A. Outdoor- and Return-Air Mixing Dampers: Parallel- or opposed-blade galvanized-steel dampers mechanically fastened to cadmium plated for galvanized-steel operating rod in reinforced cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.
1. Damper Motor: Modulating with adjustable minimum position.
2. Relief-Air Damper: Gravity actuated or motorized, as required by the latest addition of ASHRAE/IESNA 90.1, with bird screen and hood.
3. Capacity: 0-100% outside air.

2.8 ELECTRICAL POWER CONNECTION

A. Provide for single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

2.9 CONTROLS

A. Thermostat: Low-voltage, wall-mounted, 7-day programmable type to control compressor and evaporator fan, with the following features:
1. Compressor time delay.
2. 24-hour time control of system stop and start.
3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.

4. Fan-speed selection including auto setting.

2.10 ACCESSORIES

A. Hail guards of galvanized steel, painted to match casing.

2.11 ROOF CURBS

A. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.
   1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
      a. Materials: ASTM C 1071, Type I or II.
      b. Thickness: 1 inch (25 mm).
   2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.
      a. Liner Adhesive: Comply with ASTM C 916, Type I.
      b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
      c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
      d. Liner Adhesive: Comply with ASTM C 916, Type I.

B. Curb Height: 14 inches (355 mm).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Roof Curb: Install on roof structure, level and secure, according to ARI Guideline B. Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Division 07 Section "Roof Accessories." Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.

B. Install condensate drain, minimum connection size, with trap and indirect connection as indicated on the drawings.

C. Install piping adjacent to RTUs to allow service and maintenance.

D. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
   1. Connect supply ducts to RTUs with flexible duct connectors specified in Division 23 Section "Air Duct Accessories."

3.2 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Report results in writing.

B. Tests and Inspections:
   1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
   2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
   3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

3.3 CLEANING AND ADJUSTING

A. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

- END OF SECTION -

- SECTION 23 8129 -

VARIABLE REFRIGERANT FLOW HVAC SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes variable refrigerant flow air-conditioning and heat-pump systems consisting of multiple evaporator-fan components connected to a single or multiple compressor-condenser components via common refrigerant piping.

1.3 SUBMITTALS

A. Product Data: Provide manufacturer's product data for each unit indicated on the drawings. Data to be specific to the equipment proposed for the project with all options and accessories indicated. Include the following as a minimum:
   1. Manufacturer and model number.
   2. Rated capacity based on scheduled conditions and project elevation.
   3. Equipment dimensions and weights.
   4. Required clearances.
   5. Electrical data.
      a. Motor horsepower.
      b. Voltage/Phase/Hz.
      c. Full load ampacity, minimum circuit ampacity and maximum overcurrent protection device requirements.
      d. Electrical service point(s) of connection.
      e. AIC rating of the equipment.
   6. Materials of construction.
   7. Accessories and options.
   8. Controls.

B. System Schematic: Manufacturer generated system schematic indicating unit locations, refrigerant piping lengths, routing, and fittings.

C. Warranty information.

D. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance:
1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
2. Applicable requirements in the latest addition of ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - " Procedures," and Section 7 - "Construction and System Start-Up."

C. ASHRAE/IESNA Compliance: Applicable requirements in the latest addition of ASHRAE/IESNA 90.1.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of variable refrigerant flow systems that fail in materials or workmanship within specified warranty period.
1. Warranty Period:
a. For Compressor: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Daikin.
2. LG Electronics.
3. Mitsubishi.

2.2 INDOOR UNITS

A. General: Provide the indoor unit type indicated on the drawings.

B. Recessed Ceiling-Fan Components:
1. Cabinet: Zinc coated steel with hinged grilles to provide access and rear outside air intake.

2. Face: White plastic with integral supply and return grilles.
3. Insulation: Faced, glass-fiber duct liner or coated polystyrene.
4. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and electronic-expansion valve. Comply with ARI 210/240.
5. Fan: Direct drive, centrifugal.
6. Fan Motors: Variable speed with permanently lubricated ball bearings.
7. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in the latest addition of ASHRAE 62.1.
8. Filters: Provide filter rack with factory supplied cleanable filters.
9. Condensate Drain Pans:
   a. Fabricated with slope to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and direct water toward drain connection.
   b. Provide condensate pump with overflow switch to shut off the unit in case of pump malfunction.
10. Air Discharge: Adjustable louvers discharging air at the unit perimeter, user selectable air sweet, 1, 2, 3, or 4-way pattern as indicated on the drawings.

C. Wall-Mounted and Ceiling Suspended Evaporator-Fan Components:
1. Cabinet: Zinc coated steel chassis with removable, white, enameled steel or plastic panels on front and ends, with rear outside air intake.
2. Insulation: Faced, fiberglass duct liner or coated polystyrene.
3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and electronic-expansion valve. Comply with ARI 210/240.
4. Fan: Direct drive, centrifugal.
5. Fan Motors: Variable speed with permanently lubricated ball bearings.
6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in the latest addition of ASHRAE 62.1.
7. Filters: Factory supplied cleanable filter.
8. Condensate Drain Pans:
   a. Fabricated with slope to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and direct water toward drain connection.
   b. Provide condensate pump with overflow switch to shutoff the unit in case of pump malfunction.
9. Air Discharge: Front discharge with horizontal air sweep.

D. Ducted Units
1. Chassis: Designed for concealed mounting above a ceiling. Constructed of galvanized steel with flanged edges, removable panels for servicing, and insulation on the exterior of the casing.
2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and electronic-expansion valve. Comply with ARI 210/240.
3. Fan: Direct drive, centrifugal.
4. Fan Motors: Variable speed with permanently lubricated ball bearings.
5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

6. Filters: Provide the filter type indicated on the drawings.
   a. Factory supplied cleanable filter.
   b. Provide return plenum with filter holding frame for 1 inch thick filter, with access door on side of plenum.
7. Condensate Drain Pans:
   a. Fabricated with slope to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and direct water toward drain connection.
   b. Provide condensate pump with overflow switch to shutoff the unit in case of pump malfunction.

2.3 OUTDOOR UNITS

A. Description: Factory assembled and tested, air cooled; consisting of casing, compressors, condenser coil, condenser fans and motors, and unit controls.

B. Casing: Steel, finished with baked enamel. Designed for outdoor installation with weather protection for components and controls and with removable panels for required access to compressors, controls, condenser fans, motors, and drives, weep holes for water drainage, and mounting holes in base.

C. Controls: Provide microprocessor based controls for modulating operation of the outdoor unit and communication with indoor units.

D. Compressor(s): Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices.
   1. Compressor Type: Inverter driven scroll.
   2. Refrigerant Charge: R-407c or R-410A as scheduled.

E. Refrigerant System: Single circuit with strainer, check valves, oil separator, accumulator, electronic expansion valve, high and low side charging ports, high pressure safety switch, and interconnecting piping.

F. Condenser Coil: Copper-tube, aluminum-fin coil, including subcooling circuit.

G. Condenser Fan: Vertical discharge, aluminum-propeller type, statically and dynamically balanced directly connected to motor.

H. Motor: Variable speed, totally enclosed, permanently lubricated, with integral thermal-overload protection.

I. Operating Range: The system, when equipped with standard controls, shall operate within the following temperature ranges:
   1. Cooling Mode: 25 degrees F to 120 degrees F.
   2. Heating Mode: 0 degrees F to 60 degrees F.

J. Low Ambient Kit: Permits operation down to 0 deg F.

2.4 ACCESSORIES

A. Controls: Where indicated on the drawings provide a low-voltage, wired, wall-mounted, 7-day programmable type zone controller to control the indoor unit(s) operation, with the following features:
   1. 24-hour time control of system stop and start.
   2. Mode selector.
   3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
   4. Fan-speed selection including auto setting.

B. Building Automation System Gateway: Provide a BACnet gateway to allow the building automation system to read and write information to the VRF system.

C. Digital Output Kit: Relay interface to allow VRF system to control other devices such as an exhaust fan, outside air fan, heat exchanger, etc. See drawings for sequence of operation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordinate the installation with the system manufacturer.

B. Installation shall only be performed by installers trained by the system manufacturer.

C. Install units level and plumb.

D. Install indoor units using manufacturer's standard mounting devices securely fastened to building structure.

E. Install ground-mounted, outdoor units on 4-inch-thick, reinforced concrete base that is 4 inches larger, on each side, than unit. Concrete, reinforcement, and formwork are specified in Division 03. Coordinate anchor installation with concrete base.

F. Install roof-mounted, outdoor units on equipment supports installed in accordance with Division 07. Anchor units to supports with removable, cadmium-plated fasteners.

G. Install and connect refrigerant piping in accordance with the manufacturer’s written instructions and in accordance with Division 23 Section “Refrigerant Piping.”. Install piping to allow access to units and components requiring service.

3.2 CONNECTIONS

A. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

B. Duct Connections: Duct installation requirements are specified in Division 23 Section "Metal Ducts" Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Division 23 Section "Air Duct Accessories."

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
   1. Engage a factory authorized representative to review the installed system for compliance with the manufacturer's installation instructions. Correct any deficiencies.
   2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

- END OF SECTION -

- SECTION 23 8219 -

FAN COIL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes fan-coil units and accessories.

1.3 SUBMITTALS

A. Product Data: Provide manufacturer's product data for each unit indicated on the drawings. Data to be specific to the equipment proposed for the project with all options and accessories indicated. Include the following as a minimum:
   1. Manufacturer and model number.
   2. Rated capacity based on scheduled conditions and project elevation.
   3. Equipment dimensions and weights.
   4. Required clearances.
   5. Electrical data.
      a. Motor horsepower.
      b. Voltage/Phase/Hz
      c. Full load ampacity, minimum circuit ampacity and maximum overcurrent protection device requirements.
      d. Electrical service point(s) of connection.
      e. Wiring diagrams.
   6. Materials of construction.
   7. Accessories and options.
   8. Controls.

B. Warranty information.

C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
1. Carrier Corporation.
2. Enviro-tec.
3. International Environmental Corp.
4. Daikin International.
5. Trane; American Standard Inc.
6. York International Corporation.

2.2 GUESTROOM FAN-COIL UNITS

A. Description: Factory-packaged and -tested units rated according to ARI 440, ASHRAE 33, and UL 1995.

B. Coil Section Insulation: Minimum 1/2-inch thick, coated glass fiber, foil-covered, closed-cell foam or matte-finish, closed-cell foam complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.
1. Fire-Hazard Classification: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

C. Main and Auxiliary Drain Pans: Plastic or stainless steel. Fabricate pans and drain connections to comply with ASHRAE 62.1-2004. Provide condensate overflow switch wired to shut off unit in case of condensate drain malfunction.

D. Chassis: Galvanized steel where exposed to moisture. Floor mounted units shall have leveling screws.

E. Cabinet: Steel with baked-enamel finish.
   1. Vertical Unit Front Panels: Removable, steel, with return grille and channel-formed edges, cam fasteners, and insulation on back of panel.

F. Filters: Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
   1. Pleated Cotton-Polyester Media: 1” thick, 90 percent arrestance and 7 MERV.

G. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins maximum of 12 fins per inch, rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.

H. Fan and Motor Board: Removable.
   1. Fan: Forward curved, double width, centrifugal; directly connected to motor.
   2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
   3. Wiring Termination: Connect motor to chassis wiring with plug connection.

I. Factory, Hydronic Piping Package: ASTM B 88, Type L copper tube with wrought-copper fittings and brazed joints. Label piping to indicate service, inlet, and outlet. Mounted within fan coil cabinet.
   1. Two-way, modulating control valve for chilled-water coil.
   2. Two-way, two-position control valve for heating-water coil.
   3. Flexible Connector: Minimum 400-psig working pressure, and operating temperatures from 33 to 211 deg F.
      a. Hose Material: Reinforced synthetic rubber.
      b. Exterior Cover: Braided stainless steel.
      c. Couplings: Solid brass or stainless steel.
      d. Length: 12 inches to 24 inches.
      e. Minimum Diameter: Equal to fan-coil-unit connection size.
   4. Two-Piece Ball Valves: Bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem in both supply and return connections.
   5. Insertion test port in both supply and return connections.
   6. Calibrated-Orifice Balancing Valves: Bronze body, multi-turn globe type; 125-psig working pressure, 250-deg F maximum operating temperature; with calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, threaded ends, and equipped with a memory stop to retain set position.
   7. Y-Pattern Hydronic Strainers: Brass or cast-iron body (ASTM A 126, Class B); 125-psig working pressure; with threaded connections, bolted cover, perforated stainless-steel basket, and bottom drain connection.
   8. Wrought-Copper Unions: ASME B16.22.

J. Control devices are specified in Division 25 Sections "Integrated Automation Control".

K. Basic Unit Controls:
   1. Control voltage transformer.
   2. Unit mounted disconnect switch.
   3. Condensate overflow switch.

L. Electrical Connection: Factory wire motors and controls for a single electrical connection.

2.3 FREE HANGING FAN-COIL UNITS

A. Description: Factory-packaged and -tested units rated according to ARI 440, ASHRAE 33, and UL 1995.

B. Coil Section Insulation: Minimum 1/2-inch thick, coated glass fiber, foil-covered, closed-cell foam or matte-finish, closed-cell foam complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.
   1. Fire-Hazard Classification: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
   2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

C. Main and Auxiliary Drain Pans: Plastic or stainless steel. Fabricate pans and drain connections to comply with ASHRAE 62.1-2004. Provide condensate overflow switch wired to shut off unit in case of condensate drain malfunction.

D. Chassis: Galvanized steel where exposed to moisture. Floor-mounting units shall have leveling screws.

E. Cabinet: Steel with baked-enamel finish.
   1. Horizontal Unit Bottom Panels: Fastened to unit with cam fasteners and hinge and attached with safety chain; with discharge and intake grilles.

F. Filters: Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
   1. Pleated Cotton-Polyester Media: 1” thick, 90 percent arrestance and 7 MERV.

G. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins maximum of 12 fins per inch, rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.

H. Fan and Motor Board: Removable.
   1. Fan: Forward curved, double width, centrifugal; directly connected to motor.
   2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
   3. Wiring Termination: Connect motor to chassis wiring with plug connection.

I. Factory, Hydronic Piping Package: ASTM B 88, Type L copper tube with wrought-copper fittings and brazed joints. Label piping to indicate service, inlet, and outlet.
   1. Two-way, modulating control valve for chilled-water coil.
   2. Two-way, modulating control valve for heating coil.
   3. Hose Kits: Minimum 400-psig working pressure, and operating temperatures from 33 to 211 deg F. Tag hose kits to equipment designations.
      a. Hose Material: Reinforced synthetic rubber.
      b. Exterior Cover: Braided stainless steel.
      c. Couplings: Solid brass or stainless steel.
      d. Length: 24 inches.
      e. Minimum Diameter: Equal to fan-coil-unit connection size.
   4. Two-Piece Ball Valves: Bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem.
   5. Calibrated-Orifice Balancing Valves: Bronze body, multi-turn globe type; 125-psig working pressure, 250-deg F maximum operating temperature; with calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, threaded ends, and equipped with a memory stop to retain set position.
   6. Y-Pattern Hydronic Strainers: Cast-iron body (ASTM A 126, Class B); 125-psig working pressure; with threaded connections, bolted cover, perforated stainless-steel basket, and bottom drain connection. Include minimum NPS 1/2 hose-end, full-port, ball-type blowdown valve in drain connection.
   7. Wrought-Copper Unions: ASME B16.22.

J. Control devices are specified in Division 23 Sections "Instrumentation and Control for HVAC."

K. Basic Unit Controls:
   1. Control voltage transformer.
   2. Unit mounted disconnect switch.

L. Electrical Connection: Factory wire motors and controls for a single electrical connection.

2.4 DUCTED FAN-COIL UNITS

A. Description: Factory-packaged and -tested units rated according to ARI 430, ASHRAE 33, and UL 1995.

B. Casing Insulation: 1-inch thick coated glass fiber complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.
   1. Fire-Hazard Classification: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
   2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

C. Drain Pans: Plastic or stainless steel. Fabricate pans and drain connections to comply with ASHRAE 62.1-2004. Provide condensate overflow switch wired to shut off unit in case of condensate drain malfunction.

D. Chassis: Galvanized steel where exposed to moisture, with baked-enamel finish and removable access panels.

E. Cabinets and Structural Components: Galvanized steel or steel with baked-enamel finish.
   1. Mixing Plenum: Sheet metal plenum finished and insulated to match the chassis with outdoor- and return-air, formed-steel dampers.
   2. Dampers: Galvanized steel with extruded-vinyl blade seals, flexible-metal jamb seals, and interlocking linkage.

F. Filters: Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2 as noted on the drawings.

G. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins maximum of 12 fins per inch, rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain.

H. Direct-Driven Fans: Double width, forward curved, centrifugal; with permanently lubricated, multispeed motor resiliently mounted in the fan inlet. Aluminum or painted-steel wheels, and painted-steel or galvanized-steel fan scrolls.

I. Belt-Driven Fans: Double width, forward curved, centrifugal dynamically balanced; with permanently lubricated, single-speed motor installed on an adjustable fan base resiliently mounted in the cabinet.
   1. Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

J. Factory, Hydronic Piping Package: ASTM B 88, Type L copper tube with wrought-copper fittings and brazed joints. Label piping to indicate service, inlet, and outlet.
   1. Two-way, modulating control valve for chilled-water coil.
   2. Two-way, modulating control valve for heating coil.
   3. Hose Kits: Minimum 400-psig working pressure, and operating temperatures from 33 to 211 deg F. Tag hose kits to equipment designations.
      a. Length: 24 inches.
      b. Minimum Diameter: Equal to fan-coil-unit connection size. Not to be used on units with connections larger than 1-1/2 inch NPS.
   4. Two-Piece Ball Valves: Bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem.
   5. Calibrated-Orifice Balancing Valves: Bronze body, multi-turn globe type; 125-psig working pressure, 250-deg F maximum operating temperature; with calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, threaded ends, and equipped with a memory stop to retain set position.
   6. Y-Pattern Hydronic Strainers: Cast-iron body (ASTM A 126, Class B); 125-psig working pressure, with threaded connections, bolted cover, perforated stainless-steel basket, and bottom drain connection. Include minimum NPS 1/2 hose-end, full-port, ball-type blowdown valve in drain connection.
   7. Wrought-Copper Unions: ASME B16.22.

K. Control devices are specified in Division 23 Section "Building Automation System for HVAC."

L. Basic Unit Controls:
   1. Control voltage transformer.
   2. Motor contactor and disconnect switch.

M. Electrical Connection: Factory wire motors and controls for a single electrical connection.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fan-coil units to comply with NFPA 90A.

B. Suspend fan-coil units from structure with elastomeric hangers. Vibration isolators are specified in Division 23 Section "Vibration and Seismic Control for HVAC Piping and Equipment."

C. Install new filters in each fan-coil unit within two weeks after Substantial Completion.

D. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:
   1. Install piping adjacent to machine to allow service and maintenance.
   2. Connect piping to fan-coil-unit factory hydronic piping package. Install piping package if shipped loose.
      a. Maximum hose bend: Do not exceed 180 degrees.
      b. Maximum pipe offset: Not to exceed 3 inches.
      c. Comply with manufacturer's written limitations and instructions.
   3. Connect condensate drain to indirect waste.
      a. Install condensate trap of adequate depth to seal against the pressure of fan. Install cleanouts in piping at changes of direction.

E. Connect supply and return ducts to fan-coil units with flexible duct connectors specified in Division 23 Section "Air Duct Accessories." Comply with safety requirements in UL 1995 for duct connections.

3.2 FIELD QUALITY CONTROL

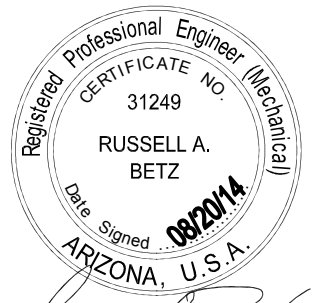
A. Perform the following field tests and inspections and prepare test reports:
   1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

- END OF SECTION -

DIVISION 25 – INTEGRATED AUTOMATION

TABLE OF CONTENTS



EXPIRES: 03/31/15

- SECTION 25 5110 -

INTEGRATED AUTOMATION CONTROL OF GUESTROOM EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Provide a complete, integrated hotel guestroom automation system for the following:
      a. HVAC Equipment.
         1) Motion Sensor Thermostats
      b. Central Interface (CI) Server Application.
      c. Remote Room Monitoring and Communications.

B. Related Sections:
   1. Section 08 11 13 – Hollow Metal Doors and Frames
   2. Section 08 71 00 - Door Hardware
   3. Section 23 82 19 - Fan Coil Units.
   4. Division 23 - Heating, Ventilating, And Air Conditioning (HVAC).
   5. Division 26 – Electrical; Power Wiring to System Hardware
   6. Division 27 – Communications

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

B. Submit “Letter of Conformance” in accordance with Section 01 33 00 (01330) indicating specified items selected for use in project with the following supporting data.
   1. Product Data: Submit the Manufacturer's product data and installation instructions for each component and system.
   2. Shop Drawings: Submit list of components and equipment to be supplied, including proposed locations, clearances, and power requirements.

3. Operations and Maintenance Manual: Submit the Manufacturer's standard operations and maintenance manual, including emergency maintenance provider.
4. Qualifications: Submit documentation from the Manufacturer and Installer indicating qualifications listed under Quality Assurance.
5. Warranty: Submit the Manufacturer's standard one-year labor and parts warranty for turnkey installation.

1.4 QUALITY ASSURANCE

A. Qualifications of Manufacturer: The Manufacturer shall have a minimum of 20 years documented experience manufacturing integrated room automation systems having similar or more stringent requirements than the system for the current project. The Manufacturer shall submit a list of at least 15 completed projects using similar integrated room automation systems.

B. Qualifications of Installer: Submit a letter signed by the Manufacturer stating that the Installer is licensed by or acceptable to the Manufacturer of the integrated room automation system.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver materials and products in unopened, factory-labeled packages. Store and handle in strict compliance with the Manufacturer's instructions and recommendations. Protect from damage. Sequence deliveries to avoid delays, but minimize on-site storage.

1.6 COORDINATION

A. Conference: Convene a pre-installation conference to establish procedures to coordinate this work with related and adjacent work.

B. Coordination: Furnish inserts and anchors that must be built into other work. Work closely with installers of finish materials so that units are properly aligned with adjacent materials.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Approved Manufacturers:
1. INNCOM International, Inc. (860-739-4468)

2.2 SYSTEM DESCRIPTION

A. HVAC Controls:
1. HVAC Type: The control strategy will be dependent on the type of HVAC equipment that is being proposed. The control equipment shall be compatible with the HVAC equipment with 4 relay control specified for Project. Refer to Section 23 8219 "Fan Coil Units". The following control strategies shall be applied:
a. Fan Coils (4-Pipe): The System shall control one 4-pipe fan coil in each room. The System shall directly control a 1 or 2-speed, low-voltage interface. The System will

also control the 2-position modulating chilled water valve and 2-position heating hot water valve. INNCOM International, Inc. shall provide the 4-pipe fan coil Vendor with the necessary control card or connectors to be installed at point of manufacture or in the rooms. The System shall provide automatic switchover from heating to cooling operation at each room.

2. HVAC Control Strategies: Provision shall be made to prevent the system from switching repeatedly from cooling to heating and back while attempting to maintain a constant target temperature. The System's temperature-control performance shall meet the requirements defined below for proportional valves. The System's humidity-refresh performance shall meet the requirements defined below.
   a. Temperature Control: The System in the room shall employ a PID algorithm to minimize fan speed and valve changes and to reduce servo-loop error. Such error, measured as the temperature difference between the set target temperature and the measured room temperature, shall not exceed 1.0 degree C under steady-state conditions and will automatically compensate for changes in the heat/cooling load of the room. The temperature control algorithm shall be capable of using the full resources of the FCU to maintain target temperature. Proportional-only algorithms that set the fan speed in proportion to the error shall not be accepted (as they cause a temperature control error that increases with the fan speed).
   b. Humidity Refresh: The System in the room shall be capable of maintaining a maximum level of humidity. The refresh cycle will activate in unoccupied rooms only.
      1) Humidity Refresh Cycle: The room air conditioning shall be activated on a pre-defined duty cycle to remove excess humidity. The System shall monitor, via central sensors or individual room sensors, the air temperature and relative humidity. When the relative humidity exceeds a preset threshold, the room AC shall be activated if the AC has been shut down for a period of time that exceeds a programmable time value (for example, if the AC has not run for the last one hour).
   c. Fan Speed Control: Fan speed shall be selected automatically by the System to match the heat gain/loss in the room. Fixed-fan operation shall also be available to the guest. Fan speeds shall be field-programmable to allow limiting fan speeds to a desired range of speeds. Fan operation shall be configurable to provide for "Continuous Fan" or "Automatic Fan." Continuous Fan means that the fan shall run even when the target temperature has been satisfied. Automatic Fan means that the fan shall run only on active heating or cooling call.
   d. Temperature History: The System shall have the capability to store the temperature, valve, and fan states for each room for at least three months, with all changes being reported.
   e. Energy Conservation:
      1) The System shall provide optimized energy conservation measures with minimum inconvenience to the guest. At least four setback strategies shall be employed: two when a room is un-rented (either occupied by staff or unoccupied), and two more when a room is rented (either occupied or unoccupied).
      2) When connected to a Central Network Server, the System shall obtain rented status automatically from the Property Management System (PMS). No manual data entry shall be required by the hotel to update the room rented status.
      3) The System shall determine room occupancy automatically. The System shall keep the room status as occupied even while the guest is asleep.

4) Setback values and related parameters shall be independently adjustable for rented and un-rented modes.

5) Reduced on/off switching during the night or "night setback" shall be available for implementation by choice of the property as a means to further reduce energy consumption while the guest is asleep.

f. Digital Thermostat: The unit shall be modular in construction so that each of the modules can be added at a later time if not installed initially.

1) Acceptable Product: "e4 Smart Digital Thermostat Model #e528 with Integral Passive Infrared (PIR) Motion Sensor"; INNCOM International, Inc.

2) The System shall include a wall-mounted, illuminated digital thermostat. The thermostat will be able to display current room temperature, target temperature, and outside temperature in degrees F and degrees C, as well as the humidity level.

3) The thermostat shall be easy to operate, and shall allow changing the target temperature in steps of 1 degree F or 0.5 degree C. Clear indication shall be provided when the HVAC has been turned off.

4) The thermostat shall have the capacity to work with a built-in Passive Infrared (PIR) motion sensor OR a remote Passive Infrared (PIR) motion sensor OR combinations of both.

5) The thermostat shall be capable of directly controlling HVAC units operating on voltages ranging from 12VDC to 277VAC without the requirement of secondary control relays for the higher voltage applications. The thermostat shall also be available in a battery operated version to facilitate installation where the provision of power may not be practical.

6) The thermostat shall be connectable to the System via a 2-conductor, low-voltage cable. The thermostat shall also have the capability of connecting to the HVAC equipment wirelessly via RF signals.

7) The thermostat shall be capable of controlling HVAC units wirelessly using RF (Zigbee) technology.

8) The thermostat shall include the ecoMODE® green button that the guest can use to opt-in to the property's sustainability practices.

3. Occupancy Detection: The System shall use a PIR motion detector to determine whether the room is occupied at any time. Activation of any switch on the digital thermostat shall place the room in the occupied mode.

a. The current occupancy state of the room shall be available to the room controller that controls the room HVAC system, as well as to a server and its workstations.

B. Central Interface (CI) Server Application:

1. Each guestroom system or sub-system will communicate in real time with a central server running INNcontrol-II application software. The software shall provide a comprehensive list of room status information and alarms, and shall also interface among the rooms and other systems in the hotel.

a. PMS Interface: The software shall interface with the PMS computer through a serial link or TCP/IP. The PMS will provide the INNcontrol-II software with current sale status of the guestrooms (rented/un-rented and check-in/checkout). This information shall be transferred from the INNcontrol-II software to the room within five seconds, and will be used to determine the operation of the HVAC, lights, and other loads in the room. The INNcontrol-II server shall also be linked and interfaced with the EDL server.

b. Management Display: The INNcontrol-II application, or terminals connected to the INNcontrol-II server, shall provide access to management to view and control such parameters as room temperature, room target temperature, HVAC operation, light control, and other conditions and statuses. In general, the INNcontrol-II application shall provide access to any function of the room control system that is available to the guest in the room. The System shall be capable of interfacing with the Hotel Ethernet System via an RS 485 or TCP/IP interface.

c. Remote Access/Diagnostics: The application shall provide full support of a remote terminal connected via modem or TCP/IP, or via a serial link to the server. The server software architecture shall be of a client/server structure. The remote terminals shall be PCs operating under MS Windows 2000 or later. The application shall be capable of running complete diagnostics of the System from a remote service center via dial-up phone lines or TCP/IP.

d. Alarm Outputs: The application software shall be programmable to route alarm conditions to a printer, paging system, file, hard disk, third-party interface, or the PMS.

e. The user shall have the option of not logging on, which will allow View (read-only) use of the software, or logging on, which will allow Control functions based on the logon identification.

f. The software shall open to a pre-determined default language. It shall also be possible to choose another language available from the list.

g. In the software, the first screen that appears when INNcontrol-II is opened is the ‘Quick View’ screen. Each guestroom selected for Quick View display shall be represented by a block on the screen. The block shall be numbered to correspond to the actual room number. By right-clicking on a room block, the user shall be able to access the menus and sub-menus that will display selected information for that room. The resulting menu shall allow the display of butler calls, MUR calls, valet requests, pick up tray requests, DND indications, SOS indications, and possibly one or two other requests if desired by the property – for example, cab request.

h. All service requests shall be displayed at once on the Quick View screen. The color coding shall allow easy recognition of each type of call.

i. The software shall allow for the display of guest preferences including kosher/Sabbath rooms or eco-Mode rooms.

   1) Kosher/Sabbath rooms are set up such that all automatic functions that would be triggered by guests are suspended and the HVAC does not respond to occupancy information.

   2) eco-Mode rooms are activated when the guest presses the Green Button on the thermostat or eco-Mode programmed switches, thus enrolling in the property’s environmental sustainability programs.

j. The software shall offer a Dynamic Suite Linking option and it shall display rooms that are linked as suites. The linked rooms shall be color-coded, and the type of link (common door or connecting door) shall be shown displayed in the room blocks.

k. The software shall be able to display as a minimum the following room conditions:

   1) Rented – Shows which rooms are currently rented.

   2) Occupancy – Shows which rooms are currently occupied, either by guests or staff.

   3) Rented + Occupancy – Shows which rooms are rented and occupied.

   4) Clean Status – Shows which rooms have been cleaned and which need cleaning. This option also shows “supervisor required” and “out-of-order.”

5) Dirty Rooms – Shows which rooms need cleaning. The color coding will indicate the rented and occupancy status for these rooms.
6) Supervisor Visit Requested – Shows which rooms have been cleaned and are ready for review by a supervisor.
7) Out of Order – Shows which rooms are out of order for any reason (such as equipment needing repair).
8) Measured Room Temperature – Shows the temperature of each room on the block grid.
9) Target Room Temperature – Shows the desired room temperature for each room on the block grid.
10) AC Mode – Shows the operational status of the air conditioning system for all rooms on the block grid.
11) Measured, Target and AC Mode – Shows all the above on the block grid.
12) Measured Humidity – Shows the humidity for each room on the block grid.
13) HVAC Equipment Operation – Shows heating, cooling, and fan operation for each room on the block grid.
14) Second Stage Operation – Shows forced, ready, active, and normal status for each room on the block grid.
15) Peak Demand/Load Shedding/Fire – Shows high, medium, low, and normal for peak demand/load shedding, and shows HVAC response to fire.
16) VIP/Reduced Energy Management – Indicates room thermostat is not being controlled by the system.
17) De-Humidification – Shows all rooms on the block grid that are being dehumidified.
18) De-Icing – Shows all rooms on the block grid that are being de-iced.
19) HVAC Trouble – Shows all rooms on the block grid with active HVAC alarms.
20) Equipment Type – Shows the HVAC equipment type for all rooms on the block grid.

l. The software shall display diagnostic information for guestroom devices.

m. The software shall have Navigation Tree Displays. The rows of icons allow the user to display property views in the navigation area below the icon bars by clicking on the icon. A room can be selected from the Navigation Tree for display of its statuses. In the Floor View and Network View displays, a plus (+) or minus (-) sign will appear before each room. A plus sign indicates that more information can be displayed by clicking on the plus sign.

n. The default icon in the navigation area shall be the Floor View, which shall display a list of hotel floors. Double clicking on a floor shall display a list of rooms on the floor.

o. The software shall have a Network View icon to display the guestrooms organized according to their network connectivity status.

p. The software shall be able to display a graph of the HVAC trend for each room. The display shall show the room's temperature band as a yellow block. The HVAC trend line shall be color-keyed: black (the HVAC is not currently heating or cooling), red (the HVAC is heating), or blue (the HVAC is cooling).

q. The software shall be able to generate reports that show outstanding guest requests at the time of report generation. The report shall be able to be generated in a printable notepad format with the time of day of the report generation shown at

the top of the report. The report can be saved and/or printed, making it convenient for staff to carry as a reminder of outstanding requests.

r. The software shall allow staff to “take ownership” of guest requests. By taking ownership, the staff member commits to performing the request or ensuring that it is performed. Once ownership is taken, the room shall be re-listed along with the name of the person who has taken ownership. This allows anyone on a terminal anywhere in the property to see who has taken responsibility for a guest request.

s. The software shall allow Hotel staff to designate a room needing cleaning or as being out of order. Once the room has been cleaned, staff can report that it has been cleaned and request review by a supervisor. The software indicates that a hotel maid has seen that the room needs to be cleaned.

C. Room Communications, Monitoring and Control:

1. Throughput: The INNcontrol-II application server and the network that links it to the rooms shall be able to handle a minimum of five transactions per second per 500 rooms. A transaction is defined as the sending of a command or data to a room from the INNcontrol-II server and the receipt of acknowledgment of the proper execution of such command back at the INNcontrol-II server. The System and its network shall guarantee a response within five seconds when accessing any room component remotely. Such response shall not be conditional on any other activities that take place at that time anywhere else in the System.

2. Network Integrity: The communication in the System shall comply with ISO/OSI standards. The network shall be secure from insertion of commands from external stations. Errors in communications shall be detected and corrected automatically. The addition and removal of stations shall be captured and reported as an alarm by the INNcontrol-II server.

a. Networking Capabilities: The System shall be capable of communicating from the INNcontrol-II server to the guestroom devices using a single shielded or unshielded twisted pair of wires, Cat3 or better.

b. Networking Capabilities: The System shall be capable of communicating from the INNcontrol-II server to the guestroom devices using a dedicated hybrid RS-485/Ethernet network or a shared Ethernet network, running on Cat 6 or fiber.

D. Field Programmability:

1. Parameter Changes: All room-related parameters, such as target temperature upon check-in, setback temperatures, and the like, shall reside in non-volatile memory in each room and shall be available for programming from the INNcontrol-II server as well as the in-room thermostat. The server shall be able to access rooms on an individual basis, in groups, or in total (i.e., the entire property at one time).

2. Program Changes: The application program residing in the room controller shall be modifiable through the INNcontrol-II server computer without the need to visit the room. The program stored in each room shall not be affected by the temporary loss of power, regardless of the duration of the power outage.

3. Power Fail Recovery: After a power outage, the System throughout the hotel shall start up automatically and will be fully operational within five minutes after restoration of power. In the rooms, all loads controlled by the System will be returned to their previous states, including target temperature, selected fan speed operation, and lights, regardless of the duration of the power outage.

4. Noise Restriction: All system components shall be installed in such a manner as to eliminate audible noise to the guest when the System operates while the guest is asleep.

5. Code Compliance: Components installed by the Vendor and wiring/installation performed by the Vendor shall comply with the applicable standards and electrical codes.

E. Wiring: All field wiring to the System shall be made through plug-in connectors to facilitate service and diagnostics. The Vendor shall provide as-run wiring diagrams for room wiring and network wiring.

PART 3 - EXECUTION

3.1 INSTALLATION

A. There shall be strict compliance with the Manufacturer's instructions and recommendations. The onset of work shall indicate that the Installer accepts the existing substrates and conditions. System installation shall be coordinated with related and adjacent work.

B. The system shall be tested for proper operation in accordance with the Manufacturer's commissioning guide. Damaged components shall be repaired or replaced until the proper operation is achieved.

3.2 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:
   1. Train Owner's maintenance personnel on procedures and schedules for starting up and shutting down, troubleshooting, servicing, and maintaining cooling towers.
   2. Review data in maintenance manuals.
   3. Schedule training with Owner, through Owner's Representative, with at least seven days' advance notice.

- END OF SECTION -

- SECTION 25 5500 -

INTEGRATED AUTOMATION CONTROL OF HVAC & PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes a Building Automation System (BAS) to control equipment for the HVAC and plumbing systems and components not located in the guest rooms.

B. The BAS Contractor is responsible for the complete installation of this system as necessary to provide the sequence of operations, and monitor and control the equipment and points as shown on the drawings. The complete installation includes all required 120 volt wiring, all low voltage wiring, and communication wiring, refer to Division 23 Section “Electrical and Control Wiring for Mechanical Systems” for requirements.

1.3 SUBMITTALS

A. Product Data: For the complete Building Automation System indicated and intended for this project. Include the following as a minimum:
   1. Sequence of operations intended for each system component on this project.
   2. Copy of each graphic screen intended for this project.
   3. Operator work station and all associated components.
   4. All control hardware including controllers, panels, sensors, thermostats, valves, dampers, etc. intended for this project. Include the following:
      a. Manufacturer and model number.
      b. Equipment dimensions.
      c. Required clearances.
      d. Electrical data.
         1) Amperage.
         2) Voltage/Phase/Hz.
         3) Electrical service point(s) of connection.
      e. Materials of construction.
      f. Accessories and options.

5. Point chart for each system component intended for this project.
6. Power, signal, and control wiring diagrams.
7. Damper schedule.
8. Valve schedule.

B. Software and firmware operational documentation.

C. Field quality-control test reports.

D. Warranty information.

E. Operation and maintenance data: Include the following:
1. Table of contents.
2. As-builts of the system showing all points and terminations in both AutoCAD and hardcopy format.
3. Manufacturer's product data for each item installed.
4. System operator's manuals.
5. Electronic back-up copy of site specific programming, databases, and sequences.
6. Network diagrams.
7. Wiring termination schedules.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. The BAS Contractor shall be a recognized distributor, manufacturer's representative, or wholesaler of a national manufacturer of Building Automation Systems.

C. The BAS Contractor shall have a facility within a 100-mile radius of the job site supplying complete maintenance and support services on a 24 hour, 7-day-a-week basis. This support facility shall have spare parts and all necessary test and diagnostic equipment required to install, commission and service the specified BAS.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of the BAS that fail in materials or workmanship within specified warranty period.
1. Extended warranties include, but are not limited to, the following:
a. Reprogramming of sequences and updating graphics.
b. Parts and labor.
2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 CONTROL SYSTEM

A. Manufacturers:
   1. Alerton Inc.
   2. Andover Controls Corporation.
   3. Automated Logic Corporation.
   4. Carrier Corporation.
   5. Circon by Efficient Building Automation Corporation.
   6. Honeywell International Inc.; Home & Building Control.
   7. Invensys Building Systems.
   8. Siemens Building Technologies, Inc.

B. Communications between the operator workstation and network control units shall use BACNET protocol.

C. Communications between the network controllers and DDC controllers shall use BACNET protocol.

D. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

2.3 SOFTWARE

A. The software operating the BAS shall provide the following features:

B. Downloading and Uploading:
   1. Provide the capability to generate BAS software-based sequences, database items and associated operational definition information and user-required revisions to any OWS and the means to download same to the associated Application Node.
   2. Application software tool used for the generation of custom logic sequences shall be resident in both the application node and the OWS.

C. Graphics:
   1. Provide graphics to allow for monitoring and control of each piece of equipment on the project.

2. Graphics shall include clickable site plans, floor plans, etc. showing the actual location of each piece of equipment.
3. Floor plans shall use color-coding to indicate areas or items in alarm or not meeting the desired temperature setpoint.
4. Dynamic graphics shall be provided for each piece of equipment showing real-time operating data and allowing modification of adjustable parameters.

D. Schedules:
1. The system shall provide multiple schedule input forms for automatic time-of-day scheduling and override scheduling of BAS operations. At a minimum, the following spreadsheet types shall be accommodated:
   a. Weekly schedules.
   b. Temporary override schedules.
   c. Special “Only Active If Today Is A Holiday” schedules.
   d. Monthly schedules.
2. Schedules shall be provided for each system or sub-system in the BAS. Each schedule shall include all commandable points residing within the system. Each point may have a unique schedule of operation relative to the system use schedule, allowing for sequential starting and control of equipment within the system. Scheduling and rescheduling of points shall be accomplished easily via the system schedule spreadsheets.
3. Monthly calendars for a 12-month period shall be provided that allow for simplified scheduling of holidays and special days in advance. Holidays and special days shall be user-selected with the pointing device or keyboard, and shall automatically reschedule equipment operation as previously defined on the weekly schedules.

E. Alarms:
1. Alarms shall be routed directly from primary application nodes to PCs and servers. It shall be possible for specific alarms from specific points to be routed to specific PCs and servers. The alarm management portion of the OWS software shall, at the minimum, provide the following functions:
   a. Log date and time of alarm occurrence.
   b. Generate a “Pop-Up” window, with audible alarm, informing a user that an alarm has been received.
   c. Allow a user, with the appropriate security level, to acknowledge, temporarily silence, or discard an alarm.
   d. Provide an audit trail on hard drive for alarms by recording user acknowledgment, deletion, or disabling of an alarm. The audit trail shall include the name of the user, the alarm, the action taken on the alarm, and a time/date stamp.
   e. Provide the ability to direct alarms to an e-mail address or alpha-numeric pager. This must be provided in addition to the pop up window described above. Systems which use e-mail and pagers as the exclusive means of annunciating alarms are not acceptable.
   f. Any attribute of any object in the system may be designated to report an alarm.
2. BAS shall annunciate diagnostic alarms indicating system failures and non-normal operating conditions.
3. The BAS shall annunciate application alarms at minimum.

F. Reports:
1. Reports shall be generated and directed to one or more of the following: User interface displays, printers, or archive at the user's option. As a minimum, the system shall provide the following reports:
   a. All points in the DDC System.
   b. All points in each DDC System application.
   c. All points in a specific application node.
   d. All points in a user-defined group of points.
   e. All points currently in alarm in an DDC System application.
   f. All points locked out in an DDC System application.
   g. All DDC System schedules.
   h. All user defined and adjustable variables, schedules, interlocks and the like.
   i. DDC System diagnostic and system status reports.

G. Historical Trending and Data Collection:
1. Trend and store point history data for all BAS points and values as selected by the user.
2. The trend data shall be stored in a manner that allows custom queries and reports using industry-standard software tools.
3. At a minimum, provide the capability to perform statistical functions on the historical database:
   a. Average.
   b. Arithmetic mean.
   c. Maximum/minimum values.
   d. Range - difference between minimum and maximum values.
   e. Standard deviation.
   f. Sum of all values.
   g. Variance.

H. Application Routines:
1. Event Messaging: Provide for the automatic execution of user-defined messages on the occurrence of each predefined BAS real-time event including equipment/point status change, approaching limit or alarm, time of day and the like. Direct messages to any number of operator PCs, e-mail destinations, and pagers.
2. Indoor Air Quality: Provide monitoring of outside air, return air and supply air CO_2 concentration, calculate and maintain fresh air requirements. Adjust outdoor air intake to ensure return air CO_2 high level limit is not exceeded.
3. Optimum Start/Stop: Provide software to start equipment on a sliding schedule based upon indoor and outdoor conditions, to determine the minimum time of HVAC system operation needed to satisfy the space environmental requirements. The program shall also determine the earliest possible time to stop the mechanical systems. The optimum start/stop program shall operate in conjunction with, and be coordinated with, the scheduled start/stop and night setback programs.
4. Auto Alarm Lockout: Provide for scheduled and automatic lockout of alarm annunciation from equipment during non-normal operating conditions including shutdown, emergency power operation, fire alarm and the like.

5. Energy Monitoring: Provide software to monitor and totalize consumption as measured by pulse meters.
6. Event Initiated Programs and Custom Logic: Provide software to define custom logic sequences that will reside in the nodes. The definition software will also reside in the node and be accessible via the standard user interface via a browser.
7. System Restart: Upon restoration of the AC power to an HVAC Node, automatically restart all equipment and restore all loads to the state as required by the BAS. Provide appropriate time delays to prevent demand surges or overload trips.
8. Heavy Equipment Delays: The system shall provide protection against excessive demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.
9. Runtime Totalization: Automatically sample, calculate and store runtime hours for binary input and output points as listed in the point schedule of this specification.
10. Analog/Pulse Totalization: Sample, calculate and store consumption totals on a daily, weekly, or monthly basis for user-selected analog and binary pulse input-type points.

2.4 DDC EQUIPMENT

A. Operator Workstation (OWS): PC-based microcomputer with minimum configuration as follows:
1. Motherboard: With integrated USB ports, Ethernet network port, audio, bios, and hardware monitoring.
2. Processor: Minimum Intel Pentium.
3. Random-Access Memory: 4 GB.
4. Graphics: Discrete video adapter, minimum 1600 x 1200 pixels, minimum 512-MB video memory, with TV out.
5. Monitor: Minimum 19 inches (480 mm), LCD color.
6. Keyboard: QWERTY, 105 keys in ergonomic shape.
7. Hard-Disk Drive: Minimum 500 GB.
8. CD-ROM Read/Write Drive.
9. Mouse: Three button, optical.
10. Uninterruptible Power Supply: Minimum of 2 kVa.
11. Operating System: Latest version of Microsoft Windows.
12. Printer: Color, ink-jet type with one set of spare ink cartridges.

B. Web Access Server:
1. Provide a web access server to allow users to observe, access and modify set points, scheduling data, operating conditions, alarms, and reports; and save any changes made to the system.
2. Access shall be allowed via any internet connected computer with a standard web browser when the proper password is given.
3. The system information shall be provided using the same style of graphics used at the main operator interface.

C. Network Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.

1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
   a. Global communications.
   b. Discrete/digital, analog, and pulse I/O.
   c. Monitoring, controlling, or addressing data points.
   d. Software applications, scheduling, and alarm processing.
   e. Testing and developing control algorithms without disrupting field hardware and controlled environment.

D. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
   a. Global communications.
   b. Discrete/digital, analog, and pulse I/O.
   c. Monitoring, controlling, or addressing data points.
3. Local operator interface provides for download from or upload to operator workstation.

E. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
1. Binary Inputs: Allow monitoring of on-off signals without external power.
2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation with three-position (on-off-auto) override switches and status lights.
5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA) with status lights, two-position (auto-manual) switch, and manually adjustable potentiometer.
6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
7. Universal I/Os: Provide software selectable binary or analog outputs.

F. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
1. Output ripple of 5.0 mV maximum peak to peak.
2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

G. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:
   1. Minimum dielectric strength of 1000 V.
   2. Maximum response time of 10 nanoseconds.
   3. Minimum transverse-mode noise attenuation of 65 dB.
   4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

H. Uninterruptible Power Supply (UPS):
   1. Where indicated for supporting operator PCs, servers, and other equipment as indicated, provide a UPS.
   2. UPS shall be sized for 50% spare capacity. The UPS shall be complete with batteries, external bypass and line conditioning.

I. Power Fail / Auto Restart:
   1. Provide for the automatic orderly and predefined shutdown of parts or all of the BAS following total loss of power to parts or all of the BAS.
   2. Provide for the automatic orderly and predefined startup of parts or all of the BAS following total loss of power to those parts or all of the BAS. Archive and annunciate time and details of restoration.
   3. Provide for the orderly and predefined scheduling of controlled return to normal, automatically time scheduled, operation of controlled equipment as a result of the auto restart processes.
   4. Maintain the BAS real-time clock operation during periods of power outage for a minimum of 72 hours.

2.5 UNITARY CONTROLLERS

A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
   1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72-hour battery backup.
   2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform scheduling with real-time clock. Perform automatic system diagnostics; monitor system and report failures.
   3. Enclosure: Dustproof rated for operation at 32 to 120 deg F (0 to 50 deg C).

2.6 ANALOG CONTROLLERS

A. Step Controllers: 6- or 10-stage type, with heavy-duty switching rated to handle loads and operated by electric motor.

B. Electric, Outdoor-Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range minus 10 to plus 70 deg F (minus 23 to plus 21 deg C), and single- or double-pole contacts.

C. Electronic Controllers: Wheatstone-bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.

1. Single controllers can be integral with control motor if provided with accessible control readjustment potentiometer.

D. Fan-Speed Controllers: Solid-state model providing field-adjustable proportional control of motor speed from maximum to minimum of 55 percent and on-off action below minimum fan speed. Controller shall briefly apply full voltage, when motor is started, to rapidly bring motor up to minimum speed. Equip with filtered circuit to eliminate radio interference.

2.7 ELECTRONIC SENSORS

A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

B. Thermistor Temperature Sensors and Transmitters:

1. Accuracy: Plus or minus 0.5 deg F (0.3 deg C) at calibration point.
2. Wire: Twisted, shielded-pair cable.
3. Insertion Elements in Ducts: Single point, 18 inches (460 mm) long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (0.84 sq. m).
4. Averaging Elements in Ducts: 36 inches (915 mm) long, flexible; use where prone to temperature stratification or where ducts are larger than 10 sq. ft. (1 sq. m).
5. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches (64 mm).
6. Room Sensor: Wallbox or surface mounting with the following features where indicated:
   a. Override button.
   b. LCD display for room temperature and setpoint.
   c. Setpoint adjustment device to provide ± 3 degree (adjustable) range.
   d. Color: White unless noted otherwise.
7. Room Security Sensors: Wallbox mounting, stainless-steel cover plate with insulated back and security screws.
8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.

C. RTDs and Transmitters:

1. Accuracy: Plus or minus 0.2 percent at calibration point.
2. Wire: Twisted, shielded-pair cable.
3. Insertion Elements in Ducts: Single point, 18 inches (460 mm) long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (0.84 sq. m).
4. Averaging Elements in Ducts: 24 inches (610 mm) long, rigid; use where prone to temperature stratification or where ducts are larger than 9 sq. ft. (0.84 sq. m); length as required.
5. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches (64 mm).
6. Room Sensor: Wallbox or surface mounting with the following features where indicated:
   a. Override button.

b. LCD display for room temperature and setpoint.
c. Setpoint adjustment device to provide ± 3 degree (adjustable) range.
d. Color: White unless noted otherwise.

7. Room Security Sensors: Wallbox mounting, stainless-steel cover plate with insulated back and security screws.
8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.

D. Humidity Sensors: Bulk polymer sensor element.
1. Accuracy: 5 percent full range with linear output.
2. Room Sensor Range: 20 to 80 percent relative humidity.
3. Room Sensor: Wallbox or surface mounting with the following features where indicated:
a. LCD display for room humidity and setpoint.
b. Color: White unless noted otherwise.
4. Room Security Sensors: Wallbox mounting, stainless-steel cover plate with insulated back and security screws.
5. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.
6. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of 32 to 120 deg F (0 to 50 deg C).
7. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.

E. Pressure Transmitters/Transducers:
1. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
b. Output: 4 to 20 mA.
c. Building Static-Pressure Range: 0- to 0.25-inch wg (0 to 62 Pa).
d. Duct Static-Pressure Range: 0- to 5-inch wg (0 to 1240 Pa).
2. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig (1034-kPa) operating pressure; linear output 4 to 20 mA.
3. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig (1034-kPa) operating pressure and tested to 300-psig (2070-kPa); linear output 4 to 20 mA.
4. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
5. Pressure Transmitters: Direct acting for gas or liquid service; range suitable for system; linear output 4 to 20 mA.

F. Room Sensor: Wallbox or surface mounting with the following features:
1. Color: White unless noted otherwise.

G. Room sensor accessories include the following:
1. Insulating Bases: For sensors located on exterior walls.
2. Guards: Locking; heavy-duty, transparent plastic; mounted on separate base, or metal wire, tamperproof, or locking, solid metal, ventilated as indicated on drawings.
3. Adjusting Key: As required for calibration and cover screws.

H. Water Flow Measuring Sensor:
1. Basis of Design: UniMag DT Series manufactured by Emco Flow Systems or comparable product with prior approval.
2. Electromagnetic flow tube sensor with field replaceable sensors.
3. Display: Remote mount, multi-character LCD display that shows instantaneous flow as well as totalized flow.

2.8 STATUS SENSORS

A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg (0 to 1240 Pa).

B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig (55 to 414 kPa), piped across pump.

C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.

D. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.

E. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.

F. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.

G. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

H. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.

2.9 GAS DETECTION EQUIPMENT

A. Carbon Dioxide Sensor and Transmitter: Single detectors using solid-state infrared sensors; suitable over a temperature range of 23 to 130 deg F (minus 5 to plus 55 deg C) and calibrated for 0 to 2 percent, with continuous or averaged reading, 4- to 20-mA output;, for wall mounting.

B. Occupancy Sensor: Passive infrared, with time delay, daylight sensor lockout, sensitivity control, and 180-degree field of view with vertical sensing adjustment; for flush mounting.

2.10 THERMOSTATS

A. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.

B. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type; with adjustable set point in middle of range, adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.

C. Electric, Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual-reset switch that trips if temperature sensed across any 12 inches (300 mm) of bulb length is equal to or below set point.

1. Bulb Length: Minimum 20 feet (6 m).
2. Quantity: One thermostat for every 20 sq. ft. (2 sq. m) of coil surface.

D. Electric, High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic- reset switch that trips if temperature sensed across any 12 inches (300 mm) of bulb length is equal to or above set point.

1. Bulb Length: Minimum 20 feet (6 m).
2. Quantity: One thermostat for every 20 sq. ft. (2 sq. m) of coil surface.

E. Heating/Cooling Valve-Top Thermostats: Proportional acting for proportional flow, with molded-rubber diaphragm, remote-bulb liquid-filled element, direct and reverse acting at minimum shutoff pressure of 25 psig (172 kPa), and cast housing with position indicator and adjusting knob.

2.11 HUMIDISTATS

A. Duct-Mounting Humidistats: Electric insertion, 2-position type with adjustable, 2 percent throttling range, 20 to 80 percent operating range, and single- or double-pole contacts.

2.12 ACTUATORS

A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.

1. Manufacturer: Belimo Automation AG.
2. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
3. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
4. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running torque of 150 in. x lbf (16.9 N x m) and breakaway torque of 300 in. x lbf (33.9 N x m).
5. Spring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running and breakaway torque of 150 in. x lbf (16.9 N x m).
6. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running torque of 150 in. x lbf (16.9 N x m) and breakaway torque of 300 in. x lbf (33.9 N x m).
7. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running and breakaway torque of 150 in. x lbf (16.9 N x m).

B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
   1. Manufacturer: Belimo Automation AG.
   2. Valves: Size for torque required for valve close off at maximum pump differential pressure.
   3. Dampers: Size for running torque calculated as follows:
      a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. (86.8 kg-cm/sq. m) of damper.
      b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. (62 kg-cm/sq. m) of damper.
      c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft (49.6 kg-cm/sq. m) of damper.
      d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. (37.2 kg-cm/sq. m) of damper.
      e. Dampers with 2- to 3-Inch wg (500 to 750 Pa) of Pressure Drop or Face Velocities of 1000 to 2500 fpm (5 to 13 m/s): Increase running torque by 1.5.
      f. Dampers with 3- to 4-Inch wg (750 to 1000 Pa) of Pressure Drop or Face Velocities of 2500 to 3000 fpm (13 to 15 m/s): Increase running torque by 2.0.
   4. Coupling: V-bolt and V-shaped, toothed cradle.
   5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
   6. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
   7. Power Requirements (Two-Position Spring Return): 24 or 120-V ac.
   8. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
   9. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
   10. Temperature Rating: Minus 22 to plus 122 deg F (Minus 30 to plus 50 deg C).
   11. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F (Minus 30 to plus 121 deg C).
   12. Run Time: 12 seconds open, 5 seconds closed.

2.13 CONTROL VALVES

A. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.

B. Hydronic system globe valves shall have the following characteristics:
   1. NPS 2 (DN 50) and Smaller: Class 125 bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.
   2. NPS 2-1/2 (DN 65) and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
   3. Internal Construction: Replaceable plugs and stainless-steel or brass seats.
      a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom.

b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom.

4. Sizing: 5-psig (35-kPa) maximum pressure drop at design flow rate or the following:
   a. Two Position: Line size.
   b. Two-Way Modulating: Either the value specified above or twice the load pressure drop, whichever is more.
   c. Three-Way Modulating: Twice the load pressure drop, but not more than value specified above.
5. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
6. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for two-way valves and 100 percent of pressure differential across valve or 100 percent of total system (pump) head.

C. Butterfly Valves: 150-psig (1034-kPa) maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.
1. Disc Type: Nickel-plated ductile iron.
2. Sizing: 1-psig (7-kPa) maximum pressure drop at design flow rate.

D. Terminal Unit Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.
1. Rating: Class 125 for service at 125 psig (860 kPa) and 250 deg F (121 deg C) operating conditions.
2. Sizing: 3-psig (21-kPa) maximum pressure drop at design flow rate, to close against pump shutoff head.
3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

2.14 DAMPERS

A. Dampers: AMCA-rated, opposed-blade design; 0.108-inch- (2.8-mm-) minimum thick, galvanized-steel or 0.125-inch- (3.2-mm-) minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch- (1.6-mm-) thick galvanized steel with maximum blade width of 8 inches (200 mm) and length of 48 inches (1220 mm).
1. Secure blades to 1/2-inch- (13-mm-) diameter, zinc-plated axles using zinc-plated hardware, with oil-impregnated sintered bronze blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
2. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).
3. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. (50 L/s per sq. m) of damper area, at differential pressure of 4-inch wg (1000 Pa) when damper is held by torque of 50 in. x lbf (5.6 N x m); when tested according to AMCA 500D.

2.15 CONTROL CABLE

A. Electronic and fiber-optic cables for control wiring are specified in Division 23 Section "Electrical and Control Wiring for Mechanical Systems."

PART 3 - EXECUTION

3.1 ROOM SENSOR APPLICATION SCHEDULE

A. Furnish the room sensor listed below unless indicated otherwise. Install where indicated on the drawings.
   1. Room security sensor: Public areas such as lobbies, corridors, restrooms, etc., where the occupants are transient in nature and not permitted to adjust the room temperature.
   2. Room sensor: Storage rooms, commercial kitchens, back-of-house areas, gymnasiums, shop areas, warehouses, etc. where occupants are transient or not permitted to adjust room setpoints. Provide wire guards where sensors may be exposed to mechanical damage due to activities within the area and as indicated.
   3. Room sensor with display, override button, setpoint adjustment: Private offices, open office areas, meeting rooms, conference rooms, reception areas provided with a reception desk, etc. where occupants are permitted to override the occupied/unoccupied mode, and adjust the room setpoints.

3.2 INSTALLATION

A. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices at an elevation per ADA Requirements.
   1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

B. Install automatic dampers according to Division 23 Section "Air Duct Accessories."

C. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

D. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."

E. Install hydronic instrument wells, valves, and other accessories according to Division 23 Section "Hydronic Piping."

F. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.

G. Install electronic and fiber-optic cables according to Division 23 Section "Electrical and Control Wiring for Mechanical Systems."

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, cabinets building wire, cable, signal and communication cable according to Division 23 Section "Electrical and Control Wiring for Mechanical Systems."
   1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
   2. Install exposed cable in raceway.
   3. Install concealed cable in raceway.
   4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
   5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
   6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
   7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

B. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

C. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust central plant optimization controllers and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:
   1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
   2. Test and adjust controls and safeties.
   3. Test calibration of controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
   4. Test each point through its full operating range to verify that safety and operating control set points are as required.
   5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
   6. Test each system for compliance with sequence of operation.
   7. Test software and hardware interlocks.

C. DDC Verification:
   1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
   2. Check instruments for proper location and accessibility.

3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check instrument tubing for proper fittings, slope, material, and support.
5. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
6. Check temperature instruments and material and length of sensing elements.
7. Check control valves. Verify that they are in correct direction.
8. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
9. Check DDC system as follows:
    a. Verify that DDC controller power supply is from emergency power supply, if applicable.
    b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
    c. Verify that spare I/O capacity has been provided.
    d. Verify that DDC controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.5 COMMISSIONING

A. Commission all functions of the BAS.

B. Acceptance Check Sheet:
1. Prepare a check sheet that includes all points for all functions of the BAS.
2. Submit the check sheet to the Engineer for approval one month prior to testing.
3. Complete the check sheet for all items and functions of the BAS and initial each entry with time/date as record of having fully calibrated and tested the BAS. Submit to Engineer.
4. The Engineer will use the check sheet as the basis for acceptance testing with the BAS Contractor.

C. Provide all necessary specialist labor, materials and tools to demonstrate to the Engineer that the BAS has been commissioned and is operating in compliance with the contract. Prepare a list of noted deficiencies signed by both the Engineer and the BAS Contractor.

D. Promptly rectify all listed deficiencies and submit to the Engineer that this has been done.

3.6 TRAINING

A. The BAS Contractor shall provide the following training services:
1. One eight-hour day of on-site orientation by a system technician who is fully knowledgeable of the specific installation details of the project. This orientation shall, at a minimum, consist of a review of the project as-built drawings, the DDC System software layout and naming conventions, and a walk through of the facility to identify panel and device locations.

2. Factory training for one Owner representatives in a factory training lab. This training shall be performed by a factory-certified professional trainer and, at a minimum, shall consist of:
   a. Two 8-hour days training covering basic system operation.
   b. One 8-hour day training covering system reporting and alarm management.
   c. One 8-hour day training of scheduling and point trending.

- END OF SECTION -

DIVISION 26 – ELECTRICAL

TABLE OF CONTENTS

Pages

EXPIRES: 09/30/15

- SECTION 26 0500 -

GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SCOPE

A. Provisions of this section apply to all work specified in all sections under Division 26.

B. In addition, work in Division 26 is governed by the provisions of the Bidding Requirements, Contract Forms, General Conditions, and all sections under Division 01.

1.3 DEFINITIONS

A. Exposed, not concealed.

B. Finished Spaces: Spaces other than mechanical, electrical, and communication equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and utility tunnels.

C. Exposed, Interior Installations: Exposed to view indoors. Examples include un-finished spaces, mechanical, electrical, and communication equipment rooms.

D. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations and equipment yards.

E. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

F. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

G. Unfinished Space: A room or space that is ordinarily accessible only to building maintenance personnel, a room noted on the "Finish Schedule" with exposed and unpainted construction for walls, floor or ceilings, or specifically mentioned as "unfinished."

1.4 EXAMINATION OF PREMISES

A. Visit the site, verify all measurements and job conditions, and pay all costs necessary to perform the work.

1.5 ELECTRICAL CONTRACTOR

A. The Electrical Contractor shall be licensed and hold a current contracting license that has been valid for a minimum of two years in the State of Arizona as an electrical contractor.

1.6 REGULATIONS, PERMITS, FEES, CHARGES, INSPECTIONS

A. Regulations: Comply with all applicable codes, rules and regulations.

B. Fees and Permits: Pay all connection, installation, use, development, etc., fees and/or charges. Obtain and pay for all required permits and licenses. Refer to Division 01.

C. Inspections: All work must be inspected and approved by local authorities. Prior to final approval, furnish the Architect and Engineer with certificates of inspections and approvals by the local authorities in accordance with Division 01.

1.7 DRAWINGS AND SPECIFICATIONS

A. If a conflict exists on the drawings or between the drawings and specifications, promptly notify the Architect and Engineer.

1.8 SUBMITTALS

A. Submittals are for information and coordination only. The Engineer will diligently review the submittals and attempt to verify compliance with the project requirements. Such review, however, does not constitute approval or disapproval of obligation to comply with all project requirements. The submittals are not to be construed to be contract documents. Any failure by the Engineer to note a point of non-compliance shall not be construed to be acceptance or approval of the discrepancy.

B. Product Information Sheets: Provide manufacturer's literature which includes the information required by the Product Data paragraph of the applicable Specification Section. Where Product Information Sheets show multiple models or options, clearly mark the model and options to be provided.

C. Assembly: Assemble all required submittal information for each specification section and submit in PDF format.

1. Assemble PDF submittals in one PDF file for each Division. Separate and order sections within each file by corresponding specification number. Provide bookmarks at the first page of each section and label each bookmark with the specification number and name to allow for easy navigation of the submittal.
2. Partial submittals will be returned without review.

D. Identification and Information:
   1. Name the PDF file with the Project name, Division number and sequential submittal number. (I.E. The first submittal shall be No. 1, the second submittal shall be No. 2.)
   2. Provide a cover sheet at the front of each submittal with the following information:
      a. Project name.
      b. Date.
      c. Name of Engineer.
      d. Name of Contractor.
      e. Name of subcontractor.
   3. Provide a cover sheet at the front of each submittal section with the following information:
      a. Name of supplier.
      b. Name of manufacturer.
      c. Number and title of appropriate Specification Section.
      d. Drawing number and detail references, as appropriate.
      e. Other necessary identification.

E. Options:
   1. Identify options requiring selection by the Engineer.
   2. Identify options included with submittal item.

F. Deviations: Identify deviations from the Contract Documents on submittals

1.9 MATERIAL SAFETY DATA SHEETS

A. Provide current, Material Safety Data Sheets (MSDS), for all hazardous chemicals that are proposed for use at the project site.
   1. Provide one complete set to the Owner for review and approval a minimum of one week prior to the delivery of any hazardous chemicals to the site.
   2. Maintain a second complete set at the project location, readily accessible by both the Owner's personnel and the contractor's personnel.

1.10 REQUEST FOR INFORMATION

A. Request for Information:
   1. A document submitted by the Contractor requesting clarification of a portion of the Contract Documents, hereinafter referred to as RFI.
   2. A properly prepared request for information shall include a detailed written statement of the clarification, apparent conflict, or information requested that indicates the specific drawings or specification in need of clarification and the nature of the clarification requested.
      a. Drawings shall be identified by drawing number and location on the drawing sheet.
      b. Specifications shall be identified by section number, page, and paragraph.
   3. Include a proposed solution, where appropriate, based upon the field conditions and best knowledge of the Contractor.

B. Improper or Frivolous RFIs: RFIs which are not properly prepared or that request information which is clearly shown in the contract documents will be returned unanswered. Processing time

for multiple submissions of improper or frivolous RFIs will be billed at the Engineer's standard hourly rate to the Owner who may deduct an equal amount from the monies due the Contractor.

1.11 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings, Submittals and Shop Drawings.

1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Include underground and overhead conduit. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
    a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    b. Include dimensions both horizontally and vertically to permanent points of reference accurate within 6 inches. Include descriptors such as "below slab", "above ceiling", etc.
    c. Record data daily or as soon as possible after obtaining it.
    d. Record and check the markup before enclosing concealed installations.
2. Mark the Contract Drawings, Submittals and Shop Drawings completely and accurately. Utilize personnel proficient at recording graphic information in production of marked-up record prints.
3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
4. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints and newly prepared Record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Identification: As follows:
    a. Project name.
    b. Date.
    c. Designation "PROJECT RECORD DRAWINGS."
    d. Name of Engineer.
    e. Name of Contractor.
3. Remove or obscure Engineer's seal from Record Drawings.

C. Building Information Model: Prepare and maintain an up to date building information model throughout the project.

1. Prepare a Building Information Model at the beginning of construction using the latest version of Autodesk REVIT software.
2. Use manufacturer prepared families wherever they are available for the actual equipment used on the project. Include manufacturer's name, model number, serial number, and include links to Operation and Maintenance Information.
3. Update the information contained in the model as the project progresses.

4. Deliver the updated model and all support files to the Owner at the completion of the project.

1.12 OPERATION AND MAINTENANCE MANUAL

A. Prior to completion of the project, compile a complete equipment, operation and maintenance manual for all equipment supplied under Division 26.

B. Schedule:
1. Submit a preliminary copy of the manual not less than 30 days prior to substantial completion for review and comment.
2. Submit the final version the manual not more than four weeks after substantial completion of the project.

C. Format: Submit manuals in both of the following formats:
1. PDF electronic file. Assemble each manual into a composite electronically-indexed file. Submit on digital media acceptable to Engineer.
   a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically-linked operation and maintenance directory.
   b. Enable inserted reviewer comments on draft submittals.
   c. Provide one final copy to Engineer and two copies to Owner.

D. Provide operating and maintenance manuals for all systems, subsystems, and equipment that requires operation and regular maintenance, or has replaceable parts.

E. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, product data, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below. In addition to requirements in this Section, include operation and maintenance data required in individual Specification Sections.

F. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

G. Product Data: Include the following information:
1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Approved submittals.
3. Include the following if not shown on approved submittals:
   a. Product name and model number. Use designations for products indicated on Contract Documents.
   b. Manufacturer's name.
   c. Equipment identification with serial number of each component.
   d. Equipment function.
   e. Operating characteristics.
   f. Limiting conditions.

g. Performance curves.
h. Engineering data and tests.

H. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures. Including precautions against improper use.
10. Operating logs.

I. Wiring Diagrams: Diagram of factory installed wiring including any options as well as any field modifications.

J. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

K. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins.
2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

L. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

M. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

N. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

O. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

P. Licenses: Include copies of any licenses with requirements including inspection and renewal dates.

Q. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1.13 WORK AND MATERIALS

A. Unless otherwise specified, all materials must be new and of the quality specified. The workmanship shall be of a quality that is acceptable to the Architect, Engineer, and Owner, and is equal to the standards of the trades. Contractor must staff the project with sufficient skilled workmen, including a fully qualified construction superintendent, to complete the work in the time allotted. The superintendent must be qualified to supervise all of the work in his work category.

B. Uniformity: Unless otherwise specified, provide all equipment and products of same type or classification by the same manufacturer.

1.14 APPROVALS OF MATERIALS AND EQUIPMENT

A. Refer to Division 01 for description of material and equipment for prior approvals and substitutions.

1.15 COOPERATIVE WORK

A. Correct without charge any work requiring alteration due to lack of proper supervision or failure to make proper provision in time. Correct without charge any damage to adjacent work caused by the alteration. See Division 01 for additional requirements.

B. Cooperative Work Includes:

1. General supervision and responsibility for proper location, rough-in, and size of work related to Division 26 but provided under other divisions of these specifications.
2. Installation of sleeves, inserts and anchors bolts for work under sections in Division 26.

1.16 EXISTING MATERIALS AND EQUIPMENT

A. Disposition: With the exception of items that are to be reused or retained by the Owner, all other materials indicated to be removed shall be removed and disposed of by the Contractor. Items that are indicated to be retained or returned to the Owner and shall be delivered to a storage area designated by the Owner.

B. Unused Materials: All unused raceways, conductors, boxes, equipment, and miscellaneous materials shall be removed by the Contractor except where located within walls, below or above existing construction which is not being altered and would require removal and replacement of this existing construction. All visible raceways, conductors, boxes, equipment, and miscellaneous materials shall be removed and sealed or capped within wall, below floor unless noted otherwise.

C. Exterior Services: The Contractor shall be responsible for maintaining electrical and control service to the existing building during the construction period. Existing services are to be retained until such a time that the new services, if any, are completely installed and ready for

use. Scheduling of service interruptions is to be coordinated with the Architect and Engineer and Owner.

D. Disconnect, demolish, and remove electrical systems, equipment, and components that are indicated to be removed.
   1. Conduit to be Removed: Remove portion of conduit indicated to be removed and cap or plug remaining conduit with same or compatible conduit material. Patch insulation, as required, to match adjacent areas.
   2. Conduit to be Abandoned In Place: Cap or plug conduit with same or compatible conduit material.
   3. Equipment to be Removed: Disconnect services and remove equipment.
   4. Equipment to be Removed and Reinstalled: Disconnect and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
   5. Equipment to be Removed and Salvaged: Disconnect and remove equipment and deliver to Owner.

E. Continuity of Services in Existing Building: Contractor shall permanently reroute existing electrical and control services or provide temporary connection as required to maintain service to existing fixtures in building which are to remain in service.

F. Rerouting and Relocation of Existing Electrical Equipment and Services in Existing Building:
   1. General: Contractor shall reroute, relocate all existing materials which are in conflict with the building alterations and which are required to be maintained in use.
   2. Existing Raceways and Conductors: Where applicable, existing material may be reused in their original location unless otherwise indicated.

G. Testing: All existing services affected by the new construction and which are to remain in operation shall be returned to their original condition. The existing services shall be tested as new, as described in other sections of these specifications. If for any reason these requirements cannot be met, the Contractor shall immediately notify the Architect and Engineer.

1.17 CONSTRUCTION FACILITIES

A. General: Under this division of the specifications, execute all work in a manner to provide safe and lawful ingress and egress to the Owner's establishment and such facilities shall be kept clear of materials or equipment. Refer to Division 01 for additional requirements.

B. Furnish and maintain from the beginning to the completion of all work all lawful and necessary guards, railings, fences, canopies, lights, and warning signs. Take all necessary precautions required by city and state laws to avoid injury or damage to any and all persons and property.

1.18 GUARANTEE

A. Guarantee all material, equipment, installation and workmanship for all sections under Division 26 in writing to be free from defects of material and workmanship for one year from date of final acceptance as outlined in Division 01. Equipment warranties shall be a minimum of two year from date of substantial completion or as specified elsewhere. Replace without charge any material or equipment proving defective during this period. The guarantee shall include performance of the equipment under all conditions of load, installing any additional items of control and/or protective devices as required and the replacing of any refrigerant lost.

1.19 ELECTRICAL WIRING

A. Provide all line voltage power wiring, line voltage interlock wiring, and line voltage control wiring for the equipment that is to be provided under Divisions 21, 22 & 23 unless wiring is specifically shown on electrical drawings.

B. The following schedule is intended to summarize the division of work material responsibilities between the Mechanical Contractor, Controls Contractor and the Electrical Contractor.

Item	Furn. By	Set By	Power Wiring	Control Wiring
Equipment Motors	MC	MC	EC	--
Motor Starters, Controllers, Contactors and Overload Heaters	MC*	EC**	EC	CC
Fused and Non-Fused Disconnect Switches	EC	EC	EC	--
Manual Operating Switches, Multispeed Switches, Pushbutton Stations and Pilot Lights	CC	CC	CC	CC
Control Relays and Transformers	CC	CC	CC	CC
Line Voltage Thermostats and Time Switches***	MC	MC	EC	EC
Low Voltage Thermostats	MC	MC	-	MC
Temperature Control Panels	MC	MC	EC	CC
Smoke Detectors (Duct Mounted)	EC	MC	EC	MC or CC
Motor and Solenoid Valves, Damper Motors, PE and EP Switches	CC	MC	CC	CC
Water Treatment Equipment	MC	MC	EC	CC

MC = Mechanical Contractor
CC = Controls Contractor
EC = Electrical Contractor

*Except where such devices are located in MCC's.

**Unless required by these specifications to be provided as part of a factory furnished assembly (i.e. fan coils, air handlers, chillers, etc.).

***Motor-drive units which are controlled from line voltage automatic controls such as line voltage thermostats, float switches or time switches which conduct full load current of the motor shall be wired for both power and control circuit under the electrical contract.

1.20 CONNECTIONS TO UTILITY SYSTEMS

A. Provide connections to serving utility companies including but not limited to power as indicated on the plans. Contact utility companies and obtain the final design plans. Coordinate equipment, installation, and inspections with the serving utility. The Contractor shall include contact, coordination, inspections, utility company fees and work described on the serving utility design plans as part of the work of this contract.

1.21 CONSTRUCTION FACILITIES

A. General: Under this section of the specifications, execute all work in a manner to provide safe and lawful ingress and egress to the Owner's establishment. Construction facilities shall be kept clear of materials or equipment as directed by the Architect and Engineer.

B. From the beginning to completion, furnish and maintain all lawful and necessary guards, railings, fences, canopies, lights, warning signs, etc. Take all necessary precautions required by city and state laws and OSHA to avoid injury or damage to any persons and property.

C. Temporary toilet facilities are specified and furnished under another section.

PART 2 - PRODUCTS

2.1 CONCRETE

A. Where used for structures to be provided under the contract such as bases, etc., concrete work and associated reinforcing shall be as specified under that Division.

B. See other sections for additional requirements for underground vaults, cable ducts, etc.

2.2 FRAMING CHANNEL

A. The framing channel shall be a cold-rolled, high-quality, carbon steel channel with factory-applied, hot-dipped-after-fabrication finish. Utilize factory-built interconnecting components, mounting straps, connectors, etc., designed for use with the framing channel supplied. Channel nuts shall be spring type and shall utilize standard US threads. Provide heavy zinc paint for field touch-up. B-Line “B” series, Unistrut “P” series, or as accepted by the Architect and Engineer.

2.3 ANCHORS

A. Anchors shall be expandable lead type, as manufactured by Ackerman-Johnson, Pierce, Diamond, Hilti, or as accepted by the Architect and Engineer.

B. Adjustable concrete hanger inserts shall be as manufactured by Grinnell or as accepted by the Architect and Engineer.

PART 3 - EXECUTION

3.1 SUBMITTALS

A. Prepare submittals as directed for review by the Contractor, Owner, [Architect, and Engineer].

B. Submit one copy of PDF submittals via email, project website or other electronic media.

3.2 RECORD DRAWINGS

A. Recording: Post changes and modifications to project record documents as they occur; do not wait until the end of Project.

B. Maintenance of Record Documents and Samples: Store record documents in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Engineer's reference during normal working hours.

3.3 OPERATION AND MAINTENANCE MANUALS

A. Prepare Operation and Maintenance Manuals as directed for review by the Contractor, Owner, Architect, and Engineer.

B. Make corrections and resubmit as required.

3.4 VERIFICATION OF DIMENSIONS

A. Scaled and figured dimensions are approximate only. Before proceeding with work, carefully check and verify dimensions at site, and be responsible for properly fitting equipment and materials together and to the structure in spaces provided.

B. Drawings are diagrammatic and many offsets, bends, special fittings and exact locations are not indicated. Carefully study drawings and premises in order to determine best methods, exact locations, routes, building obstructions, and install apparatus and equipment in available locations. Install apparatus and equipment in manner and in locations to avoid obstructions, preserve headroom, and keep openings and passageways clear.

3.5 CUTTING AND PATCHING

A. Cut work and patch per Division 01 as necessary to properly install the new work. As the work progresses, coordinate necessary openings, holes, chases, etc., in their correct location. If the required openings, holes and chases are not in their correct locations, make the necessary corrections at no cost to the Owner. Avoid excessive cutting and do not cut structural members without the consent of the Architect and Engineer. Include as a part of the work all structural framing required by penetrations through the roof and necessary steel to support ducts and pipes between structural steel unless shown on the structural drawings.

3.6 CLOSING-IN OF UNFINISHED WORK

A. Cover no work until inspected, tested and approved. Where work is covered before inspection and test, uncover it, and when inspected, tested and approved, restore all work to original proper condition.

3.7 EXCAVATION AND BACKFILL

A. Perform all necessary excavation, shoring and backfilling required for the proper laying of all raceways, ducts, and conduits inside the building and premises, and outside as may be necessary. Remove all excess excavated materials from the site or dispose of on site as directed by General Contractor.

B. Excavate all trenches open cut, keep trench banks as nearly vertical as practicable, and sheet and brace trenches where required for stability and safety. Excavate trenches true to line and make bottoms not less than 18" wide but no wider than necessary to provide ample work room. Grade trench bottoms accurately to provide uniform bearing and support for each section of pipe on undisturbed soil along its entire length. Dig "bell" holes after the trench bottom has been graded. Machine grade only to the top line of the raceways, doing the balance by hand. Do not cut any trench near or under footings without first consulting the Architect and Engineer. Comply with OSHA requirements.

C. Provide not less than 4 inches of granular material as pipe bedding prior to laying pipe in trench to continuously support pipe and maintain required slope. Granular material shall be pea gravel or sand per MAG Standards.

D. Provide backfilling and compaction in accordance with provisions of these specifications and under the direction of the Architect and Engineer to the required density.

E. Provide not less than 4 inches of granular material, same as conduit bedding, all around pipe. Make the first 2 feet of fill in 6 inch layers, each thoroughly compacted as directed, and free from rocks, large clods of earth, leaves, branches, and debris. Compact the rest of the backfill as directed, using in the backfill no rocks larger than 4 inches in diameter, and using no rock in the top 12 inches.

3.8 ACCESSIBILITY

A. Install all control devices or other specialties requiring reading, adjustment, inspection, repairs, removal or replacement conveniently and accessibly throughout the finished building. Where any of these devices are shown on the contract drawings to be installed above any inaccessible ceiling or behind any inaccessible wall, the Electrical Contractor shall furnish access doors or panels as required.

B. All access doors or panels in walls and ceilings required for access to control devices, traps, valves and similar devices are to be furnished and installed as part of the work under this section. Provide type as specified under Division 08.

C. Refer to architectural drawings for type of wall and ceiling in each area and for rated construction.

D. Coordinate work of various sections to locate valves, traps, and dampers with others to avoid unnecessary duplication of access doors.

E. The Contractor, along with the Owner's representative, shall complete the Electrical Accessibility/Clearance Checklist at the end of this section for all electrical equipment. The chart shall be submitted to the Architect and Engineer for approval prior to substantial completion. All conflicts shall be resolved to the Architect's, Engineer's, and Owner's satisfaction prior to submission.

F. Provide doors that pierce a fire separation with the same fire rating as the separation.

3.9 ROOF FLASHINGS

A. Flash and counterflash all conduit penetrating roofing membrane with flashing per roofing manufacturer's recommendations. Refer to architectural drawings for detailing of duct and pipe penetrations through roof.

3.10 PRODUCT AND EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. All equipment, detectors, etc., shall be installed in strict conformance with the manufacturer's recommendations and all codes.

B. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

D. Install electrical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations.

E. Do not install any equipment in an application not recommended by the manufacturer.

3.11 EQUIPMENT ROUGH-IN

A. Rough in all equipment and fixtures as designated on the drawings and in the specifications. The drawings indicate only the approximate location of rough-ins. The exact rough-in locations must be determined from large-scale certified drawings. The Contractor shall obtain all certified rough-in information before progressing with any work for rough-in final connections.

B. Be responsible for providing all outlets and services of proper size at the required locations.

C. Minor changes in the contract drawings shall be anticipated and provided for under this Division.
   1. Rough-in only (unless otherwise designated on the drawings) shall include providing all services as indicated and required, including all conduit and conductors. Cap all conduit stub-outs. Cap all conduits stub-outs in a manner suitable for future extension.

3.12 EQUIPMENT FINAL CONNECTIONS

A. Provide all final connections for the following:
   1. All equipment furnished under this Division.
   2. Electrical equipment furnished under other sections of the specifications (except as otherwise designated).

3. Owner-furnished equipment as shown on the drawings.

3.13 OWNER-FURNISHED AND OTHER EQUIPMENT

A. Rough-in only for all Owner-furnished equipment reference Division 01 and all equipment furnished under other sections of the specifications, except as otherwise specified and/or noted on the drawings.

3.14 WIRING OF EQUIPMENT FURNISHED UNDER OTHER SECTIONS

A. All electrical wiring including power wiring and control wiring (except as specified in Divisions 21, 22 & 23), including all raceways, wiring, outlet and junction boxes, and labor for installation of the wiring and equipment, shall be included in this section of the specifications.

B. Wiring diagrams, complete with all connection details, shall be furnished under each respective section.

C. Provide all connections as described per Divisions 21, 22 & 23.

3.15 EQUIPMENT SUPPORTS

A. Erection of Metal Supports and Anchorages:
   1. Refer to Division 05 for structural steel.
   2. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment. Neatly fabricate and erect steel work with burrs and welding spatter ground off. Paint after fabrication with a rust-inhibitive primer.
   3. Field Welding: Comply with AWS D1.1.

B. Erection of Wood Supports and Anchorages:
   1. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support and anchor electrical materials and equipment.
   2. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
   3. Attach to substrates as required to support applied loads.

C. Concrete Inserts: Furnish and install all concrete inserts required for all materials and equipment specified and/or shown on the drawings for Division 26.

D. Concrete Bases: Work under this section includes coordination of construction of all concrete foundations indicated or required for equipment specified under Division 26. Materials and workmanship shall be described under Division 03. Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at project.
   1. Construct concrete bases of dimensions indicated, but not less than 1 inch (25 mm) larger in both directions than supported unit footprint. Where servicing apparatus for draw-out circuit breakers requires a level surface in front of the switchboard or switchgear, coordinate pad front extension so as to allow service to occur using standard apparatus. Where utility meters occur, pads shall conform to the serving utility requirements.

2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extends through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

E. Grouting:
1. Grout under all equipment after leveling, filling completely the space between machinery bed plate and foundation surface as specified in Division 03.
2. Mix and install grout for electrical equipment base bearing surfaces and other equipment base plates, and anchors.
3. Clean surfaces that will come into contact with grout.
4. Provide forms as required for placement of grout.
5. Avoid air entrapment during placement of grout.
6. Place grout, completely filling equipment bases.
7. Place grout on concrete bases and provide smooth bearing surface for equipment.
8. Place grout around anchors.
9. Cure placed grout.
10. Finish exposed surface of grout for a neat appearance.

3.16 CLEANUP

A. In addition to cleanup specified under Division 01, thoroughly clean all parts of the equipment. Where exposed parts are to be painted, thoroughly clean off any splattered construction materials and remove all oil and grease spots. Wipe the surface carefully and scrape out all cracks and corners.

B. During the progress of the work, keep the premises clean and free of debris.

3.17 PAINTING

A. Except as otherwise specified or indicated in the architectural drawings and/or specifications, paint all exposed unfinished metal with one coat of rust-inhibiting primer. Galvanized ductwork and factory painted equipment shall be considered as having primed surface.

B. Damage and Touch-Up: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

C. Finished painting is specified under Division 09.

3.18 OBJECTIONABLE NOISE AND VIBRATION

A. Construct and brace the metal partitions, ducts and sheet metal housings to prevent vibration or rattling when systems are in operation. Install connections to equipment so noise and vibration

will not reach the conditioned area through ducts, conduit, sheet metal work, or the building structure.

3.19 TESTING

A. Upon completion of the electrical work, the entire installation shall be tested and demonstrated to be operating satisfactorily. Tests and documentation shall be in accordance with NETA Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems.

B. Tests, calibrations, and settings shall include the following:
   1. Wiring shall be tested for continuity, short circuits and/or accidental grounds. All systems shall be entirely free from grounds, short circuits, and any or all defects.
   2. Motors shall be operating in proper rotation and control devices shall be functioning properly. Check all motor controllers to determine that properly sized overload devices are installed. Check all electrical equipment for proper operation.
   3. Insulation resistance test for all switchboard buses, bus ducts, motor and feeder conductors, including neutrals, using a megohmeter. Apply to each conductor and maintain for 15 seconds or until reading stabilizes. Minimum value for each conductor shall be 20 megohms at 30 deg C. This test shall be performed by an independent testing company.
   4. Test, calibrate, and set all relays, circuit breaker trip devices, and ground fault protection trip units after receipt of engineered settings. Circuit breaker setups shall be performed or witnessed by a qualified representative of the circuit breaker manufacturer. This representative shall be identified by name and initial related test report(s).
   5. Additional equipment-specific testing is described in the equipment's respective section of this Division.

C. Furnish a written report of testing to the Architect and Engineer. At a minimum, the report shall include:
   1. Testing Contractor's letterhead
   2. Testing technician's name and signature.
   3. Date and time that test was performed.
   4. Ambient temperature and weather conditions.
   5. Test equipment manufacturer, model number, and last calibration date.
   6. The manufacturer, model number, and, as applicable, trip unit model number and available adjustments of tested equipment.
   7. Statement of "As Left" conditions.
   8. Pass/Fail statement relative to NETA Chapter 10 recommendations.
   9. Recommendations if any.

D. The Contractor shall submit the testing schedule to the Architect and Engineer two weeks prior to initiation of testing activity.

E. Upon placing an order for equipment, but in no case less than two weeks prior to energization, provide the following to the Architect and Engineer:
   1. List of circuit breakers supplied on the project. The list shall include manufacturer and model number, trip unit model number, frame rating, trip plug rating, available adjustments, and proposed circuit breaker trip settings. Categorize the submission by plan electrical equipment name (switchboard, panelboard, MCC, etc.), then by frame ampere rating. The Contractor shall implement settings.

2. List of ground fault protection trip units supplied on the project. The list shall include manufacturer and model number, trip unit model number, and available adjustments. Categorize the submission by plan electrical equipment name (switchboard, panelboard, MCC), then by frame ampere rating.

F. Ground fault protection (GFP) trip units shall be calibrated and tested prior to energizing any equipment served by GFP devices.

G. The Contractor shall furnish the necessary instruments and labor required for testing, calibration, and implementation of engineered settings.

H. Tests and adjustments shall be made prior to acceptance of the electrical installation by the Architect and Engineer, and a certificate of inspection and acceptance of the electrical installation shall be provided by local inspection authorities.

I. Any equipment or wiring provided, which through testing proves to be defective or operating improperly, shall be corrected or replaced promptly, at no additional cost to the Owner.

3.20 COORDINATION STUDY

A. The Contractor shall provide an overcurrent and ground-fault device coordination study to determine device types and trip settings, in order to achieve a fully-coordinated electrical power delivery system. Clearly indicate all component equipment/device conflicts that exist based on the study information. Provide recommendations for a fully coordinated system.

B. The study shall include service entrance switchboard main devices and downstream overcurrent and feeder ground fault devices.

C. The study shall be performed by an Engineer registered in the state in which the project is being constructed.

D. Submit a sealed written report inclusive of backup data, graphs, charts, coordination curve overlays, and final settings for each adjustable parameter of each overcurrent and feeder ground fault device.

E. The coordination study shall be completed prior to any affected equipment submittals are prepared for review. Coordinate equipment.

- END OF SECTION -

ELECTRICAL ACCESSIBILITY / CLEARANCE CHECKLIST (See Paragraph 3.8.E)									
Bldg. Name	Equipment Name	Room No.	Acceptable Access		Conflict	Date	Action	Observer	
			Yes	No				Owner	Contractor

- SECTION 26 0501 -

SCOPE OF WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. The work under this Division includes furnishing all labor, material and equipment necessary for the installation and placing into operation of the electrical systems as indicated on the drawings.

B. The work shall also include the completion of such minor details of electrical work not mentioned or shown which are necessary for the successful operation of all electrical systems described on the drawings or required by these specifications.

1.3 SCOPE

A. The work includes, but is not necessarily limited to, furnishing and installing the following:

1. Complete power and lighting systems, service switchboards, distribution switchboards, distribution panelboards, generators and all accessories, transformers, branch circuit panelboards, switches, feeders, branch circuits, lighting fixtures, lamps, controls and accessories.
2. Motor and power wiring for all motors and/or equipment furnished under the contract. Except as otherwise specified to be furnished by or under other Divisions of these specifications, all wiring devices, starter wiring, conduit, feeders, control wiring, accessories and final connections to all equipment shall be furnished under this section.
3. Install controls for all equipment except as specified under automatic temperature control system.
4. All equipment and materials specified in this Division.
5. Empty conduits for connections to the serving utility company. Provide concrete pads, trenching and installation as required by and to the specifications of the serving utility.
6. Empty conduit systems as indicated on the drawings.
7. All other items and/or work indicated on the drawings.
8. Equipment lists and maintenance manuals.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

- END OF SECTION -

- SECTION 26 0502 -

TEMPORARY & REMODELING WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Perform all temporary and remodeling work as shown on the drawings and described in the specifications including minor items of material or equipment necessary to meet the requirements and intent of the project.

B. All temporary and remodeling work shall be considered a part of this contract and no extra charges will be allowed.

C. Examine architectural, structural and mechanical drawings and specifications to determine the sequence of construction throughout the project, including existing, temporary, remodeled and new areas.

D. Where drawings indicate existing conditions, an attempt has been made to show electrical equipment, buildings, site details, etc., but accuracy cannot be guaranteed. Verify exact location of all conduits, outlets, etc. and all building and site details.

E. Branch circuits shall be reused where practical and shall, in addition, be revised as required. Conceal all work where possible. Where exposed work is required in finished areas, use Wiremold or similar raceway system components as approved by the Architect.

F. Existing electrical wiring intended to remain in use but which will be disturbed due to construction changes required by this contract shall be restored to operating condition, as required and/or directed. Where required, shown and/or directed, outlets and conduit runs shall be relocated. In some cases it may be necessary to extend conduits and pull in new wiring or install junction boxes and splice in new wiring, or replace old wiring with new.

G. Outlets from which lighting fixtures, switches, receptacles, and/or other electrical devices are removed and are not intended to be reused shall be removed or, if it is not possible to remove, place a blank cover on the outlet box. Where outlets, boxes, etc., are completely removed, the Contractor shall cut off conduits and remove wiring.

H. Where conduits extending through floors are to be abandoned, the Contractor shall cut and cap or plug conduit, so that it will not protrude above the floor.

I. Where existing conduit is to be abandoned, the conduit shall be removed if it is exposed, in a crawl space or in an accessible ceiling. Where it is impossible to remove the conduit, it shall be cut off and capped or plugged.

J. The Contractor shall be held fully responsible for the proper restoration of all existing surfaces requiring patching, plastering, painting and/or other repair due to the installation of electrical work under the terms of this specification. Close all openings, repair all surfaces, etc., as required.

K. The Contractor shall employ qualified and experienced workmen for this work. All restoration work shall be subject to the approval of the Architect and/or the Owner.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

- END OF SECTION -

- SECTION 26 0519 -

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS & CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

B. Related Documents:
1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

C. Related Sections:
1. Section 07 84 00 - Firestopping
2. Section 26 05 00 – General Provisions
3. Section 26 05 53 - Identification for the Electrical Systems

1.3 SUBMITTALS

A. Submit “Letter of Conformance” in accordance with Section 01 33 00 indicating specified items selected for use in Project with the following supporting data:
1. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.4 QUALITY ASSURANCE

A. Listing and Labeling: Provide wires and cables specified in this Section that are listed and labeled.
1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

B. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver wires and cables according to NEMA WC 26.

1.6 COORDINATION

A. Coordinate layout and installation of cables with other installations.

B. Revise locations and elevations from those indicated, as required to suit field conditions and as approved by Owner representative.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Avendra, LLC Preferred Manufacturers:
   1. Wires and Cables:
      a. None.
   2. Connectors for Wires and Cables:
      a. None.

B. Approved Manufacturers:
   1. Wires and Cables:
      a. American Insulated Wire Corp.; Leviton Manufacturing Co. (800-366-2492)
      b. Carol Cable Co., Inc. (401-728-7000)
      c. Southwire Company (800-444-1700)
      d. Alcan Cable Division of Alcan Aluminum Corporation (770-392-2368)
   2. Connectors for Wires and Cables:
      a. AMP Incorporated (800-522-6752)
      b. General Signal; O-Z/Gedney Unit (203-584-0571)
      c. Square D Co.; a Division of Groupe Schneider (888-778-2733)
      d. Alcan Cable Division of Alcan Aluminum Corporation (770-392-2368)

2.2 BUILDING WIRES AND CABLES

A. UL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as specified in Part 3 "Wire and Insulation Applications" Article.

B. Rubber Insulation Material: Comply with NEMA WC 70.

C. Thermoplastic Insulation Material: Comply with NEMA WC 70.

D. Cross-Linked Polyethylene Insulation Material: Comply with NEMA WC 70.

E. Ethylene Propylene Rubber Insulation Material: Comply with NEMA WC 70.

F. Conductor Material: Copper
   1. Feeders 100 ampere or greater may be aluminum "Alcan Stabiloy #8000", or approved substitution by listed manufacturers.

G. Stranding: Solid conductor for No. 10 AWG and smaller; stranded conductor for larger than No. 10 AWG.

H. Multiconductor Cable: Metal-clad cable, Type MCI.

2.3 CONNECTORS AND SPLICES

A. UL-listed, factory-fabricated wiring connectors of size, ampacity rating, material, type, and class for application and service indicated. Comply with Project's installation requirements and as specified in Part 3 "Wire and Insulation Applications" Article.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine raceways and building finishes to receive wires and cables for compliance with requirements for installation tolerances and other conditions affecting performance of wires and cables. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 WIRE AND INSULATION APPLICATIONS

A. Service Entrance: Type RHW or THWN, in raceway.

B. Horizontal Feeders: Type THHN/THWN, in raceway.

C. Vertical Feeders: Type THHN/THWW in raceway or type MC cable.

D. Fire-Pump Feeder: Type MI, 3-conductor.

E. Horizontal Branch Circuits: Type THHN/THWN, in raceway.

F. Vertical Branch Circuits: Type THNN/THWW in raceway or Type MC Cable

G. Fire alarm Circuits: Power-limited, fire-protective, signaling circuit cable.

H. Fire Alarm Circuits: Type THHN/THWN, in raceway.

I. Class 1 Control Circuits: Type THHN/THWN, in raceway.

J. Class 2 Control Circuits: Power-limited tray cable, in cable tray.

K. Class 2 Control Circuits: Power-limited cable, concealed in building finishes.

L. Class 2 Control Circuits: Type THHN/THWN, in raceway.

3.3 INSTALLATION

A. Install wires and cables as indicated, according to manufacturer's written instructions and NECA's "Standard of Installation."

B. Pull Conductors: Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables, parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Section 26 05 00 - "Common Work Results for Electrical."

F. Seal around cables penetrating fire-rated elements according to Section 07 84 00 (07840) "Firestopping."

G. Identify wires and cables according to Section 26 05 53 "Identification for Electrical Systems."

3.4 CONNECTIONS

A. Conductor Splices: Keep to minimum.

B. Install splices and tapes that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.

C. Use splice and tap connectors compatible with conductor material.

D. Use oxide inhibitor in each splice and tap connector for aluminum conductors.

E. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

F. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer.

G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

A. Testing: On installation of wires and cables and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.

B. Correct malfunctioning conductors and cables at Project site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

- END OF SECTION -

- SECTION 26 0520 -

LOW-VOLTAGE OPEN WIRING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. The extent of low voltage open wiring is indicated on the drawings, schedules, and contract documents.

B. Types of low voltage open wiring specified in this Section apply to the following:
   1. Access control systems.
   2. Building management systems.
   3. CCTV systems.
   4. Fire alarm systems.
   5. HVAC/temperature control wiring.
   6. Paging/sound systems.
   7. Security systems.

C. The drawings illustrate the work specified and are intended to agree in every respect with one another and with these specifications.

D. All discrepancies that appear shall be brought to the attention of the Engineer for correction. No omission from any drawing shall release the Contractor from furnishing equipment, materials, or services called for by the specifications or other drawings.

1.3 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in the manufacture of low voltage open wiring components of the types as specified herein and on the drawings, whose products have been in satisfactory use in similar service for not less than five years.

B. NEC Compliance: Comply with NEC Articles 300, 640, 720, 725, 760, 770, and 800, national, state, and local codes as applicable to wiring methods, construction, and installation of low voltage open wiring systems.

C. NFPA Compliance: Comply with NFPA, national, state, and local codes as applicable to wiring methods, construction, and installation of low voltage open wiring systems.

D. UL Compliance: Comply with applicable requirements of UL Standard 83 “Thermoplastic-Insulated Wires and Cables” and Standard 486A “Wire Connectors and Soldering Lugs for Use with Copper Conductors.”

E. Provide wiring/cabling and connector products which are ETL or UL listed and labeled.

F. NEMA/ICEA Compliance: Comply with NEMA/ICEA Standard Publication Numbers WC-5 and WC-30, pertaining to electrical type wires and cables.

G. IEEE Compliance: Comply with applicable requirements pertaining to low voltage open wiring systems.

PART 2 - PRODUCTS

2.1 GENERAL

A. Components shall be of the latest type and design manufactured for the intended use, and shall be laid out and installed such as to afford easy maintenance and/or replacement without major disassembly of adjacent components.

B. Any deviations from the products contained in these specifications shall be noted and shall be bid as an alternate, with deducts specified.

2.2 CABLES

A. All cables shall be in accordance with the applicable system manufacturer's specifications.

B. Plenum-rated cables shall be used in plenum-rated ceiling spaces.

C. Factory “shorts,” scrap, or warehouse and prior project leftovers, will not be acceptable.

D. The outer jacket of the cable shall be printed with the manufacturer's identification and required UL markings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Whenever possible, primary cable routing paths shall follow the logical structure of the building. All cable servicing an area shall be routed parallel and perpendicular to the building structure, following corridors and hallways. Diagonal runs are not acceptable.

B. Where a wall must be breached, the cable shall pass through pre-established metal conduit sleeved openings.

C. Corridor crossovers should be kept to a minimum.

D. All non-plenum-rated cables must be routed in conduits through “return air plenum” spaces.

E. It is the responsibility of the Contractor to verify “non-plenum” rating requirements.

F. Cable that is run open above a suspended ceiling shall be supported by either a cable tray, channel, or hangers, as accepted. Do not lay low voltage open wire cables in the joist or on ductwork, piping and plumbing systems, or on top of the lay-in ceiling tiles.

G. Cable shall be routed above the bottom of all metal framing such as floor joists or trusses for the next floor or roof above.

H. Cables shall be supported by rings and bails and shall be neatly bunched, bundled and tied together, and routed above the bottom of the joist, with supports mounted from the bar joist or truss.

I. Cables shall not be supported from ductwork, piping, plumbing systems, ceiling tile and lighting fixture suspension wires, or building structure.

J. Low voltage open wiring shall not be routed in or through data/telecommunication or other cabling raceways, conduits, cable trays, sleeves, etc. The Contractor shall provide a dedicated raceway system for this system installation, unless noted otherwise.

K. Cables and wiring routed above an accessible ceiling may be run as “open wiring,” unless noted otherwise.

L. Cables and wiring routed through open ceiling commercial/industrial spaces shall be routed in conduit, enclosed wireway, or cable tray, unless noted otherwise.

M. All low voltage wiring exposed below the bottom of the joist line shall be enclosed in conduit or other raceway system.

N. Maximum allowable spacing between cable/wiring supports (rings, bails, etc.) shall be 60".

O. Plenum-rated cable ties and cable supports must be utilized in all plenum-rated spaces. Electrical tape is not acceptable as a cable tie, and cable ties are not acceptable as cable supports.

P. All cables shall be free of tension at both ends, as well as over the entire length of the run.

Q. Cable ties and supports shall not pinch, bind, crimp, or in any way cause physical or electrical characteristic damage to the cabling.

R. The Contractor shall assure that during and upon completion of the installation, all cables are free of kinks, sharp bends, twists, gouges, cuts, or any other physical damage.

S. For those locations where cables pass through metal studs, the Contractor shall install a bushing or grommet in all metal studs to prevent damage to the cables.

T. Cables routed above non-accessible ceiling areas, or in open areas subject to abuse, shall be routed in conduit or other suitable raceway, subject to acceptance by the Architect.

U. Cables shall be routed and supported away from building structure and system components, with a minimum clearance of 3".

- END OF SECTION -

- SECTION 26 0526 -

GROUNDING & BONDING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Grounding of Electrical Systems and Equipment.
      a. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

B. Related Sections:
   1. Section 26 05 19 - Low Voltage Electrical Power Conductors and Cables.
   2. Section 26 41 13 - Lightning Protection for Structures: For additional grounding and bonding materials.
   3. Section 32 90 00 - Planting.

1.3 SUBMITTALS

A. Submit “Letter of Conformance” in accordance with Section 01 33 00 indicating specified items selected for use in Project with the following supporting data:
   1. Product Data: For the following:
      a. Ground rods.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
   1. Comply with UL 467.

B. Comply with NFPA 70; for overhead-line construction and medium-voltage underground construction, comply with IEEE C2.

C. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Avendra, LLC Preferred Manufacturers:
   1. None.

B. Approved Manufacturers:
   1. Grounding Conductors, Cables, Connectors, and Rods:
      a. Chance/Hubbell (573-682-5521)
      b. Copperweld Corp. (931-433-7177)
      c. Thomas & Betts, Electrical (800-816-7809)

2.2 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Section 26 05 19 - "Low-Voltage Electrical Power Conductors and Cables."

B. Material: Aluminum, copper-clad aluminum, and copper.

C. Equipment Grounding Conductors: Insulated with green-colored insulation.

D. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.

E. Grounding Electrode Conductors: Stranded cable.

F. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.

G. Bare Copper Conductors: Comply with the following:
   1. Solid Conductors: ASTM B3.
   2. Assembly of Stranded Conductors: ASTM B8.
   3. Tinned Conductors: ASTM B33.

H. Copper Bonding Conductors: As follows:
   1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in diameter.
   2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
   3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
   4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

I. Ground Conductor and Conductor Protector for Wood Poles: As follows:

1. No. 4 AWG minimum, soft-drawn copper conductor.
2. Conductor Protector: Half-round PVC or wood molding. If wood, use pressure-treated fir, or cypress or cedar.

J. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.

K. Equipment Ground Conductor (Green) shall be included with all circuit conductors. In addition, provide a neutral conductor where applicable.

2.3 CONNECTOR PRODUCTS

A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.

B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.

C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

2.4 GROUNDING ELECTRODES

A. Ground Rods: copper-clad steel.
1. Size: 120” long by 3/4” in diameter.

PART 3 - EXECUTION

3.1 APPLICATION

A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.

B. In raceways, use insulated equipment grounding conductors.

C. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells.

D. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.

E. Ground Rod Clamps at Test Wells: Use bolted pressure clamps with at least two bolts.

F. Grounding Bus: Install in electrical and telecommunication equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
1. Use insulated spacer; space 1 inch from wall and support from wall 6 inches above finished floor, unless otherwise indicated.
2. At doors, route the bus up to the top of the door frame, across the top of the doorway, and down to the specified height above the floor.

3.2 EQUIPMENT GROUNDING CONDUCTORS

A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

B. Install equipment grounding conductors in all feeders and circuits.

C. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate equipment grounding conductor. Isolate equipment grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

D. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

E. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.

F. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus.
2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

G. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a grounding electrode in addition to installing a separate equipment grounding conductor with supply branch-circuit conductors.

H. Common Ground Bonding with Lightning Protection System: Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

3.3 COUNTERPOISE

A. Ground the steel framework of the building with a driven ground rod at the base of every corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart. Provide a grounding conductor (counterpoise), electrically connected to each ground rod and to each steel column, extending around the perimeter of the building. Use tinned-copper conductor not less than No. 2/0 AWG for counterpoise and for tap to building steel. Bury counterpoise not less than 18 inches below grade and 24 inches from building foundation.

3.4 INSTALLATION

A. Ground Rods: Install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes.

1. Drive ground rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.

B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

C. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

D. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

E. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.

F. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.

G. Install one test well for each service at the ground rod electrically closest to the service entrance. Set top of well flush with finished grade or floor.

3.5 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

D. Non-contact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding

bus or terminal in housing. Bond electrically non-continuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

E. Connections at Test Wells: Use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and ground rods.

F. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A .

G. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

H. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.6 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

A. Manholes and Handholes: Install a driven ground rod close to wall and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide a No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

B. Connections to Manhole Components: Connect exposed-metal parts, such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

C. Pad-Mounted Transformers and Switches: Install two ground rods and counterpoise circling pad. Ground pad-mounted equipment and non-current-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Use tinned-copper conductor not less than No. 2 AWG for counterpoise and for taps to equipment ground pad. Bury counterpoise not less than 18 inches below grade and 6 inches from the foundation.

3.7 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:

1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing

natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 81.

3. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
   a. Equipment Rated 500 kVA and Less: 10 ohms.
   b. Equipment Rated 500 to 1000 kVA: 5 ohms.
   c. Equipment Rated More Than 1000 kVA: 3 ohms.
   d. Substations and Pad-Mounted Switching Equipment: 5 ohms.
   e. Manhole Grounds: 10 ohms.
4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Owner representative promptly and include recommendations to reduce ground resistance.

3.8 GRADING AND PLANTING

A. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Comply with Section 32 90 00 (02900) - "Planting." Maintain restored surfaces. Restore disturbed paving as indicated.

- END OF SECTION -

- SECTION 26 0533 -

RACEWAY & BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Raceways include the following:
      a. RMC.
      b. PVC, Schedule 40 or 80.
      c. EMT.
      d. FMC.
      e. LFMC.
      f. LFNC.
      g. RNC.
      h. Wireways.
      i. Surface raceways.
   2. Boxes, enclosures, and cabinets include the following:
      a. Device boxes.
      b. Floor boxes.
      c. Outlet boxes.
      d. Pull and junction boxes.
      e. Cabinets and hinged-cover enclosures.

B. Related Sections:
   1. Section 01 81 13 - Sustainable Design Requirements
   2. Section 07 84 00 (07840) - Firestopping.
   3. Section 26 05 00 (16050) - Common Work Results for Electrical: For raceways and box supports.
   4. Section 26 27 26 (16140) - Wiring Devices: For devices installed in boxes and for floor-box service fittings.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. FMC: Flexible metal conduit.

C. IMC: Intermediate metal conduit.

D. LFMC: Liquidtight flexible metal conduit.

E. LFNC: Liquidtight flexible nonmetallic conduit.

F. RMC: Rigid metal conduit.

G. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

B. Submit “Letter of Conformance” in accordance with Section 01 33 00 indicating specified items selected for use in project with the following supporting data.

1. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.5 QUALITY ASSURANCE

A. Comply with NFPA 70 "National Electric Code".

B. Listing and Labeling: Provide raceways and boxes specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in NFPA 70, "National Electric Code" Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.
3. Comply with NECA 111 “Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC) (ANSI)”

1.6 COORDINATION

A. Coordinate layout and installation of raceways and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved Manufacturers:
1. Metal Conduit and Tubing:
   a. Anixter Brothers, Inc. (800-323-8166)
   b. Carol Cable Co., Inc. (401-728-7000)
   c. Wheatland Tube Co. (800-257-8128)
2. Flexible Conduit:
   a. Carol Cable Co., Inc. (401-728-7000)
   b. Electri-Flex Co. (800-323-6174)
3. Nonmetallic Conduit and Tubing:
   a. Hubbell, Inc.; Raco, Inc. (800-722-6437)
   b. Lamson & Sessions; Carlon Electrical Products (800-322-7566)
   c. Thomas & Betts Corp. (800-816-7809)
4. Conduit Bodies and Fittings:
   a. Emerson Electric Co.; Appleton Electric Co. (800-727-5102)
   b. Hubbell, Inc.; Killark Electric Manufacturing Co. (314-531-0460)
   c. Lamson & Sessions; Carlon Electrical Products (800-322-7566)
5. Metal Wireways:
   a. Hoffman Engineering Co. (203-425-8900)
   b. Keystone/Rees, Inc. (219-495-9811)
   c. Square D Co.; a Division of Groupe Schneider (888-778-2733)
6. Nonmetallic Wireways:
   a. Hoffman Engineering Co. (203-425-8900)
   b. Lamson & Sessions; Carlon Electrical Products (800-322-7566)
7. Surface Metal Raceways:
   a. Airey-Thompson Co., Inc.; A-T Power Systems (800-421-6196)
   b. Butler Manufacturing Co.; Walker Division (304-485-1611)
   c. Wiremold Co. (The); Electrical Sales Division (800-621-0049)
8. Surface Nonmetallic Raceways:
   a. Hubbell, Inc.; Wiring Device Division (203-882-4900)
   b. Panduit Corp. (800-777-3300)
   c. Wiremold Co. (The); Electrical Sales Division (800-621-0049)
9. Boxes, Enclosures, and Cabinets:
   a. Hoffman Engineering Co.; Federal-Hoffman, Inc. (203-425-8900)
   b. Hubbell Inc.; Killark Electric Manufacturing Co. (314-531-0460)
   c. Thomas & Betts Corp. (800-816-7809)

2.2 METAL CONDUIT AND TUBING

A. Rigid Steel Conduit: ANSI C80.1.

B. Plastic-Coated Steel Conduit and Fittings: NEMA RN 1.

C. EMT and Fittings: ANSI C80.3.
1. Fittings: Set-screw or compression type.

D. FMC: Zinc-coated steel.

E. LFMC: Flexible steel conduit with PVC jacket.

F. Fittings: NEMA FB 1; compatible with conduit/tubing materials.

2.3 NONMETALLIC CONDUIT AND TUBING

A. RNC: NEMA TC 2, Schedule 40 or 80 PVC.

B. RNC Fittings: NEMA TC 3; match to conduit or conduit/tubing type and material.

C. LFNC: UL 1660.

2.4 METAL WIREWAYS

A. Material: Sheet metal sized and shaped as indicated.

B. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

C. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

D. Wireway Covers: As indicated

E. Finish: Manufacturer's standard enamel finish.

2.5 NONMETALLIC WIREWAYS

A. Description: PVC plastic, extruded and fabricated to size and shape indicated, with snap-on cover and mechanically coupled connections using plastic fasteners.

B. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

C. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

2.6 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating.

B. Surface Nonmetallic Raceways: 2-piece construction, manufactured of rigid PVC compound with matte texture and manufacturer's standard color.

C. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

2.7 OUTLET AND DEVICE BOXES

A. Sheet Metal Boxes: NEMA OS 1.

2.8 FLOOR BOXES

A. Floor Boxes: Cast metal, fully adjustable, rectangular.

2.9 PULL AND JUNCTION BOXES

A. Small Sheet Metal Boxes: NEMA OS 1.

B. Cast-Metal Boxes: NEMA FB 1, cast aluminum with gasketed cover.

2.10 ENCLOSURES AND CABINETS

A. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.

B. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage, and include accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of raceway installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 WIRING METHODS

A. Outdoors: Use the following wiring methods:
1.
2. Exposed: Rigid steel.
3. Concealed: Rigid steel.
4. Underground, Single Run: RNC.

5. Underground, Grouped: RNC.
6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
7. Boxes and Enclosures: NEMA 250, Type 3R or Type 4.

B. Indoors: Use the following wiring methods:
1. Exposed on ceilings and wall in Mechanical Equipment Rooms galvanized rigid steel conduit.
2. Concealed in spaces above hung ceiling and wall: Electrical Metallic Tubing (EMT).
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except in wet or damp locations, use LFMC.
4. Damp or Wet Locations: Rigid steel conduit.
5. Boxes and Enclosures: NEMA 250, Type 1, except as follows:
a. Damp or Wet Locations: NEMA 250, Type 4, stainless steel.

C. Underground or concrete encased:
1. Schedule 40 PVC.

3.3 INSTALLATION – GENERAL

A. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions.

B. Do not install aluminum conduits embedded in or in contact with concrete.

C. Set floor boxes level and adjust to finished floor surface.

D. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

E. Size all conduits supplying motors and associated control equipment to include equipment grounding conductor sized per NFPA 70 whether or not shown on the drawings or specified.

F. Unless otherwise noted, terminate all conduits stubbing up inside rooms or roof as follows:
1. Conduits for AC power: Stub up 6” above finished floor and provide concrete sill to protect stub-ups.
2. On PVC conduit for AC power and control cable, provide PVC to galvanized steel rigid conduit adaptor.
3. Plug or cap all conduits during construction or until permanent conductors are installed. Taped ends will not be allowed.

G. In exposed conduit runs longer than 300 feet, expansion fittings shall be installed. Where embedded conduit crosses a structural expansion joint, expansion and deflection fitting shall be installed.

H. Tighten set screws of threadless fittings with suitable tools.

I. Complete raceway installation before starting conductor installation.

3.4 INSTALLATION - RACEWAYS

A. Minimum Raceway Size: 3/4-inch trade size (DN21).

B. Conceal conduit and EMT, unless otherwise indicated, within finished walls, ceilings, and floors.

C. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

D. Install raceways level and square and at proper elevations. Provide adequate headroom.

E. Support raceways as specified in Section 26 05 00 (16050) - "Basic Electrical Materials and Methods."

F. Use temporary closures to prevent foreign matter from entering raceways.

G. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above the finished slab.

H. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.

I. Use raceway fittings compatible with raceways and suitable for use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings, unless otherwise indicated.

J. Run concealed raceways, with a minimum of bends, in the shortest practical distance considering the type of building construction and obstructions, unless otherwise indicated.

K. Raceways Embedded in Slabs: Install in middle third of slab thickness where practical, and leave at least 1-inch concrete cover.
   1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
   2. Space raceways laterally to prevent voids in concrete.
   3. Run conduit larger than 1-inch trade size (DN27) parallel to or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
   4. Transition from nonmetallic tubing to Schedule 80 nonmetallic conduit or rigid steel conduit, before rising above floor.

L. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow the surface contours as much as practical.
   1. Run parallel or banked raceways together, on common supports where practical.
   2. Make bends in parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.

M. Join raceways with fittings designed and approved for the purpose and make joints tight.
   1. Make raceway terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.
   2. Use insulating bushings to protect conductors.

N. Terminations: Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against the box. Where terminations are not secure with 1 locknut, use 2 locknuts: 1 inside and 1 outside the box.

O. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align raceways so the coupling is square to the box and tighten the chase nipple so no threads are exposed.

P. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of the pull wire.

Q. Telephone and Signal System Raceways, 2-Inch Trade Size (DN53) and Smaller: In addition to the above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

3.5 SURFACE RACEWAYS

A. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying the raceways to receptacle or fixture ground terminals.
   1. Select each surface raceway outlet box, to which a lighting fixture is attached, of sufficient diameter to provide a seat for the fixture canopy.
   2. Where a surface raceway is used to supply a fluorescent lighting fixture having central-stem suspension with a back plate and a canopy (with or without extension ring), no separate outlet box is required.
   3. Provide surface metal raceway outlet box, and the back plate and canopy, at the feed-in location of each fluorescent lighting fixture having end-stem suspension.
   4. Where a surface metal raceway extension is made from an existing outlet box on which a lighting fixture is installed, no additional surface-mounted outlet box is required. Provide a back plate slightly smaller than the fixture canopy.

3.6 INSTALLATION - ACCESSORIES

A. Install raceway sealing fittings according to manufacturer's written instructions. Locate fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
   1. Where conduits pass from warm to cold locations, such as the boundaries of refrigerated spaces.
   2. Where otherwise required by NFPA 70.

B. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches above the floor. Install screwdriver-operated, threaded flush plugs flush with floor for future equipment connections.

C. Flexible Connections: Use maximum of 6 feet of flexible conduit for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquidtight flexible conduit in wet or damp locations. Install separate ground conductor across flexible connections.

D. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.

3.7 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure coatings, finishes, and cabinets are without damage or deterioration at the time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.8 CLEANING

A. On completion of installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

- END OF SECTION -

- SECTION 26 0543 -

UNDERGROUND DUCTS & RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Furnish and install multi-cell conduit as shown on the drawings and as specified herein.

PART 2 - PRODUCTS

2.1 CONDUIT

A. Multi-Cell conduit system shall be a standard ‘C’ size 4.350" nominal outer diameter shell with four interior cells with 1.194" nominal interior dimension and .063" nominal wall dimension. Carlon #Multi-gard MX-4 Way. Provide conduit system with 6" bell end housings with anti-reversing gaskets.

B. Multi-Cell conduit individual cells shall be smooth interior. Utilize prelubricated nylon pull cord throughout the system. If, because of document requirements, construction coordination, a larger radius conduit bend or sweep is required, the Contractor shall so furnish without further cost to the Owner. Rigid bends shall be Carlon #Multi-gard MX-4 Way with 4' radius minimum and degrees of bend as required. Flexible bends shall be Carlon #Multi-gard MX-4 Way with 4' radius minimum and degrees of bend as required.

C. The conduit shall conform to GTS-8343, NEMA TC-10 and Bellcore CAO-8546 standards. Nominal conduit system lengths shall be 20'. Provide the UL listing number on each section of conduit.

D. The Contractor shall be entirely responsible for the proper protection of this work from the other trades on the job. When conduit becomes bent, holes are punched through same or outlets moved after being roughed-in, the Contractor shall replace same, without additional cost to the Owner.

E. Each length of conduit shall be stamped with the name or trademark of the manufacturer and shall bear the UL label.

F. Conduit shall be as manufactured by Carlon or as prior approved. No substitutions will be allowed unless prior approved.

G. Rigid Galvanized outer shell shall be used in explosion-proof areas, for all conduits above grade or where rigid galvanized steel is specified.

H. All underground installation conditions shall utilize an outer shell consisting of PVC Schedule 40.

I. Utilize accessories as required. These shall include, but not limited to coupling kit, slip coupling kit, manhole terminator kit, line blowing kit, cable lubrication point and repair kit.

J. All multi-cell conduit joints shall be made up in accordance with the manufacturer's recommendations for the particular conduit and coupling selected. Conduit joint couplings shall be made watertight.

K. All underground multi-cell conduits shall be concrete encased unless noted otherwise. Each conduit shall be completely encased in sand not less than 3" all around. Separators or spacing blocks shall be made of plastic or other suitable nonmetallic, non-decaying material placed on not greater than 5 foot centers. Ducts shall be anchored to prevent movement during placement of sand.

L. Plastic conduit shall be stored on a flat surface and protected from the direct rays of the sun.

M. Conduit shall be continuous from outlet to outlet, cabinet or junction box, and shall be so arranged that wire may be pulled in with the minimum practical number of junction boxes.

N. All raceways which are not embedded in sand shall be supported by straps, clamps, or hangers to provide a rigid installation. Exposed conduit shall be run in straight lines at right angles to or parallel with walls, beams, or columns. In no case shall conduit be supported or fastened to other pipes or installed to prevent the ready removal of other pipe.

O. It shall be the responsibility of the Contractor to consult the other trades before installing conduit. Any conflict between the location of conduit and boxes, piping, ductwork, or structural steel supports shall be adjusted before installation. In general, large pipe mains, waste, drain, and steam lines which pitch, large air ducts, and all structural steel shall be given priority.

P. All empty conduits shall be provided with nylon pull cord.

Q. The ends of all conduits shall be securely plugged, and all non-installed conduits temporarily covered to prevent foreign material from entering the conduits. All conduit shall be kept clean throughout the installation process. The conduit is specified as prelubricated; therefore, conduit shall be replaced if conduit is contaminated with debris.

R. Supports: Conduits shall be supported at intervals no greater than 8 feet, within 3 feet of any bend, and within 3 feet of every outlet or junction box, panel, etc. This shall apply to vertical runs as well as horizontal runs. Where conduits are run individually, they shall be supported by approved conduit straps or beam clamps. Straps shall be secured by means of toggle bolts on hollow masonry; expansion shields and machine screws or standard preset inserts on concrete or solid masonry, machine screws or bolts on metal surfaces, and wood screws on wood construction. No perforated straps or wire hangers of any kind will be permitted. Where individual conduits are suspended from the ceiling, or above ceiling, they shall be supported by hanger rods and hangers. Conduits installed exposed in damp locations shall be provided with

clamp backs under each conduit clamp, to prevent accumulation of moisture around the conduits. Where a number of conduits are to be run exposed and parallel, one with another, they shall be grouped and supported by trapeze hangers. Hanger rods shall be fastened to structural steel members with suitable beam clamps or to concrete inserts set through the opening provided in the concrete inserts. Beams clamps shall be suitable for structural members and conditions. Rods shall be galvanized steel 3/8" diameter minimum. Each conduit shall be clamped to the trapeze hanger with conduit clamps. In no case shall conduits be supported by the ceiling system support hangers or by caddy clips attached to the T-bar ceiling system.

S. All concrete inserts and pipe clamps shall be galvanized. All steel bolts, nuts, washers, and screw shall be galvanized or cadmium plated. Individual hangers, trapeze hangers and rods shall be prime-coated.

PART 3 - EXECUTION

3.1 CONDUIT

A. Applications:

1. PVC conduit may be used for all exterior underground systems, in slab, below slab on grade, and in concrete or masonry walls. All plastic conduit shall be rigid, Schedule 40, heavy wall PVC. All PVC conduit shall be UL listed. Install bell ends at all conduit terminations in manholes and pull boxes. All bends over 30 degrees shall be made with wrapped intermediate metallic conduit. All plastic conduit, except that used for telephone, shall contain a code-sized bond wire.
2. Intermediate metallic conduit (IMC) shall be used for all conduit larger than 2", and for all underground or in-slab conduit, except where PVC is permitted or where rigid galvanized steel is specified. IMC conduit shall be used in explosion-proof areas.
3. Rigid galvanized steel (RGS) conduit shall be used in place of IMC or where it is specified on plans.
4. PVC-coated rigid galvanized steel (PVC-RGS) conduit shall be used in corrosive areas where exposed to physical damage, or where specified on the plans.

B. Conduit shall be continuous from outlet to outlet, cabinet or junction box, and shall be so arranged that wire may be pulled in with the minimum practical number of junction boxes.

C. Provide sleeves and chases where conduit passes through floors as part of the work of this section. Core drilling will only be permitted where accepted by the Architect.

D. Conduit stubbed up/down or through floor slabs shall be wrapped RGS or wrapped IMC with a minimum of 6" of conduit exposed out of slab for connection of threaded or compression fitting. Where conduit bends extend out of slab, the conduit shall be placed at the maximum allowable distance from the exit surface and shall have a bend radius as allowed by code to provide as true and square a conduit exit as possible. Conduit deck flanges will be used where conditions allow and where the flange can be tightly secured flush to the face of a concrete form.

E. Openings through fire-rated floors and fire walls through which conduit passes shall be sealed by fire stop material to seal off cold smoke and toxic fumes. Fire-seal material shall have an hourly fire rating equal to or higher than the fire rating of the floor or wall through which the

cable or conduit passes. Material used shall conform to the Authority Having Jurisdiction requirements. Openings through smoke walls through which cable or conduit passes shall be sealed with non-shrink, non-combustible material approved by the Authority Having Jurisdiction to seal off cold smoke and toxic fumes.

F. Conduit runs shall be installed to maintain the following minimum spacing wherever practical:
   1. Water and Waste Piping: Not less than 3".
   2. Steam and Condensate Lines: Not less than 12".
   3. Radiation and Reheat Lines: Not less than 6".

G. All underground conduit outside of any buildings shall be a minimum of 24" below finished grade, except where noted otherwise on the drawings.

H. All underground feeder conduit outside of any buildings shall be concrete encased. Concrete shall be 3/8" aggregate with a nominal compressive strength of 2,500 PSI. The slump shall be 7" to 8". It shall have enough slump to flow to the bottom of the duct formation and not so wet as to cause the ducts to float. Each conduit shall be completely encased in concrete not less than 3" all around. Concrete shall not be poured until conduit has been inspected by the Architect. Separators or spacing blocks shall be made of plastic or other suitable non-metallic, non-decaying material placed on not greater than 5-foot centers. Ducts shall be anchored to prevent movement during placement of concrete.

I. Provide corrosion protection for metallic conduit under concrete or in earth. Provide half-lap wrap of polyethylene 20-mil tape, factory PVC coating, or as accepted. Where PVC coating is provided, joints must be sealed in accordance with the coating manufacturer’s published instructions.

J. PVC-coated rigid galvanized steel (PVC-RGS) joints must be sealed in accordance with the coating manufacturer’s published instructions.

K. Empty conduit shall be provided with a nylon pull string installed in each.

L. Medical equipment conduit shall be provided with a calibrated pull string/measuring tape installed in each.

M. Bending: Changes in direction shall be made by bends in the conduit wherever possible, and these bends shall be made smooth and even without flattening the pipe or flaking the finish. Bends shall be of as long a radius as possible, but in no case less than shown in the NEC.

N. Not more than four 90 degree bends will be allowed in one raceway run. Where more bends are necessary, a pull box shall be installed. All bends in 1" and smaller conduit shall be made with a conduit bender, and all larger conduit sizes shall have machine bends.

O. Plastic conduit joints shall be made up in accordance with the manufacturer's recommendations for the particular conduit and coupling selected. Conduit joint couplings shall be made watertight. Plastic conduit joints shall be made up by brushing a plastic solvent cement on the inside of a plastic coupling fitting and on the outside of the conduit ends. The conduit and fitting shall then be slipped together with a quick one-quarter turn twist to set the joint tightly. Transition from plastic to steel conduit shall be with PVC female threaded adaptors.

P. Plastic conduit shall be stored on a flat surface and protected from the direct rays of the sun.

Q. The ends of all conduit shall be securely plugged, and all boxes temporarily covered to prevent foreign material from entering the conduit. All conduit shall be thoroughly swabbed out with a dry swab to remove moisture and debris before conductors are drawn into place.

3.2 FITTINGS

A. Bushings and Locknuts: Where conduit enters boxes, panels, cabinets, etc., it shall be rigidly clamped to the box by locknuts on the outside and inside, and a bushing on the inside of the box. All conduit shall enter the box squarely.

B. Provide insulated bushings per the NEC on all conduit. The use of insulated bushings does not exclude the use of double locknuts to fasten conduit to the box.

C. Provide expansion fittings for all conduit where it crosses building expansion joints, or not to exceed 100 feet apart. Fittings shall be complete with bonding jumpers and clamps and shall be suitably bonded to conduit.

D. Provide weatherproof fittings in exterior installations or as noted on the plans.

3.3 SUPPORTS

A. All raceways that are not buried or embedded in concrete shall be supported by straps, clamps, or hangers to provide a rigid installation.

- END OF SECTION -

- SECTION 26 0544 -

UNDERGROUND PULL BOXES & HANDHOLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Furnish and install underground pull boxes and handholes as specified herein and as required by the National Electrical Code, NFPA 70.

PART 2 - GENERAL

2.1 CONCRETE

A. The concrete for pull boxes and manholes shall be in accordance with MAG Specification No. 725, "Portland Cement Concrete," using coarse aggregate and concrete psi based on the applicable listing category required.

2.2 STEEL

A. Reinforcing steel shall be deformed bars of intermediate grade meeting the requirements of MAG Specification No. 727, "Steel Reinforcement."

2.3 FRAMES AND COVERS

A. Frames and covers shall be structural steel conforming to the requirements of MAG Specification No. 770. Frames and covers shall be hot-dip galvanized.

2.4 GROUNDING

A. Ground rods shall be copper or copper-clad steel 3/4" diameter by 10-feet long. All non-current-carrying metallic components shall be bonded to the ground rods with minimum #6 copper wire.

PART 3 - EXECUTION (NOT USED)

- END OF SECTION -

- SECTION 26 0548 -

VIBRATION & SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes seismic restraints and other earthquake-damage-reduction measures for electrical components. It complements optional seismic construction requirements in the various electrical component Sections.

B. Related Sections:
1. Section 03 30 00 - Cast-In-Place Concrete
2. Section 04 20 00 - Unit Masonry
3. Section 05 12 00 - Structural Steel
4. Section 06 10 00 - Rough Carpentry
5. Section 26 05 00 – General Provisions

1.3 DEFINITIONS

A. IBC: International Building Code

B. Seismic Restraint: A fixed device (a seismic brace, an anchor bolt or stud, or a fastening assembly) used to prevent vertical or horizontal movement, or both vertical and horizontal movement, of an electrical system component during an earthquake.

C. Mobile Structural Element: A part of the building structure such as a slab, floor structure, roof structure, or wall that may move independent of other mobile structural elements during an earthquake.

1.4 SUBMITTALS

A. Submit “Letter of Conformance” in accordance with Section 01 33 00 indicating specified items selected for use in Project with the following supporting data:
1. Product Data:

a. Illustrate and indicate types, styles, materials, strength, fastening provisions, and finish for each type and size of seismic restraint component used.

b. Anchor Bolts and Studs: Tabulate types and sizes, complete with report numbers and rated strength in tension and shear as evaluated by an agency approved by authorities having jurisdiction.

2. Shop Drawings: For anchorage and bracing not defined by details and charts on Drawings. Indicate materials, and show designs and calculations signed and sealed by a professional engineer.

a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.

b. Details: Detail fabrication and arrangement. Detail attachment of restraints to both structural and restrained items. Show attachment locations, methods, and spacings, identifying components and listing their strengths. Indicate direction and value of forces transmitted to the structure during seismic events.

3. Preapproval and Evaluation Documentation: By showing maximum ratings of restraints and the basis for approval (tests or calculations).

4. Coordination Drawings: Plans and sections drawn to scale and coordinating seismic bracing for electrical components with other systems and equipment, including other seismic restraints, in the vicinity.

5. Product Certificates: Signed by manufacturers of seismic restraints certifying that products furnished comply with requirements.

6. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

7. Material Test Reports: From a qualified testing agency indicating and interpreting test results of seismic control devices for compliance with requirements indicated.

1.5 QUALITY ASSURANCE

A. Comply with seismic restraint requirements IBC unless requirements in this Section are more stringent.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing seismic engineering services, including the design of seismic restraints, that are similar to those indicated for this Project.

C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated.

1.6 PROJECT CONDITIONS

A. Project Seismic Hazard Exposure Group as Defined in IBC: I.

B. Acceleration Factor: 0.075G.

1.7 COORDINATION

A. Coordinate layout and installation of seismic bracing with building structural system and architectural features, and with mechanical, fire-protection, electrical, and other building features in the vicinity.

B. Coordinate concrete bases with building structural system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Avendra, LLC Preferred Manufacturers:
   1. None.

B. Approved Manufacturers:
   1. B-Line Systems, Inc (800-851-7415)
   2. Thomas & Betts Corp (800-816-7809)
   3. Unistrut Corporation (800-521-7730)

2.2 MATERIALS

A. Use the following materials for restraints:
   1. Indoor Dry Locations: Steel, zinc plated.
   2. Outdoors and Damp Locations: Galvanized steel.

2.3 ANCHORAGE AND STRUCTURAL ATTACHMENT COMPONENTS

A. Strength: Defined in reports by ICBO Evaluation Service or another agency acceptable to authorities having jurisdiction.
   1. Structural Safety Factor: Strength in tension and shear of components used shall be at least two times the maximum seismic forces to which they will be subjected.
      a. Concrete and Masonry Anchor Bolts and Studs: Steel-expansion wedge type.
      b. Concrete Inserts: Steel-channel type.
      c. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A325.
      d. Welding Lugs: Comply with MSS SP-69, Type 57.
      e. Beam Clamps for Steel Beams and Joists: Double sided. Single-sided type is not acceptable.
      f. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to the type and size of anchor bolts and studs used.
      g. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to the type and size of attachment devices used.

2.4 SEISMIC BRACING COMPONENTS

A. Slotted Steel Channel: 1-5/8-by-1-5/8-inch cross section, formed from 0.1046-inch thick steel, with 9/16-by-7/8-inch slots at a maximum of 2 inches o.c. in webs, and flange edges turned toward web.

1. Materials for Channel: ASTM A 570, GR 33.
2. Materials for Fittings and Accessories: ASTM A575, ASTM A576, or ASTM A36.
3. Fittings and Accessories: Products of the same manufacturer as channels and designed for use with that product.
4. Finish: Baked, rust-inhibiting, acrylic-enamel paint applied after cleaning and phosphate treatment, unless otherwise indicated.

B. Channel-Type Bracing Assemblies: Slotted steel channel, with adjustable hinged steel brackets and bolts.

C. Cable-Type Bracing Assemblies: Zinc-coated, high-strength steel wire rope cable attached to steel thimbles, brackets, and bolts designed for cable service.
1. Arrange units for attachment to the braced component at one end and to the structure at the other end.
2. Wire Rope Cable: Comply with ASTM 603. Use 49- or 133-strand cable with a minimum strength of 2 times the calculated maximum seismic force to be resisted.

D. Hanger Rod Stiffeners: Slotted steel channels with internally bolted connections to hanger rod.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install seismic restraints according to applicable codes and regulations and as approved by authorities having jurisdiction, unless more stringent requirements are indicated.

3.2 STRUCTURAL ATTACHMENTS

A. Use bolted connections with steel brackets, slotted channel, and slotted-channel fittings to spread structural loads and reduce stresses.

B. Attachments to New Concrete: Bolt to channel-type concrete inserts or use expansion anchors.

C. Attachments to Existing Concrete: Use expansion anchors.

D. Holes for Expansion Anchors in Concrete: Drill at locations and to depths that avoid reinforcing bars.

E. Attachments to Solid Concrete Masonry Unit Walls: Use expansion anchors.

F. Attachments to Hollow Walls: Bolt to slotted steel channels fastened to wall with expansion anchors.

G. Attachments to Wood Structural Members: Install bolts through members.

H. Attachments to Steel: Bolt to clamps on flanges of beams or on upper truss chords of bar joists.

3.3 ELECTRICAL EQUIPMENT ANCHORAGE

A. Anchor rigidly to a single mobile structural element or to a concrete base that is structurally tied to a single mobile structural element.

B. Anchor panelboards, motor-control centers, motor controls, switchboards, switchgear, transformers, unit substations, fused power-circuit devices, transfer switches, busways, battery racks, static uninterruptible power units, power conditioners, capacitor units, communication system components, and electronic signal processing, control, and distribution units as follows:

1. Size concrete bases so expansion anchors will be a minimum of 10 bolt diameters from the edge of the concrete base.
2. Concrete Bases for Floor-Mounted Equipment: Use female expansion anchors and install studs and nuts after equipment is positioned.
3. Bushings for Floor-Mounted Equipment Anchors: Install to allow for resilient media between anchor bolt or stud and mounting hole in concrete.
4. Anchor Bolt Bushing Assemblies for Wall-Mounted Equipment: Install to allow for resilient media where equipment or equipment-mounting channels are attached to wall.
5. Torque bolts and nuts on studs to values recommended by equipment manufacturer.

3.4 SEISMIC BRACING INSTALLATION

A. Install bracing according to spacings and strengths indicated by approved analysis.

B. Expansion and Contraction: Install to allow for thermal movement of braced components.

C. Cable Braces: Install with maximum cable slack recommended by manufacturer.

D. Attachment to Structure: If specific attachment is not indicated, anchor bracing to the structure at flanges of beams, upper truss chords of bar joists, or at concrete members.

3.5 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Make flexible connections in raceways, cables, wireways, cable trays, and busways where they cross expansion and seismic control joints, where adjacent sections or branches are supported by different structural elements, and where they terminate at electrical equipment anchored to a different mobile structural element from the one supporting them.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform the following field quality-control testing:

B. Testing Agency: Engage a qualified testing agency to perform the following field quality-control testing:

C. Testing: Test pull-out resistance of seismic anchorage devices.

1. Provide necessary test equipment required for reliable testing.
2. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.

3. Schedule test with Owner, through Owner representative, before connecting anchorage device to restrained component (unless post-connection testing has been approved), and with at least seven days' advance notice.
4. Obtain Owner's representative approval before transmitting test loads to the structure. Provide temporary load-spreading members.
5. Test at least four of each type and size of installed anchors and fasteners selected by Owner representative.
6. Test to 90 percent of rated proof load of device.
7. If a device fails the test, modify all installations of same type and retest until satisfactory results are achieved.
8. Record test results.

- END OF SECTION -

- SECTION 26 0553 -

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Electrical identification materials and devices required to comply with ANSI C2, NFPA 70, OSHA standards, and authorities having jurisdiction.

B. Related Sections:
   1. Section 26 05 19 - Low Voltage Electrical Power Conductors and Cables
   2. Section 26 05 33 - Raceways and Boxes for Electrical Systems
   3. Section 26 24 00 - Switchboards and Panel Boards
   4. Section 26 27 26 - Wiring Devices
   5. Section 26 28 16 - Enclosed Switches and Circuit Breakers

1.3 SUBMITTALS

A. Submit “Letter of Conformance” in accordance with Section 01 33 00 indicating specified items selected for use in Project with the following supporting data:
   1. Product Data: For each electrical identification product indicated.

1.4 QUALITY ASSURANCE

A. Comply with ANSI C2.

B. Comply with NFPA 70 "National Electric Code”

C. Comply with ANSI A13.1 and NFPA 70 for color-coding.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Avendra, LLC Preferred Manufacturers:
   1. None.

B. Approved Manufacturers:
   1. Brady USA, Inc. (800-541-1686)
   2. Panduit corp. (800-777-3300)
   3. Seton Identification Products (800-571-2596)

2.2 RACEWAY AND CABLE LABELS

A. Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
   1. Color: Black letters on orange field.
   2. Legend: Indicates voltage

B. Pre-tensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the line it identifies and arranged to stay in place by pretensioned gripping action when placed in position.

C. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

D. Underground-Line Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape.
   1. Not less than 6 inches wide by 4 mils thick.
   2. Compounded for permanent direct-burial service.
   3. Embedded continuous metallic strip or core.
   4. Printed legend indicating type of underground line.

E. Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

F. Aluminum, Wraparound Marker Bands: Bands cut from 0.014-inch thick aluminum sheet, with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.

G. Plasticized Card-Stock Tags: Vinyl cloth with preprinted and field-printed legends. Orange background, unless otherwise indicated, with eyelet for fastener.

H. Aluminum-Faced, Card-Stock Tags: Weather-resistant, 18-point minimum card stock faced on both sides with embossable aluminum sheet, 0.002 inch thick, laminated with moisture-resistant acrylic adhesive, punched for fasteners, and preprinted with legends to suit each application.

2.3 NAMEPLATES AND SIGNS

A. Safety Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145.

B. Engraved Plastic Nameplates and Signs: Engraving stock, melamine plastic laminate, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
   1. Engraved legend with black letters on white face.
   2. Punched or drilled for mechanical fasteners.

C. Baked-Enamel Signs for Interior Use: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for the application. 1/4-inch grommets in corners for mounting.

D. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for the application. 1/4-inch grommets in corners for mounting.

E. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32, stainless-steel machine screws with nuts and flat and lock washers.

2.4 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.
   1. Minimum Width: 3/16 inch.
   2. Tensile Strength: 50 lb minimum.
   3. Temperature Range: Minus 40 to plus 185 deg F.
   4. Color: According to color-coding.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.

C. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before applying.

E. Circuits with More Than 600 V: Identify raceway and cable with "DANGER--HIGH VOLTAGE" in black letters 2 inches high, stenciled with paint at 10-foot intervals over a continuous, painted orange background. Identify the following:

1. Entire floor area directly above conduits running beneath and within 12 inches of a basement or ground floor that is in contact with earth or is framed above unexcavated space.
2. Wall surfaces directly external to conduits concealed within wall.
3. All accessible surfaces of concrete envelope around conduits in vertical shafts, exposed in the building, or concealed above suspended ceilings.
4. Entire surface of exposed conduits.

F. Color Banding Raceways and Exposed Cables: Band exposed and accessible raceways of the systems listed below:
1. Bands: Pre-tensioned, wraparound plastic sleeves; colored adhesive tape; or a combination of both. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.
2. Band Locations: At changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
3. Apply the following colors to the systems listed below:
   a. Fire Alarm System: Red.
   b. Fire-Suppression Supervisory and Control System: Red and yellow.
   c. Combined Fire Alarm and Security System: Red and blue.
   d. Security System: Blue and yellow.
   e. Mechanical and Electrical Supervisory System: Green and blue.
   f. Telecommunication System: Green and yellow.

G. Caution Labels for Indoor Boxes and Enclosures for Power and Lighting: Install pressure-sensitive, self-adhesive labels identifying system voltage with black letters on orange background. Install on exterior of door or cover.

H. Circuit Identification Labels on Boxes: Install labels externally.
1. Exposed Boxes: Pressure-sensitive, self-adhesive plastic label on cover.
2. Concealed Boxes: Plasticized card-stock tags.
3. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.

I. Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communication lines, install continuous underground plastic line marker located directly above line at 6 to 8 inches below finished grade. Where width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches overall, use a single line marker. Install line marker for underground wiring, both direct-buried cables and cables in raceway.

J. Secondary Service, Feeder, and Branch-Circuit Conductors: Color-code throughout the secondary electrical system.
1. Color-code 208/120-V system as follows:
   a. Phase A: Black.
   b. Phase B: Red.
   c. Phase C: Blue.
   d. Neutral: White.
   e. Ground: Green.

2. Color-code 480/277-V system as follows:
   a. Phase A: Yellow.
   b. Phase B: Brown.
   c. Phase C: Orange.
   d. Neutral: White with a colored stripe or gray.
   e. Ground: Green.
3. Factory apply color the entire length of conductors, except the following field-applied, color-coding methods may be used instead of factory-coded wire for sizes larger than No. 10 AWG:
   a. Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Use 1-inch wide tape in colors specified. Adjust tape bands to avoid obscuring cable identification markings.
   b. Colored cable ties applied in groups of three ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal and spaced 3 inches apart. Apply with a special tool or pliers, tighten to a snug fit, and cut off excess length.

K. Power-Circuit Identification: Metal tags or aluminum, wraparound marker bands for cables, feeders, and power circuits in vaults, pull and junction boxes, manholes, and switchboard rooms.
1. Legend: 1/4-inch steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.
2. Tag Fasteners: Nylon cable ties.
3. Band Fasteners: Integral ears.

L. Apply identification to conductors as follows:
1. Conductors to Be Extended in the Future: Indicate source and circuit numbers.
2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color-coding to identify circuits' voltage and phase.
3. Multiple Control and Communication Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding, or cable marking tape.

M. Apply warning, caution, and instruction signs as follows:
1. Warnings, Cautions, and Instructions: Install to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
2. Emergency Operation: Install engraved laminated signs with white legend on red background with minimum 3/8-inch high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.

N. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment, including central or master unit of each system. This includes power, lighting, communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Unless otherwise indicated, provide a single line of text with 1/2-inch high

lettering on 1-1/2-inch high label; where two lines of text are required, use labels 2 inches high. Use white lettering on black field. Apply labels for each unit of the following categories of equipment using mechanical fasteners:

1. Panelboards, electrical cabinets, and enclosures.
2. Access doors and panels for concealed electrical items.
3. Electrical switchgear and switchboards.
4. Emergency system boxes and enclosures.
5. Disconnect switches.
6. Enclosed circuit breakers.
7. Motor starters.
8. Push-button stations.
9. Power transfer equipment.
10. Contactors.
11. Remote-controlled switches.
12. Dimmers.
13. Control devices.
14. Transformers.
15. Telephone switching equipment.
16. Fire alarm master station or control panel.
17. Security-monitoring master station or control panel.

- END OF SECTION -

- SECTION 26 0800 -

COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. The purpose of this section is to specify Division 26 responsibilities in the commissioning process.
      a. The systems to be commissioned are listed in Section 01 91 13.
      b. Commissioning requires the participation of Division 26 to ensure that all systems are operating in a manner consistent with the Contract Documents. The general commissioning requirements and coordination are detailed in Division 01. Division 26 shall be familiar with all parts of Division 01 and the commissioning plan issued by the CxA and shall execute all commissioning responsibilities assigned to them in the Contract Documents.

B. Related Sections:
   1. Section 01 81 13 - Sustainable Design Requirements
   2. Section 01 91 13 – General Commissioning Requirements.
   3. Section 26 08 01 – Electrical System Testing Requirements
   4. Section 26 08 02 – Electrical System Prefunctional Checklists
   5. Section 26 08 03 – Electrical System Sample Functional Test Procedures

C. Related Work:
   1. Refer to Section 01 91 13 for a listing of all Sections where commissioning requirements are found.
   2. Refer to Section 01 91 13 for systems to be commissioned and Sections 26 08 00 through 26 08 03 for functional testing requirements.

1.3 RESPONSIBILITIES

A. Electrical Contractors. The commissioning responsibilities applicable to the electrical contractor are as follows (all references apply to commissioned equipment only):
   1. Construction and Acceptance Phases
      a. Include the cost of commissioning in the contract price, if not yet let.

b. In each purchase order or subcontract written, include requirements for submittal data, O&M data and training.

c. Attend a commissioning scoping meeting and other necessary meetings scheduled by the CxA to facilitate the Cx process.

d. Contractors shall provide cut sheets and shop drawing submittals to the CxA of commissioned equipment.

e. Provide additional requested documentation, prior to normal O&M manual submittals, to the CxA for development of start-up and functional testing procedures.

1) Typically this will include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, full details of any owner-contracted tests, fan and pump curves, full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Agent.

2) The Commissioning Agent may request further documentation necessary for the commissioning process.

3) This data request may be made prior to normal submittals.

f. Contractors shall assist (along with the design engineers) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.

g. Provide limited assistance to the CxA in preparation of the specific functional performance test procedures specified in Section 26 08 00 through 26 08 00.03. Subcontractors shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.

h. Develop a full start-up and initial checkout plan using manufacturer's start-up procedures and the prefunctional checklists from the CxA. Submit manufacturer's detailed start-up procedures and the full start-up plan and procedures and other requested equipment documentation to CxA for review.

i. During the startup and initial checkout process, execute and document the electrical-related portions of the prefunctional checklists provided by the CxA for all commissioned equipment.

j. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CxA.

k. Address current A/E punch list items before functional testing.

l. Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.

m. Perform functional performance testing under the direction of the CxA for specified equipment in Section 26 08 00 through 26 08 00.03 and 01 91 13. Assist the CxA in interpreting the monitoring data, as necessary.

n. Correct deficiencies (differences between specified and observed performance) as interpreted by the CxA, GC and A/E and retest the equipment.

o. Provide training of the Owner's operating personnel as specified.

p. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

2. Warranty Period
   a. Execute seasonal or deferred functional performance testing, witnessed by the CxA, according to the specifications.
   b. Correct deficiencies and make necessary adjustments to O&M manuals and record drawings for applicable issues identified in any seasonal testing.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. Division 26 shall provide all test equipment necessary to fulfill the testing requirements of this Division.

B. Refer to Section 01 91 13 for additional Division 26 requirements.

PART 3 - EXECUTION

3.1 STARTUP

A. The electrical contractors shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this section and in 01 91 13. Division 26 has start-up responsibility and is required to complete systems and sub-systems so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the commissioning agent or Owner.

B. Functional testing is intended to begin upon completion of a system. Functional testing may proceed prior to the completion of systems, or sub-systems at the discretion of the CxA and CM. Beginning system testing before full completion does not relieve the Contractor from fully completing the system, including all prefunctional checklists as soon as possible.

3.2 FUNCTIONAL PERFORMANCE TESTS

A. Refer to Section 01 91 13 for a list of systems to be commissioned and to Section 01 91 13, Article 3.06 “Documentation, Non-Conformance and Approval of Tests” for a description of the process and to Sections 23 08 00 through 23 08 00.03 for specific details on the required functional performance tests.

3.3 TESTING DOCUMENTATION, NON-CONFORMANCE AND APPROVALS

A. Refer to Section 01 91 13 for specific details on non-conformance issues relating to prefunctional checklists and tests.

B. Refer to Section 01 91 13 for issues relating to functional performance tests.

3.4 DEFERRED TESTING

A. Refer to Section 01 91 13 for requirements of deferred testing.

3.5 WRITTEN WORK PRODUCTS

A. Written work products of Contractors will consist of the start-up and initial checkout plan described in Section 01 91 13 and the filled out start-up, initial checkout and prefunctional checklists.

- END OF SECTION -

- SECTION 26 0801 -

ELECTRICAL SYSTEMS TESTING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. This Section specifies the functional testing requirements for Division 22 systems and equipment.

B. Related Sections:
   1. Section 01 91 13 – General Commissioning Requirements.
   2. Section 26 08 00 - Commissioning of Electrical Systems
   3. Section 26 08 01 – Electrical Systems Testing Requirements
   4. Section 26 08 02 – Electrical Systems Pre-functional Checklists
   5. Section 26 08 03 – Electrical Systems Sample Functional Test Procedures

1.3 INCLUDED SYSTEMS AND EQUIPMENT

A. The following is a list of the equipment and system test requirements included in this section:
   1. Lighting Controls

1.4 DESCRIPTION

A. This section specifies the functional testing requirements for Division 26 systems and equipment. From these requirements, the Commissioning Authority (CxA) shall develop step-by-step procedures to be executed by the subcontractors or the Commissioning Authority. The general functional testing process, requirements and test method definitions are described in Section 01 91 13. The test requirements for each piece of equipment or system contain the following:
   1. The contractors responsible to execute the tests, under the direction of the CxA.
   2. A list of the integral components being tested.
   3. Pre-functional checklists associated with the components.

4. Functions and modes to be tested.
5. Required conditions of the test for each mode.
6. Special procedures.
7. Required methods of testing.
8. Required monitoring.
9. Acceptance criteria.
10. Sampling strategies allowed.

1.5 PREREQUISITES

A. The following applicable generic prerequisite checklist items are listed on each written functional test form and shall be completed and checked off by CxA prior to functional testing:

__ All related equipment has been started up and start-up reports and pre-functional checklists submitted and approved ready for functional testing:
__ All control system functions for this and all interlocking systems are programmed and operable per contract documents, including final set-points and schedules with debugging, loop tuning and sensor calibrations completed.
__ All A/E punchlist items for this equipment corrected.
__ These functional test procedures reviewed and approved by installing contractor.
__ Safeties and operating ranges reviewed by the CxA.
__ Test requirements and sequences of operation attached.
__ Schedules and set-points attached.
__ Sufficient clearance around equipment for servicing.
__ Record of all values for pre-test set-points changed to accommodate testing has been made and a check box provided to verify return to original values (control parameters, limits, delays, lockouts, schedules, etc.).
__ Other miscellaneous checks of the pre-functional checklist and start-up reports completed successfully.

1.6 MONITORING

A. Monitoring is a method of testing as a stand-alone method or to augment manual testing.

B. All points listed in the required monitoring section of the test requirements which are control system monitored points shall be trended by the controls contractor. At the option of the CxA, some control system monitoring may be replaced with datalogger monitoring. At the CxA's request, the controls contractor shall trend up to 20% more points than listed at no extra charge.

C. Hard copies of monitored data must be in columnar format with time down the left column and at least 5 columns of point values on the same page.

D. Graphical output is desirable, and will be required for all output, if the system can produce it.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 LIGHTING CONTROLS

A. Parties Responsible to Execute Functional Test
   1. Electrical contractor: assist in testing sequences
   2. CxA: to witness, direct and document testing.

B. Integral Components or Related Equipment Being Tested
   1. Lighting Control Pre-functional Checklist
   2. Building Automation Pre-functional Checklist (if Applicable)

C. Prerequisites: The applicable prerequisite checklist items listed in the beginning of Section 26 08 00.01 shall be listed on each functional test form and checked off prior to functional testing.

D. Functions / Modes Required To Be Tested and Test Methods
   1. The following testing requirements are an addition to and do not replace any testing requirements elsewhere in this Division.

Function / Mode	Test Method Manual (demonstration), Monitoring, Either or Both
MISCELLANEOUS FUNCTIONS	
1. All specified functions and features are set up, debugged and fully operable.	Verbal discussion of features
2. Power failure and battery backup and power-up restart functions.	Demonstration
3. Occupant over-ride functions and duration setting.	Demonstration
4. Scheduling features fully functional and setup, including holidays.	Observation in terminal screens or printouts
5. Date and time setting in central computer.	Demonstration
6. Interconnection with Building Automation System	Manual
DIMMING FUNCTIONS	
7. Test the sequence of operation for all features and modes.	Manual
8. Test the dimming controls during “live” conditions verifying that amperage changes in light fixtures are proportional to external light changes, and that the light levels at the specified datum points remain within specified limits. Verify this over a broad area for all areas affected. Verify that all, and only, specified light fixtures are dimming.	Either
9. Verify that delays and ramp times are set and functioning so that the speed of change of light fixture output is slow enough to be judged non-bothersome to occupants.	Manual
10. Verify that dimming does not cause lower than specified light levels in adjacent “non-dimmed” spaces.	Manual

Function / Mode	Test Method Manual (demonstration), Monitoring, Either or Both
11. Verify that the controls and sensors are not easily overridden or disabled by occupants.	Visual inspection
12. Verify that the photo sensor is in an adequate location and is not being affected by direct sunlight or obstructions.	Visual inspection
OCCUPANCY SENSOR ON/OFF CONTROL	
13. Verify operation in all modes of operation	Visual Inspection
14. Test location of sensor such that motion outside the room is not visible to the sensor through open doors or interior glazing and that the lights do not energize as a result.	Visual Inspection
PHOTOCELL DIMMING CONTROL	
15. Verify operation in all modes of operation	Visual Inspection
16. Test photocell based dimming operation verifying that light fixtures dim/ turn off when artificial light is shined on the photo-sensor.	Visual Inspection

E. Acceptance Criteria (referenced by function or mode ID)

1. 1 - 11 for the conditions, sequences and modes tested, the dimming controls, integral components and related equipment respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice.

F. Sampling Strategy for Identical Units

1. Each photo-sensor and its controlled zone must be tested (no sampling).

- END OF SECTION -

- SECTION 26 0802 -

ELECTRICAL SYSTEMS PREFUNCTIONAL CHECKLISTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Pre-functional Checklists (PC) in a form format. The Pre-functional Checklists consist of Instructions Sheets and Record Sheets.

B. Related Sections:
   1. Section 01 33 00 - Submittal and Substitution Procedures
   2. Section 01 91 13 – General Commissioning Requirements.
   3. Section 26 08 00 – Commissioning of Electrical Systems
   4. Section 26 08 00.01 – Electrical Systems Testing Requirements
   5. Section 26 08 00.03 – Electrical Systems Sample Functional Test Procedures

1.3 DESCRIPTION

A. The PC procedures displayed in a form format here are intended to provide the Contractor with an example of the format and an indication of the rigor of the required prefunctional checklists (Instruction Sheets and Record Sheets) and documentation for various equipment types. Though they were not developed specifically for this project, they are generally applicable.

B. The checklists contain items for Division 26 contractors to perform. Division 26 contractor has additional responsibilities to complete Division 22 and 23 checklists.

C. Those executing the checklists are only responsible to perform items that apply to the specific application at hand. These checklists do not take the place of the manufacturer's recommended checkout and start-up procedures or report. Some checklist procedures may be redundant of some checkout procedures that will be documented on typical factory field checkout sheets. Double documenting is required in those cases.

D. Refer to Section 01 91 13 for additional requirements regarding prefunctional checklists, startup and initial checkout. Items that do not apply should be noted along with the reasons on the

form. If supplied Prefunctional Checklist forms are not used for documenting, one of similar rigor and clarity shall be used. Contractors assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off.

E. The following is a list of the equipment and systems which will require Prefunctional Checklists (Instruction Sheets and Record Sheets) to be completed by the Contractors.
   1. Lighting Controls (Each Space Served)
   2. Division 22 and 23 – Refer to 22 08 00.02 and 23 08 00.02

F. Refer to Section 01 33 00 - Submittal and Substitution Procedures for Prefunctional Checklists.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

- END OF SECTION -

- SECTION 26 0803 -

ELECTRICAL SYSTEMS SAMPLE FUNCTIONAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. This Section contains the Functional Testing Procedures for Mechanical Systems

B. Related Sections:
   1. Section 01 33 00 - Submittal and Substitution Procedures
   2. Section 01 91 13 – General Commissioning Requirements.
   3. Section 26 08 00 – Commissioning of Electrical Systems
   4. Section 26 08 00.01 – Electrical Systems Testing Requirements
   5. Section 26 08 00.02 – Electrical Systems Pre-functional Checklists

1.3 DESCRIPTION

A. The CxA will use the functional testing requirements in Sections 26 08 00.01 and the testing protocols specified in Section 01 91 13 for developing site-specific functional test procedures and forms for this project. For illustrative purposes, sequences of operation associated with a few pieces of the equipment for which tests are included are also provided.

B. The following is a list of the equipment and systems which will require Prefunctional Checklists (Instruction Sheets and Record Sheets) to be completed by the Contractors.
   1. Lighting Controls (Each Space Served)

C. Refer to Section 01 33 00 - Submittal and Substitution Procedures for Prefunctional Checklists.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

- END OF SECTION -

- SECTION 26 0913 -

POWER SYSTEM METERING - FEEDERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Furnish and install electric power sub-meters as specified herein and as indicated on the drawings.

B. Acceptable manufacturers for feeder power meters are Square D (PM710), Cutler Hammer (IQ200), Siemens (9200 Series), Power Measurement Inc., or as accepted.

C. Acceptable manufacturer for dwelling unit power meters is E-Mon, or as accepted.

PART 2 - PRODUCTS

2.1 FEEDER POWER METERS

A. Meter shall provide true RMS ±1.0% accuracy peak KW or KVA or current recorder capable of retaining a one-year history of peaks. History shall update at a minimum of 15-minute intervals. History shall reside in non-volatile memory with no power applied for a minimum of 30 days. Recorder shall evaluate the peak for all phases present and include a digital readout of values, and shall be panel-mounted within the switchboard or panelboard. Readout shall include reset capabilities with one level of physical protection against accidental reset. Include all related components for a complete installation.

B. Meter shall be permitted to be integral with the circuit breaker in lieu of panel mounting.

C. Meter shall have an Ethernet connection to internet supports either static or DCHP IP address. The data shall be exportable to E-Mon Energy software or CSV files for billing, profiling, and interface with or software packages.

D. Meters shall include the following:

1. Full electronic and digital LCD display for kW-hr and peak demand readings.
2. Rate of consumption indication and also a segment test button (CPU) to insure integrity of the display.

3. Load indicator to indicate real-time power consumption levels for field testing and certification.
4. Non-volatile memory to maintain ready during power failures.
5. Current sensors shall be accurate with up to 2000ft of paired conductor between sensor and meter. CT's shall be rated to match the upstream overcurrent device for the feeder being monitored.
6. Heavy duty steal JIC enclosure, NEMA 1, with anti-tamper locking hasp.
7. Multiple Meter Unit (MMU) configurations up to 24 meters in one assembly. Each assembly shall include wire gutters for CT conductors. The assembly shall require only (1) power connection for all meters contained within.
8. Energy monitoring and tracking software for Microsoft XP operating system. Software shall gather all data from other meters in a campus style environment and tabulate in a user friendly format.
9. Network interface capability for connection to a campus style environment data network. Verify network configuration prior to ordering.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide current transformers of size required to enable full-scale readout for each meter.

B. Provider fusing for potential leads.

C. Feeder power meters shall be located within the switchboard or panelboard where the feeder originates. Where switchboard configuration will physically accept these meters and fit into the space allotted on the floor plan, meters may be group mounted in a single separate enclosure adjacent to the equipment metered.

3.2 TRAINING

A. Provide 6 hours of on-site training on the use and operation of the feeder power meters and related software.

B. Provide 6 hours of on-site training on the use and operation of the Dwelling Unit Meters and related software.

C. Trainers shall be factory trained and certified on the installation, use, and operation of the equipment and related software.

- END OF SECTION -

- SECTION 26 0923 -

LIGHTING CONTROL DEVICES –

RELAY PANEL BASIC SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 INTRODUCTION

A. The work covered in this section is subject to all of the requirements in the General Conditions of the specifications.

B. Contractor shall coordinate all of the work in this section with all of the trades covered in other sections of the specification to provide a complete and operable system.

C. The work included in this section shall be the installation of the networked low voltage lighting control panels fully coordinated with the BAS contactor. Reference Section 26 09 25 for additional information. Each relay shall provide status to the BAS and control of each relay through BAS scheduling, shall be fully coordinated.

1.3 DESCRIPTION OF WORK

A. Extent of lighting control system work is indicated by drawings and by the requirements of this section. It is defined to include, but not by way of limitation:

1. Low voltage switching system with a lighting automation relay panel(s), associated low voltage switches, and interior/exterior photocell daylight compensation.
2. Panel Timeclock.
3. Panel Master ON/OFF control capability.
4. Programmable panel intelligence cards with:
    a. Telephone Override.
    b. Photocell.
    c. Factory Service:
        1) Documentation.
        2) Programming.
        3) Startup.
        4) Training.

5) Extended Warranty.

B. Types of lighting control equipment and wiring specified in this section include the following:
1. Low Voltage Lighting Automation Relay Panel(s).
2. Master ON/OFF Panel Automation Cards.
3. Master Clock System that shall control all relays within the relay panel(s).

C. Requirements are indicated elsewhere in these specifications for work including, but not limited to, raceways and electrical boxes and fitting required for installation on control equipment and wiring.

D. Conduit stub-outs from switches and other devices shall be required to accessible ceilings. Where no ceilings are utilized, conduit must be routed back to the relay panel.

1.4 APPROVED MANUFACTURERS

A. Approved Manufacturers:
1. WattStopper, Douglas, Greengate, General Electric, Leviton, LC & D, Micro-Lite, Philips or approved equal.

1.5 QUALITY ASSURANCE

A. Firms regularly engaged in manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than five years.

B. All components and assemblies are to be factory pre-tested and burned-in prior to installation.

C. Factory-trained technicians shall be available to functionally test each component in a programmable system after installation to verify proper operation and confirm that the panel wiring and addressing conform to the wiring documentation.

D. System Support: Factory applications engineers shall be available for on-site training as well as telephone support.

E. Comply with NEC as applicable to electrical wiring work.

F. Comply with applicable portions of NEMA standards pertaining to types of electrical equipment and enclosures.

G. All components shall be UL listed as a system under UL 916 Energy Management Equipment.

H. All assemblies are to be in compliance with FCC Emissions Standards specified in Part 15, Subpart J, for Class A application.

1.6 SUBMITTALS

A. Submit manufacturer's product data for the lighting control system and components.

B. Submit dimensioned shop drawings at a minimum of 1/8" = 1'-0" scale indicating all lighting the location control system components and accessories.

C. Submit a one-line diagram of the system configuration proposed if it differs from that illustrated in the riser diagram included in these specifications and drawings.

D. Submit typical wiring diagrams for all components including, but not limited to, relay panels, relays, input devices such as low voltage switches, vacancy & occupancy sensors, photocells, programmable panel master switches, telephone override cards, global switching/annunciation, and wire. Show BAS interface requirements.

E. Include all conduit requirements within the submittal. Where conduits are indicated on the Division 26 drawings, the quantity and size shall be a minimum. The vendor shall confirm all quantities and sizes on the submittal.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. Low Voltage Relay Switching System:

1. Description:

a. The low voltage relay switching system shall consist of preassembled relay panel(s), low voltage switches, time controllers with astronomic feature and their associated wiring.

b. The relay panels shall be mounted in locations as indicated on the drawings. The numbered relays in the panel shall be wired to control the power to each load as indicated on the Panel Wiring Schedules included in the drawings. All power wiring shall be identified with the number of relay controlling it at the load.

c. Low voltage switches shall be mounted in the spaces as indicated on the plans. Low voltage wiring from the switches to the relay panel shall be Class 2 or Class 2P (plenum rated) as required by the National Electrical Code and local standards. Each low voltage wire shall be labeled with the relay number as indicated in schedules at each switch. Use only properly color-coded, stranded #20 AWG (or larger) wire or as indicated on the drawings. All relays and switches shall be tested after installation to confirm proper operation and the loads recorded on the directory card in each panel. Switches shall be installed in a single gang box with 3/4” conduit stub-out to above an accessible ceiling. Where no ceiling is present, route 3/4” conduit to relay panel.

d. The panel(s) shall provide expansion slots for the addition of automation cards. These cards shall be totally compatible with the manual operation of the low voltage switches and occupancy sensors; and, in the event of a card failure, these devices shall continue to operate to provide relay control.

e. The plans shall indicate the relay number that shall be located below or adjacent to the circuit number for individual relay devices, i.e., Example Homerun LA-1, 3 (RP-1, 2, 3, 4). Refer to lighting panel and relay panel schedules for cross-reference control requirements.

f. Master clock control system shall have the ability to control all relays as scheduled, to the total number of clock setpoints.

2. Hardware Features:

a. Modular relay panels shall consist of the following:

1) Tub: NEMA 1 enclosure sized to accept an interior with either 1-8. 1-24 or 1-48 SPST or HDR SPST relays as indicated. Mounting of the tub shall be flush or surface as indicated on the drawings.

2) Interior: Bracket and circuit board backplane with pre-mounted SPST or HDR SPST relays as indicated. Interiors shall be sized to accept either 8, 24, or 48 relays and will provide true ON/OFF indication of relay status through LED's mounted on the circuit board. Each relay shall be capable of direct ON/OFF control by a low voltage switch or occupancy sensor. The relays shall be momentary-pulsed mechanically latching contactors rated at 20 amps, 120/277 VAC. They shall attach to the interior by a single plug-in connector.

3) Power Supply: Transformer assembly with one 40VA transformer with separate secondaries providing power to relays, LED's, and associated low voltage switches. Transformers include internal overcurrent protection with automatic reset and metal oxide varistor protection against powerline spikes. 120/277 VAC, 50/60 Hz. 10%.

4) Cover: Standard tub with hinged, lockable configuration. Surface hinged locking covers shall provide an LED status viewing window and a lockable door for access to Low Voltage wiring compartment. A wiring schedule directory card shall be affixed to the rear of the cover to allow ready identification of circuits-relays-loads controlled when the door is open.

b. Switches and Cover Plates:

1) Provide specification grade, heavy-duty, center off toggle switches, #5935-2G (white or color specified by the Architect), as shown on the plans for overriding the relays.

2) Provide specification grade cover plate material and color(s) to match the Division 26 requirements.

c. Low Voltage Wire:

1) All low voltage wiring shall be color coded to match the relays, switches, and sensors. It must also be UL listed as conforming to Class 2 or Class 2P wiring requirements.

2) Switch color codes as follows: Red / Black / White.

3) Remote relay color-coding: Red / Black / Blue / Yellow / Yellow.

d. Photocells: Each photo control point shall consist of an architecturally compatible sensor mounted in the appropriate location for measuring the available daylighting. Each sensor will have a separate control/calibration module mounted in an enclosure in the electrical closet. The sensor shall connect to the control/calibration unit via a single 20/4 shielded conductor with a maximum distance of 500 ft. The control unit shall be powered by 24 VAC.

1) Control / Calibration Unit:

a) Control unit shall allow for either direct control of up to three separate devices. These devices can be a relay, or any other device that allows control by a three wire momentary contact.

b) Control unit shall be a standard device that can work with any of the four possible sensor devices. The unit shall be switchable between four footcandle measurement ranges (1-10 FC, 10-100 FC, 100-1,000

FC, and 1,000-10,000 FC), depending on the sensor head and application.

c) Control unit shall have separate trip points for the high and low response settings. These settings will be entered via easily readable dial switches, and will not require a separate meter or look-up table to insure a reliable footcandle setting. LED's shall be provided to illustrate whether the sensor is below the low setting, above the high setting, or in the deadband range.

d) Control unit shall allow for a momentary contact device to act as a master ON/OFF override of the photocell relays. This master override will only be in effect until the next change in light level or the next master override.

e) Control device shall employ a three-minute time delay between switching outputs to avoid nuisance tripping. It shall be possible to disable the time delay to aid in initial setup and troubleshooting.

f) Sensor Devices: Four different sensors shall be available to match the specific application. Each sensor shall employ photodiode technology to allow a linear response to daylight in its given footcandle range.

g) For Exterior Lighting: A hooded sensor that can be horizontally mounted on a 1/2" KO or threaded conduit. Sensor shall employ a flat lens, and work with a footcandle range between 1-10 or 10-100, in 10% increments. The entire sensor shall be encased in optically clear epoxy resin.

2.2 LOW VOLTAGE SWITCHING SYSTEM WITH SOFTWIRED GROUPING CAPABILITY

A. System Description:

1. Softwired grouping capability will be enabled by adding a single relay driver card for each 12 relays and a single learn mode card per panel into the base panel's expansion slots. Each relay driver card also serves to enable three separate programmable system switches.
2. Any group of relays can be softwired to any programmable system switch by:
   a. Turning every relay that is to be part of a softwired group on, and all others off.
   b. Pressing the Learn button on the learn mode card. The Learn LED will start blinking rapidly.
   c. Pressing either the on or off side of programmable system switch. At this point the Learn LED will stop blinking, and the programmable system switch has been assigned control of that group of relays.
3. Every programmable system switch can be assigned one of two scenarios. They are:
   a. On & Off: If the On side of the programmable switch is pressed when learning a group of relays, the switch will turn the relay group on when pressed on, and turn the relays off when pressed off.
   b. On & Flicker, then Off: If the Off side of the programmable switch is pressed when learning a group of relays, the switch will turn the relay group on when pressed on, and will flicker the relays (turn them off for about one second, then turn them back on) when pressed off. Five minutes later, all relays that flickered will go off automatically. However, any relay that is pressed on during the five minute wait period will be exempted from the off sweep.

4. In addition to the programmable system switches, every panel includes two master switch inputs labeled A and B that can be assigned to control any group of relays using two other scenarios:
   a. Cleaning Switch: If the On side of the master switch is pressed when learning a group of relays, it has been assigned a cleaning scenario. The switch shall allow the cleaning crew to turn ON any assigned relay group, but it will not turn OFF any relay which is scheduled ON or has an occupant override in effect; i.e. occupant overrides will have priority over cleaning.

B. Hardware Features:
   1. Relay Driver Cards:
      a. The softwired grouping function shall be enabled by plug-in relay driver cards controlling 8 relays each. The 8-relay panel shall have one relay bank (1-8) and accept one relay driver card. The 24-relay panel shall have two relay banks (1-8, 9-16 & 17-24) and accept up to two relay driver cards. The 48-relay panel shall have four banks and accept up to six cards.
      b. Each card shall include three associated programmable system switches which signal the learn card to control its associated relays ON/OFF according to the different scenarios listed above while still allowing direct switch control of each relay. These switch inputs may be either a 2- or 3- wire, maintained or momentary dry contact closure.
      c. Programmable switch inputs within a panel or in different panels shall be capable of being paralleled for common control. This requires that all panels be powered by circuits on the same phase.
      d. Each output shall be capable of operating three relays in parallel.

   2. Learn Mode Card:
      a. The learn card shall provide two momentary contact switches mounted on its front. The right switch is a relay All On/All Off override. The left button, when pushed, puts the card into the Learn Mode. The next programmable system switch that is triggered will be assigned to control all the On relays. If no programmable switch is pressed within 30 seconds, the card will cancel out of the Learn Mode and go back to its normal state.
      b. The learn mode card shall provide two LED's for visual status feedback. The right LED indicates that the learn card has power and can function. The second LED is used to show memory status: Rapidly flashing means nothing in memory; slow flashing means that the Learn button has been pressed and the next programmable system switch that is hit will be assigned to control all the On relays; steady on means that the card has been at least partially programmed.
      c. The learn card shall use an EEPROM to record the user-defined switch assignments, thus insuring a 40-year backup of information in case of power failure. Systems that require a changeable battery with less than a 10-year life for information backup shall not be allowed.

C. Programmable System Switches:
   1. System Description:
      a. Programmable system switch modules shall be added to the dataline to provide system-wide switching.
      b. Each unit shall have an address setting from 01-99 and 16 physical switch inputs. These inputs may be either 3-wire maintained or momentary.

c. The system switch modules shall transmit the switch ID (address/input) and the action (ON/OFF) whenever a switch changes state.

d. The intelligent panels shall monitor these messages and actuate their associated relays to the appropriate state. This state to be determined by the scenario assigned to the system switch - Master ON/OFF, Photocell.

2. Hardware Features:

a. Universal power supply.

b. Sixteen independent 3-wire switch inputs.

c. 18/3 switchleg wiring, 1,000 ft.

d. Maximum of 1,584 programmable system switches per system.

2.3 PANEL TIMECLOCK

A. System Description:

1. The panel timeclock will provide programming and editing capability for its own schedule function. In addition, it shall provide similar programming/editing capability for all of the devices - learn relay panels, phone override cards, and switching cards.

2. During normal operation, the panel timeclock commands will be annunciated on its LCD display showing the action and the time transmitted. Learn panel PSS overrides, telephone overrides, and switch overrides will also be displayed as they occur.

B. Hardware Features:

1. Mechanical:

a. The panel timeclock will be enclosed within relay panel enclosure.

b. The unit will include three expansion card slots - one for a telephone override card, the other two for switch/annunciator cards.

c. All wiring terminations will be made on a motherboard. Replacement of defective cards shall not require removal of any wiring.

2. Data Entry/Display: The data entry and display capability will stress ease of programming and the ability to confirm the operation of the unit. The following are minimum requirements:

a. Forty-character by eight-line LCD backlit LCD display.

b. Function-Specific Keypad:

1) Single screen format with "fill-in-the-blank" approach to both new data entry and editing

2) Programming manual and data sheets will be provided and a plastic sleeve included for storage inside in the unit.

3) The same data entry/display will be capable of programming the learn panels and the other optional devices (telephone and switch groups).

3. Startup / Testing: The network timeclock shall provide a simple means for testing all devices and demonstrating the operation of all program data.

4. Program:

a. The panel timeclock shall allow up to 99 schedule events, each event using the following logic:

1) ...At this time __:__.

2) ...On these days of the week (and/or holidays) .

3) ...Turn ON (OFF).

4) ...The following group of up to 12 PSS inputs (or relays).

b. The unit shall use a 365-day clock with the ability to define up to 32 holidays by date, provide automatic Daylight Savings Time, and compensate for leap years.

c. An internal power backup shall provide up to 10-year carryover in the event of a power outage.

5. Data Retention: The user program data will be stored in EEPROM, providing 10-year data retention without external power. Units relying on batteries with limited life for data retention will not be allowed.

2.4 TELEPHONE OVERRIDE

A. System Description:

1. Four telephone override modules shall be connected to the dataline. Each module will have its own extension number and associated RJ11 jack.
2. The phone override module will allow existing touchtone phones to initiate a dataline command to control up to 12 programmable system switches (or relays) using the following logic:
   a. When the following ID code is followed by a 1# (0#).
   b. Turn ON (OFF).
   c. The following group of up to 12 PSS switch inputs (or relays).
3. Each phone module shall be capable of storing up to 99 four-digit phone override ID codes. Each code may be defined as "ON Only" or "ON/OFF".

B. Hardware Features:

1. Up to nine telephone control modules per dataline.
2. Plugs into available card slots in RCLOCK or RDLPWR-1 with all wiring terminations on the motherboard.
3. Up to 99 phone codes per unit, each code controlling up to 12 PSS inputs.
4. User data stored in EEPROM, providing 10-year data retention without external power.

PART 3 - EXECUTION

3.1 SUPPORT SERVICES

A. System Startup: Manufacturer shall provide a factory authorized technician to confirm proper installation and operation of all system components.

B. Training: Manufacturer shall provide factory authorized Application Engineer to train Owner personnel in the operation and programming of the lighting control system.

C. Documentation: Manufacturer shall provide system documentation including:

1. System one-line showing all panels, number and type of switches and sensors, dataline, programmable system switches, and telephone override modules.
2. Drawings for each panel showing hardware configuration and numbering.
3. Panel wiring schedules.
4. Typical wiring diagrams for each component.

D. Programming:

1. Manufacturer shall provide system programming including:
   a.
   b. Wiring documentation.
   c. Programmable panel and system switch operation.
   d. Telephone overrides.
   e. Operating Schedules.

E. Extended Warranty: Manufacturer shall provide a 5 year extended warranty in addition to a required one-year warranty for all system components.

- END OF SECTION -

- SECTION 26 0925 -

LIGHTING CONTROL DEVICES - DIGITAL OCCUPANCY & DAYLIGHT MANAGEMENT SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

A. Contractors work to include all labor, materials, tools, appliances, control hardware, sensor, wire, junction boxes and equipment necessary for and incidental to the delivery, installation and furnishing of a completely operational occupancy sensor lighting control system, as described herein.

B. Contractor/Supplier shall examine all general specification provisions and drawings for related electrical work required as work under Division 26.

C. Contractor shall coordinate all work described in this section with all other applicable plans and specifications, include but not limited to, wiring, conduit, fixtures, HVAC systems, and building management systems.

1.3 REFERENCES

A. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE).

B. Underwriters Laboratories of Canada (ULC).

C. International Electrotechnical Commission.

D. International Organization of Standardization (ISO).

E. National Electrical Manufacturers Association (NEMA).

F. WD1 (R005) – General color requirements for wiring devices.

G. Underwriters Laboratories, Inc. (UL)
   1. 916 – Energy Management Equipment.

2. 924 – Emergency Lighting.

1.4 SYSTEM DESCRIPTION

A. The objective of this section is to ensure the proper installation of the occupancy sensor based lighting control system so that lighting is turned off automatically after reasonable time delay when a room or area is vacated by the last person to occupy said room or area.

B. The occupancy sensor based lighting control shall accommodate all conditions of space utilization and all irregular work hours and habits.

C. Contractor shall warrant all equipment furnished in accordance to this specification to be undamaged, free of defects in materials and workmanship, and in conformance with specifications. The supplier's obligation shall include repair or replacement, and testing without charge to the owner, all or any parts of equipment which are found to be damaged, defective or non-conforming and returned to the supplier. The warranty shall commence upon the owner's acceptance of the project. Warranty on labor shall be for a minimum period of one (1) year.

1.5 LIGHTING CONTROL APPLICATIONS

A. Unless relevant provisions of the applicable local Energy Codes are more stringent, provide a minimum application of lighting controls as follows:
   1. Space Control Requirements: Provide occupancy/vacancy sensors with manual on functionality in all spaces except toilet rooms, storerooms, library stacks, or other applications where hands free operation is desirable and automatic on occupancy sensors are more appropriate. Provide manual ON occupancy/vacancy sensors for any enclosed office, conference room, meeting room, open plan system and training room. For spaces with multiple occupants or where line-of-site may be obscured, provide ceiling or corner mounted sensors with manual on switches.
   2. Provide occupancy/vacancy sensors for any enclosed office, conference room, meeting room, and training room. For spaces with multiple occupants or where line-of-site may be obscured, provide ceiling or corner mounted with manual on switches.

1.6 SUBMITTALS

A. Submittals Package: Submit the shop drawings, and the product data specified below at the same time as a package.

B. Shop Drawings (for Sensor Systems):
   1. Composite wiring and/or schematic diagram of each control circuit as proposed to be installed (standard diagrams will not be accepted).
   2. Scale drawing for each area showing exact location of each sensor, switching module, and on-off-auto switch.

C. Product Data: Catalog sheets, specifications and installation instructions.

D. Include data for each device which:
   1. Indicates where sensor is proposed to be installed.
   2. Provide that the sensor is suitable for the proposed application.

1.7 QUALITY ASSURANCE

A. Manufacturer: Minimum [10] years of experience in manufacture of lighting controls.

1.8 PROJECT CONDITIONS

A. Do not install equipment until following conditions can be maintained in spaces to receive equipment:
   1. Ambient temperature: 0° to 40°C (32° to 104°F).
   2. Relative humidity: Maximum 90 percent, non-condensing.

1.9 WARRANTY

A. Provide a five year complete manufacturer's warranty on all products to be free of manufacturer's defects.

1.10 MAINTENANCE

A. Spare Parts: Provide 5% of each product to be used for maintenance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer:
   1. Watt Stopper:
      a. System: Digital Lighting Management (DLM).
   2. Basis of design product: Watt Stopper Digital Lighting Management (DLM) or subject to compliance with prior approval with specified requirements of this section, one of the following:
      a. Watt Stopper.
      b. Douglas.
      c. Greengate.
      d. General Electric.
      e. Leviton.
      f. LC & D.
      g. Micro-Lite.
      h. Philips.
      i. Lutron.
      j. Approved equal.

B. Substitutions:
   1. All proposed substitutions (clearly delineated as such) must be submitted in writing for approval by the design professional a minimum of 10 working days prior to the bid date and must be made available to all bidders. Proposed substitutes must be accompanied by a review of this specification noting compliance on a line-by-line basis.

2. By using pre-approved substitutions, the contractor accepts responsibility and associated cost for all required modifications to circuitry, devices, and wiring. The contractor shall provide complete engineered shop drawings (including power wiring) with deviations for the original design highlighted in an alternate color to the engineer for review and approval prior to rough-in.

2.2 SINGLE/DUAL RELAY WALL SWITCH VACANCY SENSORS

A. Type PW: Manual ON, Automatic OFF Wall switch type passive infrared occupancy sensor with built-in override control (off-auto). Furnish the Company's model which suits the electrical system parameters, and accommodates the square footage coverage and wattage requirement for each area (and type of lighting) controlled; Watt Stopper PW-100, PW-200.

B. Type UW: Manual ON, Automatic OFF Wall switch type ultrasonic occupancy sensor with built-in override control (off-auto). Furnish the Company's model which suits the electrical system parameters, and accommodates the square footage coverage and wattage requirement for each area (and type of lighting) controlled; Watt Stopper UW-100, UW-200.

C. Type DW: Manual ON, Automatic OFF Wall switch type dual technology, passive Infrared and ultrasonic occupancy sensor with built-in override control (off-auto). Furnish the Company's model which suits the electrical system parameters, and accommodates the square footage coverage and wattage requirement for each area (and type of lighting) controlled; Watt Stopper DW-100, DW-200.

2.3 DIGITAL WALL OR CEILING MOUNTED OCCUPANCY SENSOR SYSTEM

A. Wall or ceiling mounted (to suit installation) passive infrared, ultrasonic or dual technology digital (passive infrared and ultrasonic) occupancy sensor. Furnish the Company's system which accommodates the square footage coverage requirements for each area controlled, utilizing Room Controller modules and accessories which suits the lighting and electrical system parameters.

B. Digital Occupancy Sensors shall provide graphic LCD display for digital calibration and electronic documentation. Features include the following:
   1. Digital calibration and LCD entry for the following variables:
      a. Sensitivity: 0-100% in 10% increments.
      b. Time Delay: Fixed (1-30 minutes in 1 minute increments), and automatic.
      c. Test mode – Five second time delay.
      d. PIR, Ultrasonic or Dual Technology activation and/or reactivation.
      e. Walk-through mode.
      f. Load parameters including auto/manual ON, and blink warning.
   2. Assignment of occupancy sensor to a specific load within the room without wiring or special tools.

C. Units will provide for digital calibration and commissioning and will not have any dip switches or potentiometers for field settings.

D. Watt Stopper product numbers: LMPX, LMDX, LMPC, LMUC and LMDC.

PART 3 - EXECUTION

3.1 INSTALLATION

A. It shall be the contractor's responsibility to locate and aim sensors in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas per the manufacturer's recommendations. Rooms shall have ninety (90) to one hundred (100) percent coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only the rooms which are to be provided with sensors. The contractor shall provide additional sensors if required to properly and completely cover the respective room. Adjust time delay so the controlled area remains lighting for 5 minutes after occupant leaves area.

B. It is the contractor's responsibility to arrange a pre-installation meeting with manufacturer's factory authorized representative, at owner's facility, to verify placement of sensors and installation criteria.

C. Proper judgment must be exercised in executing the installation so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components. The contractor shall also provide, at the owner's facility, the training necessary to familiarize the owner's personnel with the operation, use, adjustment, and problem solving diagnosis of the occupancy sensing devices and systems.

D. Extended Warranty: Manufacturer shall provide a five (5) year extended warranty in addition to a required one-year warranty for all system components.

E. Provide written or computer generated documentation on the commissioning of the system including room by room description including:
   1. Sensor parameters, time delays, sensitivities.
   2. Sequence of operations, manual on, auto off, etc.

F. Re-commissioning: After 30 days from occupancy, re-calibrate all sensors time delays and sensitivities to meet the Owner's Project Requirements. Provide a detailed report to the Architect/Owner of re-commissioning activity.

3.2 FACTORY COMMISSIONING

A. Upon completion of the installation, the system shall be commissioned by the manufacturer's factory authorized representative who will verify a complete fully functional system.

B. The electrical contractor shall provide both the manufacturer and the electrical engineer with ten working days written notice of the system startup and adjustment date.

C. Upon completion of the system, commissioning the factory authorized technician shall provide the proper training to the Owner's personnel on the adjustment and maintenance of the system.

- END OF SECTION -

- SECTION 26 2213 -

LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Dry-Type Distribution And Specialty Transformers Rated 1000 V And Less.
      a. General-Purpose Distribution and Power Transformers
      b. Buck-Boost Transformers
      c. Control and Signal Transformers

B. Related Sections:
   1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
   2. Section 26 05 53 - Identification for Electrical Systems.

1.3 SUBMITTALS

A. Submit “Letter of Conformance” in accordance with Section 01 33 00 indicating specified items selected for use in Project with the following supporting data;
   1. Product Data:
      a. Include data on features, components, ratings, and performance for each type of transformer specified. Include dimensioned plans, sections, and elevation views. Show minimum clearances and installed devices and features.
   2. Wiring Diagrams: Detail wiring and identify terminals for tap changing and connecting field-installed wiring.
   3. Product Certificates: Signed by manufacturers of transformers certifying that the products furnished comply with requirements.
   4. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
   5. Field Test Reports: Indicate and interpret test results for tests specified in Part 3.
   6. Maintenance Data: For transformers to include in the maintenance manuals specified in Division 01.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: In addition to requirements specified in Section 01450 (01 45 00) "Quality Control," an independent testing agency shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907; or shall be a full-member company of the InterNational Electrical Testing Association.

1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or the National Institute for Certification in Engineering Technologies, to supervise on-site testing specified in Part 3.

B. Listing and Labeling: Provide transformers specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

C. Comply with IEEE C2.

D. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit throughout periods during which equipment is not energized and is not in a space that is continuously under normal control of temperature and humidity.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Avendra, LLC Preferred Manufacturers:

1. None.

B. Approved Manufacturers:

1. Acme Electric Corp.; Transformer Division (800-334-5214)
2. Cutler-Hammer/Eaton Corp. (800-498-2678)
3. GE Electrical Distribution & Control (203-747-7111)
4. Siemens Energy & Automation, Inc. (800-964-4114)
5. Square D; a Division of Groupe Schneider (888-778-2733)

2.2 TRANSFORMERS, GENERAL

A. Description: Factory-assembled and -tested, air-cooled units of types specified, designed for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous copper windings without splices, except for taps.

D. Internal Coil Connections: Brazed or pressure type.

E. Enclosure: Class complies with NEMA 250 for the environment in which installed.

2.3 GENERAL-PURPOSE DISTRIBUTION AND POWER TRANSFORMERS

A. Comply with NEMA ST 20 and list and label as complying with UL 1561.

B. Cores: One leg per phase.

C. Windings: One coil per phase in primary and secondary.

D. Enclosure: Indoor, ventilated.

E. Insulation Class: 185 or 220 deg C class for transformers 15 kVA or smaller; 220 deg C class for transformers larger than 15 kVA.
   1. Rated Temperature Rise: 115 deg C maximum rise above 40 deg C.

F. Taps: For transformers 3 kVA and larger, full-capacity taps in high-voltage windings are as follows:
   1. Taps, 3 through 10 kVA: Two 5-percent taps below rated high voltage.
   2. Taps, 15 through 500 kVA: Six 2.5-percent taps, 2 above and 4 below rated high voltage.
   3. Taps, 750 kVA and Above: Four 2.5-percent taps, 2 above and 2 below rated high voltage.

G. K-Factor Rating: Transformers indicated to be K-factor rated are listed to comply with UL 1561 requirements for non-sinusoidal load current handling capability to the degree defined by the designated K-factor.
   1. Transformer design prevents overheating when carrying full load with harmonic content corresponding to the designated K-factor.
   2. Nameplate states the designated K-factor of the transformer.

H. Wall-Mounting Brackets: Manufacturer's standard brackets for transformers up to 45 kVA.

2.4 BUCK-BOOST TRANSFORMERS

A. Units comply with NEMA ST 1 and are listed and labeled as complying with UL 506 or UL 1561.

B. Description: Self-cooled dry type, rated for continuous duty, and connected as autotransformers to provide the percentage of buck or boost indicated.

2.5 CONTROL AND SIGNAL TRANSFORMERS

A. Units comply with NEMA ST 1 and are listed and labeled as complying with UL 506.

B. Ratings: Continuous duty. If rating is not indicated, provide capacity exceeding peak load by 50 percent minimum.

C. Description: Self-cooled, 2 windings.

2.6 FINISHES

A. Indoor Units: Manufacturer's standard paint over corrosion-resistant pretreatment and primer.

B. Outdoor Units: Comply with ANSI C57.12.28.

2.7 SOURCE QUALITY CONTROL

A. Factory Tests: Design and routine tests comply with referenced standards.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with safety requirements of IEEE C2.

B. Arrange equipment to provide adequate spacing for access and for circulation of cooling air.

C. Identify transformers and install warning signs according to Section 26 05 53 - "Identification for Electrical Systems."

D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.2 GROUNDING

A. Separately Derived Systems: Comply with NFPA 70 requirements for connecting to grounding electrodes and for bonding to metallic piping near the transformer.

B. Comply with Section 26 05 26 - "Grounding and Bonding for Electrical Systems" for materials and installation requirements.

3.3 FIELD QUALITY CONTROL

A. Test Objectives: To ensure transformer is operational within industry and manufacturer's tolerances, is installed according to the Contract Documents, and is suitable for energizing.

B. Test Labeling: On satisfactory completion of tests for each transformer, attach a dated and signed "Satisfactory Test" label to tested component.

C. Schedule tests and provide notification at least 7 days in advance of test commencement.

D. Report: Submit a written report of observations and tests. Report defective materials and installation.

E. Tests: Include the following minimum inspections and tests according to manufacturer's written instructions. Comply with IEEE C57.12.91 for test methods and data correction factors.

1. Inspect accessible components for cleanliness, mechanical and electrical integrity, and damage or deterioration. Verify that temporary shipping bracing has been removed. Include internal inspection through access panels and covers.
2. Inspect bolted electrical connections for tightness according to manufacturer's published torque values or, if not available, those specified in UL 486A and UL 486B.
3. Insulation Resistance: Perform megohmmeter tests of primary and secondary winding to winding and winding to ground.
   a. Minimum Test Voltage: 1000 V, dc.
   b. Minimum Insulation Resistance: 500 megohms.
   c. Duration of Each Test: 10 minutes.
   d. Temperature Correction: Correct results for test temperature deviation from 20 deg C standard.

F. Test Failures: Compare test results with specified performance or manufacturer's data. Correct deficiencies identified by tests and retest. Verify that transformers meet specified requirements.

3.4 CLEANING

A. On completion of installation, inspect components. Remove paint splatters and other spots, dirt, and debris. Repair scratches and mars on finish to match original finish. Clean components internally using methods and materials recommended by manufacturer.

3.5 ADJUSTING

A. After installing and cleaning, touch up scratches and mars on finish to match original finish.

B. Adjust transformer taps to provide optimum voltage conditions at utilization equipment throughout normal operating cycle of facility. Record primary and secondary voltages and tap settings and submit with test results.

C. Adjust buck-boost transformer connections to provide optimum voltage conditions at utilization equipment throughout normal operating cycle of facility.

D. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in readjusting transformer tap settings to suit actual occupied conditions. Provide up to 2 visits to Project site for this purpose without additional cost.
1. Voltage Recordings: Contractor performed. Provide up to 48 hours of recording on the low-voltage system of each medium-voltage transformer.
2. Point of Measurement: Make voltage recordings at load outlets selected by Owner’s Representative.

- END OF SECTION -

- SECTION 26 2300 -

LOW-VOLTAGE SWITCHGEAR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Furnish feeder switchgear, including main breakers, and distribution breaker sections as shown on drawings and specified herein.

1.3 SUBMITTALS

A. Provide shop drawings in accordance with Section 26 05 00, Electrical Submittals. Shop drawings shall completely describe switchgear to be furnished, and shall include:
   1. Show all specified requirements
   2. Scaled plan views
   3. Scaled elevation and sectional views
   4. Bussing Diagrams
   5. Schematic and physical wiring diagrams include point to point.
   6. Interconnect wiring list and/or diagram
   7. Power Fuse and circuit breaker time - coordination curves
   8. Fault and withstand ratings of all components
   9. Material list.
   10. Cut sheets
   11. Nameplate schedule
   12. Operation instructions
   13. Detail factory installed wiring and connections to be field provided.
   14. Metering provisions.

1.4 RELATED WORK

A. Section 26 36 23 - Automatic Transfer Switches

B. Section 26 43 13 - Surge Protection Devices

C. Section 26 09 13 - Multifunction Electronic Meter

1.5 STANDARDS

A. Switchgear Construction shall be in accordance with following standards:
1.
2. ANSI C37.90 - Relays and Relay Systems Associated with Electric Power Apparatus
3. ANSI C37.100 - Definitions for Power Switchgear
4. ANSI C57.13 - Definitions for Instrument Transformers
5. ANSI C37.90 - Relays and Relay Systems Associated with Electric Power Apparatus
6. ANSI Z55.1 - Gray Finishes for Industrial Apparatus and Equipment
7. NEMA SG-3 - Standards for Low-Voltage Power Circuit Breakers
8. NEMA SG-4 - Standards for Power Circuit Breakers
9. NEMA SG-5 - Power Switchgear Assemblies
10. ANSI/IEEE 28 - Surge Arresters for Alternating Current Power Circuits
11. ANSI/IEEE 472 - Guide for Surge Withstand Capability Tests
12. ANSI C37.13 - Low-Voltage AC Power Circuit Breakers Used in Enclosures
13. ANSI C37.16 - Preferred Ratings, Related Requirements and Application Recommendations for Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors
14. ANSI 37.30 - Switchgear Assemblies
15. ANSI C37.17 - Trip Devices for AC and General Purpose DC Low-Voltage Power Circuit Breakers
16. ANSI C37-39.1 - Meters
17. ANSI C37.50 - Test Procedures for Low-Voltage AC Power Circuit Breakers Used in Enclosures
18. UL 44 - Electric Wires and Cables
19. UL 977 - Fused Power Circuit Devices
20. UL 1558 - Metal Enclosed Low Voltage Power Circuit Breaker Switchgear
21. NFPA - 70

1.6 SEISMIC REQUIREMENTS

A. Switchgear shall be constructed with all necessary bracing required for installation in seismic zone specified in section 26 05 00.

PART 2 - PRODUCTS

2.1 SWITCHGEAR

A. The switchgear shall be freestanding, deadfront, front and rear accessible, and constructed in accordance with the latest noted standards, and as described herein. Rated for 120/208 277/480 volts, 3 phase, 4 wire, wye service as shown.

B. The switchgear shall be constructed with a welded or bolted steel channel, self-supporting frame. The switchgear shall be totally enclosed on sides, top and rear with 14 gauge (minimum) steel panels fastened to channel frame. Enclosing panels shall not be larger than 36" wide and 48" high and shall have rolled edges. Prime and paint with two coats of gray enamel or lacquer inside and outside. Mount on 1/4" x 3" galvanized channel set flush in concrete pad, and bolt to the channel. The rear of switchgear shall have hinged, full height doors with three point catches and lock. Rear doors over 24" wide shall be bi-parting full height. Provide insulated cable supports to completely support main and feeder conductors independent of breaker or transfer switch terminals (minimum 4 per section).

C. Bussing shall be constructed of 98% conductivity copper with silver plated joints. Size the bussing to carry the current noted on drawings. Size the bussing bar a maximum temperature rise of 65 degrees C. above 40 degrees C. ambient, except the minimum bus size shall be based on maximum current density of 1000 amps per square inch. Brace bussing to withstand (30 cycle) short circuit current of 65,000 rms symmetrical amperes or as indicated on the drawings at rated voltage. Insulate all buses from ground and other phases by a minimum of 2" air space or other accepted insulation system. Provide a full capacity neutral bus extended the full length of the switchgear. Provide a 1/4" x 4" copper ground bus extended full length of switchgear and bond to each cubicle. Provide a removable 1/4" x 4" copper link between neutral and ground busses where shown. Provide main bussing for future extension at the end cubicles. Insulate all bussing in pullboxes with polyester or PVC sleeves rated 600 volts. The Neutral bus shall not be encircled by a steel barrier. Bus penetrations shall be 1/2" thick glass polyester, NOHL or accepted equivalent material.

D. The Switchgear shall consist of sections as shown. Separate each section of switchgear with full height, full depth solid 14 gauge steel 300 series stainless steel, or alternative 1/2" thick glass polyester barriers. Compartment bussing and devices to provide 3 compartments in each cubicle: Breaker or fuse compartment, line bus compartment, and rear and bus cabling compartment with load bussing. "Insulated - Isolated" bus system by General Electric is an acceptable alternate to this compartmentation.

2.2 CIRCUIT BREAKERS:

A. Provide bypass (all position) contacts around all controls as required for operation of the breaker in test position.

B. Provide adjustable instantaneous, short time delay and pickup, and long time delay and pickup, solid state/digital trip sensors in each pole. Provide trip targets for each function.

C. Provide ground fault protection for all circuit breakers, except tie breakers, fire pump service and generator breaker annunication only. Ground fault detection consists of current transformers for each phase measuring the total zero sequence or residual ground current, which energizes tripping mechanism in breaker when this current exceeds a pre-selected value.

1. Pickup values for trips 225 amperes and smaller shall be adjustable from 5-60 amperes; larger than 225 amperes adjustable shall be adjustable from 100-1200 amperes.
2. Ground fault detector shall be equipped with adjustable trip currents and minimum of 3 time delay settings.
3. Feeder devices shall beset at minimum and main breaker set at maximum delay as required for coordination.
4. Provide each breaker with a ground fault target indicating ground fault tripping.

5. Ground fault protection may be included in the solid state trip units of the breaker. If separate ground fault protection relays are provided furnish a ground fault test panel mounted on front of switchgear.

D. Provide load studs into cable compartments for all breakers and spaces.

E. Provide bus risers in the rear compartment for connection to breakers to busways. Construct the bus risers the same as main bussing described above.

F. Each breaker capable of being locked in open position with padlock.

G. Acceptable Circuit Breaker Manufacturers:
1. General Electric
2. Eaton
3. Siemens
4. Square D

2.3 METERING

A. Provide following metering/relay equipment where shown:
1. Voltmeter, shall be self-contained or PT rated, analog 0-600 (480 volt system) (or) 0-300 (208 volt systems) volts full scale as shown, 1% accuracy, General Electric AB-40 or accepted equivalent.
2. Ammeter (scale as noted), shall be 1% accuracy, analog, General Electric AB 40 instantaneous reading type.
3. Provide multifunction Electronic Meter, See Section 16630 for complete specification of meter.
4. The Ammeter switch shall be 4 position, General Electric SBM or accepted equivalent by Electroswitch.

B. Provide a test block and necessary test plugs, switch current jacks and potential jacks accessible in rear of switchboard for portable recording meters.

C. Other acceptable metering equipment manufacturers:
1. Crompton
2. ESI
3. Siemens
4. Eaton

D. Mount all meters, switches, control fuses, etc. on hinged doors. Provide 1/4" thick, clear Plexiglas barrier on rear of door to protect personnel from inadvertent touch of live connections.

2.4 MISCELLANEOUS PROVISION:

A. The main entrance breaker and feeder protective devices shall constitute a fully rated, selective tripping system. Coordinate tripping so that the breaker nearest fault will operate first, and only the faulty portion of the circuit will be de-energized. Instantaneous magnetic trip setting and not to exceed five times the trip rating of the breaker except as required for coordination. Coordination settings shall be provided by Consultant.

B. Provide device nameplates (breakers, switches, fuses, control devices, etc.) for all devices and per Specification Section 26 0553.

C. No breaker handle shall be mounted higher than six feet six inches (6'-6") nor lower than twelve inches (12") above the floor.

D. Provide for each Switchgear three (3) spare fuses for each size and type fuse included in the switchgear.

E. Make provisions for future devices including all studs, copper work and provisions for mounting devices in the future without additional parts or changes in the bus or structure. Bus all usable physical space.

F. Provide a 3" x 2" cardholder with plastic cover and vellum board under or adjacent to each breaker for Owner's use.

G. All control fuses shall be plug-in neon indicating type, mounted on the front doors or in a Owner approved location and labeled, (fuses shall be UL labeled, FIC Corp.), Bussman or accepted equivalent with CLF fuses. Provide 1/4" thick clear Plexiglass barriered compartments behind the fuses to prevent accidental contact with the door open.

H. All control wiring shall be tinned stranded copper, 90°C, Type SIS, XHHW-2 and VW-1 flame retardant construction. Bundle control wiring in 12 wire bundles maximum. Terminate all control circuits and wiring in the switchgear on 600 volt, barriered terminal blocks with permanent marking. Terminate all control wiring with insulated long barrel (dual crimp) crimp on locking fork connectors equivalent to Thomas and Betts "Stakon". All current transformer wiring shall terminate on shorting type terminal blocks. Identify control wiring with permanently marked PVC or vinyl wire markers on each wire with marking to correspond with terminal identification. Wire markers equivalent to Thomas & Betts type WSL.

I. Lugs and cable connectors for power cables shall be solid, long copper barrel compression type, Burndy "Hydent", Thomas & Betts color keyed compression, Anderson VCL or accepted equivalent. All lugs #1/0 and larger shall have two bolt tongue.

2.5 ACCEPTABLE MANUFACTURERS:

A. Powercon

B. Russelectric

C. Siemens

D. ASCO

E. General Electric

F. Industrial Electric Manufacturing

G. Square D

H. Cutler-Hammer

I. ABB

PART 3 - EXECUTION

3.1 INSTALLATION

A. Feeders shall be tied to insulated cable supports and neatly formed and laced.

B. Coordinate the busway and cable bus entrances into the switchgear with the busway/cable bus manufacturer.

C. Mount switchgear lineups level on 3" channel iron recessed in concrete pads, and secure each cubicle with minimum two 1/2" bolts and inserts. Provide additional bolts and bracing to secure switchgear for the Seismic Zone specified above.

D. Wiring Diagrams and operating instructions shall be framed under glass and hung as directed by Consultant. Use extruded aluminum frames bolted to wall.

E. Provide 24" wide x 1/8" thick rubber insulating operator mats in the rear of each switchgear line-up. The mat shall be designed to lay flat without curling on the ends. DO NOT install with adhesive.

3.2 TESTING

A. Factory Testing:
   1. Test switchgear after fabrication as follows:
      a. Simulate all control and relay functions.
      b. Test complete operation of all breakers including electric operation.

B. Field Test switchgear in accordance with Section 26 05 00 Testing.

C. The Switchgear manufacturer shall furnish the Owner's personnel operating and maintenance training at the site of work for four hours at completion of installation and field tests. The time and date shall be selected by Owner.

3.3 GUARANTEE

A. Refer to 26 05 00 “Guarantee.”

- END OF SECTION -

- SECTION 26 2412 -

SERVICE ENTRANCE SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Furnish and install service entrance switchboards as herein specified and as shown on the drawings.

B. Acceptable manufacturers are Cutler-Hammer, General Electric, Siemens, and Square D.

C. Submit to the serving utility for approval of metering and underground pull sections prior to releasing order for manufacture.

D. Plant of manufacture shall be ISO 9001 or 9002 certified.

PART 2 - PRODUCTS

2.1 GENERAL

A. Service entrance switchboards shall be of the dead-front safety type with voltage and ampere capacity as indicated on the drawings. NEMA 1 for indoor and NEMA 3R for outdoor applications.

B. Switchboard framework shall be fabricated on die-formed steel base or assembly consisting of formed steel and commercial channel welded or bolted together to rigidly support entire shipping unit for moving on rollers and floor mounting. The framework is to be formed code gauge steel, rigidly welded and bolted together to support all cover plates, bussing and component devices during shipment and installation. Each switchboard section shall have an open bottom and individual removable top plate for installation and termination of conduit. Top and bottom conduit area is to be clearly shown and dimensioned on the shop drawings. All front plates used for mounting meters, selector switches or other front devices shall be hinged with all wiring installed and laced with flexibility at hinged side. All closure plates shall be screw-removable and small enough for easy handling by one man. Side wiring gutter covers on all switchboards shall be hinged for access to wiring space. Paint finish shall be enamel over a rust-inhibiting phosphate primer.

C. Switchboard bussing shall be copper or tin-plated aluminum. Bus bars shall be rigidly braced to comply with the integrated equipment rating of the switchboard. Main horizontal bus bars between sections shall be full size for their entire length and located on the back of the switchboard to permit a maximum of available conduit area. End sections shall have bus bar provisions for future addition of a switchboard section as indicated on the drawings. Provisions shall include bus bars installed to the extreme side of the switchboard and pre-punched to facilitate future bolted splice plates. Vertical bus bars shall extend the full height of each section and be pre-drilled on universal centers to allow connections to any standard sized branch unit. Provide a 25 percent minimum ground bus running the full length of the switchboard, but in no case smaller than 1/4" x 2" copper. Provide a 25 percent minimum isolated ground bus running the full length of the switchboard, but in no case smaller than 1/4" x 2" copper when the distribution board is indicated to serve isolated ground feeders.

D. Switchboards shall be listed for front access only, except as noted otherwise on the plans.

E. Each switchboard as a complete unit shall be given a single integrated equipment short circuit rating by the manufacturer. Such rating shall be established by actual tests by the manufacturer on similar equipment construction as subject switchboard. This test data shall be available and shall be furnished upon request.

F. All bussing shall be braced for a minimum integrated equipment short circuit current rating of 65,000A RMS symmetrical amperes, or as shown on the drawings.

G. Switchboards shall be provided with digital ammeter, voltmeter, and power system metering for each main as indicated on the drawings. Reference Specification Section 26 09 13. Stated functions may be combined into one device. Switchboards with only one main may omit customer power meter function.

2.2 CIRCUIT BREAKERS

A. Main circuit breakers shall be stationary type with static trips, UL listed for 100 percent continuous current rating in a switchboard, minimum 65,000 amperes interrupting capacity at 480 volts, except where noted otherwise on the drawings. The trip mechanism shall be ambient insensitive, and shall have adjustable long time delay (60 to 100 percent), adjustable short time delay, and instantaneous trips. Circuit breakers shall be manually operated to provide quick-make, quick-break operation, and shall be equipped with an electrical shunt trip capable of operation at 55 percent of rated voltage. Main load current contacts to be of multi-fingered construction.

B. Manual closing operation shall be by means of a handle located on the front of the circuit breaker, with a clearly visible push-to-open button.

C. Branch circuit breakers shall be equipped with individually insulated, braced and protected connectors. The front faces of all circuit breakers shall be flush with each other. Large, permanent, individual circuit numbers shall be affixed to each breaker in a uniform position. Tripped indication shall clearly be shown by the breaker handle taking a position between ON and OFF. Breaker interrupting capacities shall be as indicated on the drawings and adequate for the available fault current.

D. Reference Specification Section 26 28 16 for additional requirements.

2.3 FUSIBLE SWITCHES

A. Fusible switches 800 amperes and larger shall be of the high pressure contact type, 100 percent equipment rated, and have a contact interrupting rating of 12 times rated current when tripped electrically or manually. Where ground fault relaying is indicated, furnish an electrical shunt trip capable of operation at 55 percent of rated voltage, and blown fuse protection to protect against single phasing. Opening mechanism must be charged before switch can be closed.

B. Fusible switches 600 amperes and smaller shall be horsepower rated, quick-make, quick-break, with a minimum contact interrupting rating of 14 times its continuous current rating. All devices shall have cover interlocked to prevent opening door when switch is energized. The door interlock shall be defeatable by qualified personnel. It shall be possible to padlock each device in the OFF position.

C. Fusible switches 200 amperes and smaller shall be Class R rejection fuses as indicated on the drawings.

2.4 GROUND FAULT PROTECTION

A. Ground fault protection (GFP) shall be provided at the service mains operating at greater than 150 volts to ground and rated over 800 amps, or where indicated on the drawings.

B. Reference Specification Section 26 28 16 for specification of equipment and devices.

2.5 POWER SYSTEM METERING

A. Reference Specification Section 26 09 13.

B. Provide a meter as follows:
   1. Where noted within the specifications, on the drawings, and One-Line Diagram(s).

PART 3 - EXECUTION

3.1 MOUNTING

A. Circuit breakers and fusible switches 800 amperes and larger shall be individually mounted.

3.2 INSTALLATION

A. Arrange for delivery and installation of each switchboard prior to construction of major walls and/or roof, or provide for suitable openings to properly install switchboard. No allowance will be made for failure to comply with this requirement. All necessary corrections shall be the responsibility of the Contractor at no additional cost to the Owner.

B. Move each switchboard in sections to the location indicated on the drawings. Completely assemble the switchboard, shim the entire structure level with metal stock, securely bolt to concrete pad, caulk or grout any gaps at the floor line. Prior to final inspection, apply factory touch-up paint to any scratches, scrapes, etc., on switchboard enclosure.

- END OF SECTION -

- SECTION 26 2416 -

PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes:
   1. Service and Distribution Switchboards Rated 600 V and Less.
   2. Load Centers and Panelboards, Overucurrent Protective Devices, and Associated Auxiliary Equipment Rated 600V and Less for the following types:
      a. Lighting and Appliance Branch-Circuit Panelboards.
      b. Distribution Panelboards.

B. Related Sections include the following:
   1. Section 03 30 00 (03300) – Cast-In-Place Concrete.
   2. Section 26 05 19 (16490) – Low-Voltage Electrical Power Conductors and Cables.
   3. Section 26 05 48 (16071) – Vibration and Seismic Controls for Electrical Work.
   4. Section 26 05 53 (16075) – Identification for Electrical Systems.

1.3 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

B. SPDT: Single pole, double throw.

1.4 SUBMITTALS

A. Submit “Letter of Conformance” in accordance with Section 01 3300 indicating specified items selected for Project with the following supporting data:
   1. Product Data:
      a. For each type of switchboard, panelboard, overcurrent protective device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturer’s technical data on features, performance, electrical characteristics, ratings, and finishes.
   2. Shop Drawings: For each switchboard, panelboard and related equipment.

a. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
   1) Enclosure types and details for types other than NEMA 250, Type 1.
   2) Bus configuration, current, and voltage ratings.
   3) Short-circuit current rating of switchboards and overcurrent protective devices.
   4) Descriptive documentation of optional barriers specified for electrical insulation and isolation.
   5) Utility company's metering provisions with indication of approval by utility company.
   6) UL listing for series rating of installed devices.
   7) Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

b. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.

3. Manufacturer Seismic Qualification Certification: Submit certification that switchboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Section 26 0548 "Vibration and Seismic Controls for Electrical Work." Include the following:
   a. Basic of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   b. The term "withstand" means "the unit will remain in place without separation of internal and external parts during a seismic event."
   c. The term "withstand" means "the unit will remain in place without separation of internal and external parts during a seismic event and the unit will be fully operational after the event."
   d. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   e. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
4. Qualification Data: Submit data for testing agencies indicating that they comply with qualifications specified in "Quality Assurance" Article.
5. Field Test Reports: Submit written test reports and include the following:
   a. Test procedures used.
   b. Test results that comply with requirements.
   c. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
6. Manufacturer's field service report.
7. Updated mimic-bus diagram for switchboard reflecting field changes after final switchboard load connections have been made, for record.
8. Maintenance Data: For Switchboards, Panelboards and components to include in maintenance manuals specified in Division 01. In addition to requirements specified in Division 01 Section "Contract Closeout," include the following:
   a. Routine maintenance requirements for switchboards and all installed components.
   b. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

c. Time-current curves, including selectable ranges for each type of overcurrent protective device.

9. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Testing agency that is a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NEMA PB 2 for switchboards.

D. Comply with NEMA PB1 for panelboards.

E. Comply with NFPA 70.

F. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards, including clearances between switchboards, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver in sections of lengths that can be moved past obstructions in delivery path.

B. Store indoors in clean dry space with uniform temperature to prevent condensation. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.

C. Handle switchboards according to NEMA PB 2.1.

1.7 PROJECT CONDITIONS

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

B. Environmental Limitations: Rate equipment for continuous operation under the following, unless otherwise indicated:

1. Ambient Temperature: Not exceeding 110 deg F.

1.8 COORDINATION

A. Coordinate layout and installation of switchboards, panelboards, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 03 30 00 (03300) "Cast-in-Place Concrete."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Avendra, LLC Preferred Manufacturers:
   1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
      a. None.

B. Approved Manufacturers:
   1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
      a. Eaton Corp.; Cutler-Hammer Products (800-498-2678)
      b. General Electric Co.; Electrical Distribution & Control Div. (888-437-3765)
      c. Siemens Energy & Automation, Inc. (800-864-4114)
      d. Square D Co.; a Division of Groupe Schneider (888-778-2733)

2.2 PANELBOARDS - FABRICATION AND FEATURES

A. Enclosures: Flush- and/or surface-mounted cabinets as indicated on drawings. NEMA PB 1, Type 1, to meet environmental conditions at installed location.
   1. Outdoor Locations: NEMA-3R.
   2. Kitchen Areas: NEMA-4X, stainless steel.
   3. Other Wet or Damp Indoor Locations: NEMA-4.

B. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.

C. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.

D. Door in Door: Entire wireway shall be accessible via door in door trim continuous hinge.

E. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.

F. Directory Card: With transparent protective cover, mounted inside metal frame, inside panelboard door.

G. Bus: Hard-drawn copper, 98 percent conductivity or tin-plated aluminum.

H. Main and Neutral Lugs: Mechanical type suitable for use with conductor material.

I. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.

J. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.

K. Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box.

L. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.

M. Gutter Barrier: Arrange to isolate individual panel sections.

N. Feed-through Lugs: Mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

2.3 PANELBOARDS - SHORT-CIRCUIT RATING

A. UL label indicating series-connected rating with integral or remote upstream devices. Include size and type of upstream device allowable, branch devices allowable, and UL series-connected short-circuit rating.

B. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.4 PANELBOARDS - LIGHTING AND APPLIANCE BRANCH-CIRCUITS

A. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.

B. Doors: Front mounted with concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.5 PANELBOARDS - DISTRIBUTION

A. Doors: Front mounted, except omit in fused-switch panelboards; secured with vault-type latch with tumbler lock; keyed alike.

B. Main Overcurrent Protective Devices: Circuit breaker.

C. Branch overcurrent protective devices shall be one of the following:
1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

2.6 LOAD CENTERS

A. Overcurrent Protective Devices: Plug-in, full-module circuit breaker.

B. Conductor Connectors: Mechanical type for main, neutral, and ground lugs and buses.

2.7 PANELBOARDS - OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
   1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
   2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
   3. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
      a. Instantaneous trip.
      b. Long- and short-time pickup levels.
      c. Long- and short-time time adjustments.
      d. Ground-fault pickup level, time delay, and I2t response.
   4. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
   5. GFCI Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity.

B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
   1. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of conductors.
   2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
   3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
   4. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
   5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.

2.8 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

2.9 EXAMINATION

A. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

2.10 INSTALLATION

A. Install switchboards and accessories according to NEMA PB 2.1.

B. Install panelboards and accessories according to NEMA PB 1.1

C. Support switchboards on concrete bases, 4-inch nominal thickness.

D. Comply with mounting and anchoring requirements specified in Section 26 05 48 (16071) "Seismic Controls for Electrical Work."

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.

F. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

G. Mounting of Panelboards: Plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.

H. Circuit Directory: Create a directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

I. Install filler plates in unused spaces.

J. Provision for Future Circuits at Flush Panelboards: Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.

K. Wiring in Panelboard Gutters: Arrange conductors into groups and bundle and wrap with wire ties after completing load balancing.

2.11 CONNECTIONS

A. Install equipment grounding connections for switchboards with ground continuity to main electrical ground bus.

B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

2.12 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:
   1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

B. Testing: After installing switchboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Sections 7.1, 7.5, 7.6, 7.9, 7.10, 7.11, and 7.14 as appropriate. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

C. Balancing Loads: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes as follows:
1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data-processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

2.13 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

2.14 CLEANING

A. On completion of installation, inspect interior and exterior of switchboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

- END OF SECTION -

- SECTION 26 2500 -

ENCLOSED BUS ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This section defines low voltage indoor and outdoor busway, fittings and plug-in units for use in AC systems, rated 600 V or less.

1.3 SUBMITTALS

A. Provide product information prior to fabrication and installation. Product data shall include all dimensions, weights, electrical ratings, wiring diagrams and required clearances.
   1. Show fabrication and installation details for enclosed bus assemblies.
   2. Show fittings, materials, fabrication, and installation methods for listed fire-stop barriers.

B. When requested, provide additional product data and certifications necessary to show conformance with this specification. Additional data limited to routine factory tests.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

B. Provide information for record purposes including field test reports and maintenance data.

1.5 RELATED STANDARDS

A. Comply with requirements of latest revisions of applicable industry standards, specifically including the following:
   1. NEMA BU 1.1 – Busways.
   2. UL 857 - Underwriters Laboratories Busway Standard.
   3. CSA C22.2 No. 27, Busway.
   4. NFPA 70 – National Electrical Code.
   5. UL 1479 - Underwriters Laboratories Fire Test of Through Penetration Firestop.

6. IBC (International Building Code), CBC (California Building Code) – Siesmic Compliance.

B. Manufacturer Seismic Qualification: The low voltage busway shall meet and be certified to seismic requirements specified in the IBC 2006 International Building Code. The low voltage busway shall be complaint with IBC 2006 parameters:
   1. Building Occupancy Category as defined in per the IBC Hazard Exposure Group I, Acceleration factor 0.075G

1.6 QUALITY ASSURANCE

A. All busway products shall be manufactured in a facility which has:
   1. A Quality Management System registered to ISO9001:2000 (EN ISO 9001:2000; BS EN ISO 9001:2000; ANSI ASQ 9001:2000).
   2. An Environmental Management System registered to ISO 14001:2004.

1.7 REGULATORY REQUIREMENTS

A. Underwriters Laboratories Listing:
   1. All straight lengths, fittings and plug-in units shall be listed and marked in accordance with UL Standard No. 857.
   2. This listing shall include mounting of the busway in any position (i.e. horizontal flat wise, horizontal edgewise and vertical) without derating.

1.8 DELIVERY, STORAGE AND HANDLING

A. Refer to NEMA Publication BU1.1, which is a guide for proper installation, operation and maintenance of busway products.

B. Handle busway in accordance manufacturer's recommendations. Utilize factory provisions for all lifting, rigging, or hoisting.

C. Store busway prior to installation in a temperature and humidity controlled space.

1.9 PROJECT CONDITIONS

A. Derate enclosed bus assemblies for continuous operation at indicated ampere ratings for ambient temperature not exceeding 110 deg F.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Products.
2. General Electric Company; Electrical Distribution & Control Division.
3. Siemens Energy & Automation, Inc.
4. Square D; Schneider Electric.

2.2 ENCLOSED BUS ASSEMBLIES

A. General

1. Furnish and install a complete low impedance prefabricated busway distribution system as shown on the plans.
2. Busway shall be rated as noted on plan drawings with minimum 50% capacity integral ground. Aluminum housing shall qualify for grounding purposes.
3. Temperature Rise: 55 deg C above 40 deg C ambient maximum for continuous rated current.
4. The ampere ratings, approximate footage, fitting, plug-in units, etc., are shown on the plans. The electrical contractor shall be responsible for routing the busway to coordinate with the other trades. Final field measurements shall be made by the contractor prior to release of the busway for fabrication.

B. Short-Circuit Rating And Tests

1. The short-circuit rating of the busway shall be as noted on plan, minimum 65,000 RMS symmetrical amperes.
2. The short circuit rating of the busway shall be determined according to UL Standard No. 857. This rating must be based upon actual tests at the rated short-circuit current for six (6) cycles.

2.3 CONSTRUCTION

A. Housing

1. The busway housing shall be of 100% aluminum construction and painted with polyester urethane powder paint to provide protection against corrosion.
2. The busway housing shall be totally enclosed non-ventilated for protection against mechanical damage and dust accumulation.
3. The busway shall be certified for IP 40 Indoor.

B. Joint

1. The busway joint shall be of the one-bolt type which utilizes a high strength steel bolt(s) and Belleville washers to maintain proper pressure over a large contact surface area.
2. The bolt shall be torque indicating, fully insulated and at ground potential.
3. The bolt shall be two-headed design to indicate when proper torque has been applied and require only a standard long handle wrench to be properly activated.
4. Access shall be required to only one side of the busway for tightening joint bolts.
5. The joint shall allow +/- .625” (15.8mm) adjustment in section length.
6. It shall be possible to remove any joint connection assembly to allow electrical isolation or physical removal of a busway length without disturbing adjacent busway lengths.

C. Bus Bars
1. The bus bars shall be fabricated from high strength, 98 percent conductivity copper and suitably plated at all contact surfaces to ensure good electrical contact at all joints and plug-in tap-off points.
2. Each bus bar shall be insulated over its entire length (except for contact surfaces) with an electrostatically applied, Class B (130ºC certified) epoxy insulation.
3. The temperature rise at any point in the busway shall not exceed 55°C rise above ambient temperature when operating at rated load current.
4. Both feeder and plug-in busway shall be of sandwich construction meaning no air gap shall exist between bus bars except at the joints.
5. Bus bars for plug-in busway shall incorporate integral (not welded) tap-off locations for plug-in units to ensure 100% electrical continuity.

D. Support Of Busway
1. Hanger spacing shall be noted on layout drawings or installation instructions and shall not exceed manufacturer's recommendations.
2. Feeder and plug-in busway shall be approved for hanger spacing of up to 10'0" for horizontally mounted runs and up to 16'0" for vertically mounted runs.

E. Plug-In Openings
1. On plug-in busway there shall be five dead-front, hinged cover type plug-in openings on each side of ten foot lengths.
2. All openings shall be usable simultaneously.
3. Busway shall be installed so that plugs are side mounted to permit practical use of all ten plug-in openings.
4. It shall be possible to inspect the plug-in opening and bus bars prior to the installation of the plug-in unit.
5. Plug-in openings to be finger safe (IP2X) with the plug-in cover open.

F. Plug-In Units
1. Plug-in units shall be circuit breaker type with visible blade, & quick make / quick break mechanism.
2. Plug-in units, which cannot be operated directly from the floor, shall be equipped with suitable means for hook stick operation.
3. The interrupting rating of circuit breaker plug-in units shall match the busway rating RMS symmetrical amperes.

G. Plug-In Unit Safety Devices
1. Each plug-in unit shall be mechanically interlocked with the busway housing to prevent installation or removal of plug-in units while the switch is in the ON position.
2. Plug-in enclosures shall make positive ground connection with the ground bus before the contact fingers make contact with the phase bars.
3. The plug-in units shall be equipped with internal barriers to prevent accidental contact with live parts on the line side of the protective device during time of wire pulling.
4. Covers of all plug-in units must have "releasable" type interlocks to prevent the cover from being opened when the switch is in the ON position.

H. Expansion Section

1. Expansion sections shall be provided and installed for every:
   a. 200 foot continuous busway run.
   b. Building expansion joint traversed.

2. The busway run shall be positioned to accommodate all expansion sections.

I. Voltage Drop

1. The voltage drop (input voltage minus output voltage) specified shall be based on the busway operating at full rated current and at stabilized operating temperature in 35º C ambient temperature.
2. The three-phase, line-to-line voltage drop shall not exceed 4.0 volts per hundred feet at 70% power factor concentrated load, which condition may exist during motor starting.

J. Fire Rating

1. The busway shall be UL listed to meet two-hour fire ratings for gypsum wallboard construction and three-hour fire rating for poured concrete or concrete block construction.

K. Seismic Rating

1. The busway shall be qualified for use in seismic areas as follows:
   a. 1997 UBC, 2001 CBC Zone 4 (1 Bar/Pole) and Zone 3 (2 Bar/Pole).
   b. 2006 IBC, 2007 CBC
      1) Single Bar/Pole=187% g, (Sps = 1.25)
      2) Two Bar/Pole=93% g (Sps = 0.62)

2. Seismic compliance shall be qualified only through shake table testing. Compliance by calculation is not acceptable.

L. Transient Surge Protection / Surge Protection Device (SPD)

1. Each busway run shall be protected by at least one Plug-In with integral Surge Protection Device “SPD”.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Support bus assemblies independent of supports for other elements such as equipment enclosures at connections to panelboards and switchboards, pipes, conduits, ceilings, and ducts.

1. Design each fastener and support to carry load indicated by seismic requirements and to comply with seismic-restraint details according to Section 260548 "Vibration and Seismic Controls for Electrical Systems."
2. Design each fastener and support to carry 200 lb (90 kg) or 4 times the weight of bus assembly, whichever is greater.
3. Support bus assembly to prevent twisting from eccentric loading.

4. Support bus assembly with not less than 3/8-inch (10-mm) steel rods. Install side bracing to prevent swaying or movement of bus assembly. Modify supports after completion to eliminate strains and stresses on bus bars and housings.
5. Fasten supports securely to building structure according to Section 260529 "Hangers and Supports for Electrical Systems."

B. Install expansion fittings at locations where bus assemblies cross building expansion joints. Install at other locations so distance between expansion fittings does not exceed manufacturer's recommended distance between fittings.

C. Construct rated fire-stop assemblies where bus assemblies penetrate fire-rated elements such as walls, floors, and ceilings. Seal around penetrations according to Section 078413 "Penetration Firestopping."

D. Install weatherseal fittings and flanges where bus assemblies penetrate exterior elements such as walls or roofs. Seal around openings to make weathertight. See Section 079200 "Joint Sealants" for materials and application.

E. Install a concrete curb at least 4 inches (100 mm) high around bus-assembly floor penetrations.

F. Coordinate bus-assembly terminations to equipment enclosures to ensure proper phasing, connection, and closure.

G. Tighten bus-assembly joints with torque wrench or similar tool recommended by bus-assembly manufacturer. Tighten joints again after bus assemblies have been energized for 30 days.

H. Install bus-assembly, plug-in units. Support connecting conduit independent of plug-in unit.

I. Set field-adjustable, circuit-breaker trip ranges [**and overload relay trip settings**] as indicated.

3.2 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of bus assembly including joints and plug-in units.

    a. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
    b. Perform 2 follow-up infrared scans of bus assembly, one at 4 months and the other at 11 months after Substantial Completion.
    c. Prepare a certified report identifying bus assembly checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

- END OF SECTION -

- SECTION 26 2660 -

LIGHTING ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Time Switches
   2. Photoelectric Relays
   3. Multi-pole Lighting Relays and Contactors.

B. Related Sections:
   1. Section 01 8113 - Sustainable Design Requirements
   2. Section 10 1400 - Signage
   3. Section 26 0500 – General Provisions.
   4. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables.
   5. Section 26 0533 - Raceways and Boxes For Electrical Systems.
   6. Section 26 0553 - Identification for Electrical Systems.
   7. Section 26 2726 - Wiring Devices: For wall-box dimmers and manual light switches.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

B. Submit “Letter of Conformance” in accordance with Section 01 3300 indicating specified items selected for use in project with the following supporting data.
   1. Product Data:
      a. Include dimensions and data on features, components, and ratings for lighting control devices.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, for their indicated use and installation conditions by a testing agency acceptable to authorities having jurisdiction.

B. Comply with NFPA 70.

1.5 COORDINATION

A. Coordinate features of devices specified in this Section with systems and components specified in other Sections to form an integrated system of compatible components. Match components and interconnections for optimum performance of specified functions. Include coordination with the following:
   1. Section 26 2400 - "Switchboards and Panelboards."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

1. Time Switches:
   a. None
2. Photoelectric Relays:
   a. None

B. Approved Manufacturers:
   1. Contactors and Relays:
      a. Challenger Electrical Equipment Corp. (412-920-2400)
      b. Cutler-Hammer Products; Eaton Corporation (800-498-2678)
      c. GE Lighting Controls (888-437-3765)
      d. Hubbell Lighting, Inc. (864-599-6000)
      e. Siemens Energy and Automation, Inc. (800-964-4114)
      f. Square D Co.; a Division of Groupe Schneider, Power Management Organization (888-778-2733)
   2. Time Switches:
      a. Diversified Electronics, Inc. (800-874-0619)
      b. Intermatic, Inc. (815-675-7000)
      c. Tork, Inc. (914-664-3542)
      d. Leviton Manufacturing Co., Inc. (718-229-4040).
   3. Photoelectric Relays:
      a. Allen-Bradley/Rockwell Automation (414-382-2000)
      b. Intermatic, Inc. (815-675-7000)
      c. Rhodes: M H Rhodes, Inc. (800-548-3647)
      d. Tork, Inc. (914-664-3542)

2.2 GENERAL LIGHTING CONTROL DEVICE REQUIREMENTS

A. Line-Voltage Surge Protection: Include in all 120- and 277-V solid-state equipment. Comply with UL 1449 and with ANSI C62.41 for Category A locations.

2.3 TIME SWITCHES

A. Description: Solid-state programmable units with alphanumeric display complying with UL 917.
   1. Astronomic dial.
   2. Two contacts, rated 30 A at 277-V ac, unless otherwise indicated.
   3. Two pilot-duty contacts, rated 2 A at 240-V ac, unless otherwise indicated.
   4. Eight-day program uniquely programmable for each weekday and holidays.
   5. Skip-day mode.

2.4 PHOTOELECTRIC RELAYS

A. Description: Solid state, with single-pole, double-throw dry contacts rated to operate connected relay or contactor coils or microprocessor input, and complying with UL 773A.

B. Light-Level Monitoring Range: 0 to 3500 fc with an adjustment for turn-on/turn-off levels.

C. Time Delay: Prevents false operation.

D. Outdoor Sealed Units: Weathertight housing, resistant to high temperatures and equipped with sun-glare shield and ice preventer.

2.5 MULTI-POLE CONTACTORS AND RELAYS

A. Description: Electrically operated and mechanically held, and complying with UL 508 and NEMA ICS 2.
   1. Current Rating for Switching: UL listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballasts with 15 percent or less total harmonic distortion of normal load current).
   2. Control Coil Voltage: Match control power source.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install equipment level and plumb and according to manufacturer's written instructions.

B. Mount lighting control devices according to manufacturer's written instructions and requirements in Section 26 0500 – General Provisions.

C. Mounting heights indicated are to bottom of unit for suspended devices and to center of unit for wall-mounting devices.

3.2 CONTROL WIRING INSTALLATION

A. Install wiring between sensing and control devices according to manufacturer's written instructions and as specified in Section 26 0519 - "Low-Voltage Electrical Power Conductors and Cables" for low-voltage connections.

B. Wiring Method: Install all wiring in raceway as specified in Section 26 0533 "Raceways and Boxes for Electrical Systems."

C. Bundle, train, and support wiring in enclosures.

D. Ground equipment.

E. Connections: Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

3.3 IDENTIFICATION

A. Identify components and power and control wiring according to Section 26 0553 - "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Schedule visual and mechanical inspections and electrical tests with at least seven days' advance notice.

B. Inspect control components for defects and physical damage, testing laboratory labeling, and nameplate compliance with the Contract Documents.

C. Check tightness of electrical connections with torque wrench calibrated within previous six months. Use manufacturer's recommended torque values.

D. Verify settings of photoelectric devices with photometer calibrated within previous six months.

E. Electrical Tests: Use particular caution when testing devices containing solid-state components. Perform the following according to manufacturer's written instructions:

1. Continuity tests of circuits.
2. Operational Tests: Set and operate devices to demonstrate their functions and capabilities in a methodical sequence that cues and reproduces actual operating functions.
    a. Include testing of devices under conditions that simulate actual operational conditions. Record control settings, operations, cues, and functional observations.

F. Correct deficiencies, make necessary adjustments, and retest. Verify that specified requirements are met.

G. Test Labeling: After satisfactory completion of tests and inspections, apply a label to tested components indicating test results, date, and responsible agency and representative.

H. Reports: Written reports of tests and observations. Record defective materials and workmanship and unsatisfactory test results. Record repairs and adjustments.

3.5 CLEANING

A. Cleaning: Clean equipment and devices internally and externally using methods and materials recommended by manufacturers, and repair damaged finishes.

- END OF SECTION -

- SECTION 26 2726 -

WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Receptacles, Connectors, Switches, and Finish Plates.

B. Related Sections:
1. Section 00 31 1343 - Interior Finish Index
2. Section 01 8113 - Sustainable Design Requirements
3. Section 25 5110 – Integrated Automation Control of Guestroom Equipment
4. Section 26 0553 – Identification for Electrical Systems.

1.3 REFERENCES

A. National Electrical Manufacturer’s Association (NEMA) Standards Publications:
1. WD 1 “General Color Requirements for Wiring Devices”
2. WD 6 “Wiring Devices—Dimensional Requirements”

B. National Fire Protection Association (NFPA) Publications:
1. 70 "National Electric Code"

C. Underwriter's Laboratories, Inc. (UL) Publications:
1. 486A “Standard For Wire Connectors and Soldering Lugs for Use with Copper Conductors”
2. 486B “Standard for Wire Connectors for Use with Aluminum Conductors”

1.4 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

1.5 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

B. Submit "Letter of Conformance" in accordance with Section 01 3300 indicating specified items selected for use in project with the following supporting data.
   1. Maintenance Data: For materials and products to include in *maintenance manuals specified in Division 01.*

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

B. Comply with NEMA WD 1.

C. Comply with NFPA 70.

1.7 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug NEMA configurations.
   1. Cord and Plug Sets: Match equipment requirements.

1.8 EXTRA MATERIALS

A. Furnish extra materials described in Section 01 7843 "Spare Parts and Materials" that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Deliver extra materials to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved Manufacturers:
   1. Receptacles, Switches and Wall Plates
      a. Legrand (877-295-3472)
      b. Leviton Manufacturing Co., Inc. (800-736-6682).
      c. Lutron Electronics Company, Inc (888-LUTRON1)
   2. Wiring Devices:
      a. GE Company; GE Wiring Devices (401-886-6200)
      b. Hubbell, Inc.; Wiring Devices Div. (203-882-4900)
      c. Killark Electric Manufacturing Co. (314-531-0460)
      d. Legrand (877-295-3472)
      e. Leviton Manufacturing Co., Inc. (800-736-6682).
   3. Illuminated Night Light with Sensor

a. Legrand (877-295-3472)

4. Pendant Cord and Connector Devices
   a. GE Company; GE Wiring Devices (401-886-6200)
   b. Hubbell, Inc.; Wiring Devices Div. (203-882-4900)
   c. Killark Electric Manufacturing Co. (314-531-0460)
   d. Legrand (877-295-3472)
   e. Leviton Manufacturing Co., Inc. (800-736-6682).
5. Cord and Plug Sets
   a. GE Company; GE Wiring Devices (401-886-6200)
   b. Hubbell, Inc.; Wiring Devices Div. (203-882-4900)
   c. Killark Electric Manufacturing Co. (314-531-0460)
   d. Legrand (877-295-3472)
   e. Leviton Manufacturing Co., Inc. (800-736-6682).
6. Multioutlet Assemblies:
   a. Airey-Thompson Co. (800-421-61969)
   b. Wiremold (800-621-0049)
7. Poke-through, Floor Service Outlets and Telephone/Power Poles:
   a. Hubbell, Inc.; Wiring Devices Div. (203-882-4900)
   b. Legrand (877-295-3472)
   c. Square D Co.; a Division of Groupe Schneider (888-778-2733)
   d. Wiremold. (800-621-0049)

2.2 RECEPTACLES

A. Straight Blade and Locking Type Recptacles: General duty grade, NEMA 5-20R duplex type.

B. GFCI Receptacles: Feed-through type, with integral NEMA WD 6, Configuration 5-20R duplex receptacle arranged to protect connected downstream receptacles on same circuit. Design units for installation in a 2-3/4-inch- deep outlet box without an adapter.

2.3 SWITCHES

A. Toggle Switches:
   1. Snap Switches: General-duty, quiet type.
   2. Combination Switch and Receptacle: Both devices in a single gang unit with plaster ears and removable tab connector that permit separate or common feed connection.
      a. Switch: 20 A, 120/277-VAC.
      b. Receptacle: NEMA WD 6, Configuration 5-15R.
   3. Where more than one switch occurs at the same location, they shall be ganged under one plate. Where space does not permit horizontal ganging, interchangeable type switches may be used, only with approval of the Owner's Representative.
   4. Locations:
      a. All Public Space locations, except Lobby spaces.
      b. All Back-of-House locations.

5. Switches shall be 15 AMP; 120/277 VAC, side-wired with grounding screw similar to "Decora Devices" as manufactured by Leviton Manufacturing Co., Inc., or approved substitution by listed manufacturers.
6. Switch and matching cover plate that hides the screws.
7. Where more than one switch occurs at the same location, they shall be ganged under one plate. Where space does not permit horizontal ganging, interchangeable type switches may be used, only with approval of the Owner's Representative.
8. Locations:
   a. Lobby Spaces.
   b. Guestrooms.

B. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switches and audible and electromagnetic noise filters.
1. Control: Continuously adjustable slide. Single-pole or three-way switch to suit connections.
2. Incandescent Lamp Dimmers: Modular, 120 V, 60 Hz with continuously adjustable slide; single pole with soft tap or other quiet switch; electromagnetic filter to eliminate noise, RF, and TV interference; and 5-inch wire connecting leads.
3. Fluorescent Lamp Dimmers: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming to a maximum of 1 percent of full brightness, with filters to reduce audible noise, RF and TV interference.

2.4 WALL PLATES

A. Single and combination types match corresponding wiring devices.
1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Provide plates for all devices and outlets with opening configuration suitable for devices to be covered.
3. Plates shall be smooth nylon plastic secured in place with screws finished to match the plates. Back of the house areas, such as equipment spaces, shall have steel plates. Stainless steel plates shall be used in kitchens. Weatherproof plates shall be used where exposed to the weather or in pool area.
4. Color:

	Device Location	Wall Finish (Int. Finish Index #)	Color
a.	Lobby Space Dark Wall Covering:	324	Brown/Mahogany
b.	Lobby Space Orange Painted Walls (Transformations Decor):	316	Aluminum* Cover Plates with Black Devices
c.	Lobby Space Blue Painted Walls (Twilight Decor):	316	Aluminum* Cover Plates with Black

e. Color of devices shall match cover plates, unless noted otherwise.

***Note: Stainless Steel cover plates are acceptable if aluminum is not available.**

f.	**Guestroom Red colored kitchen walls:**	**302**	**Black**
g.	**Guestroom Headboard wall areas:**	**344**	**Black**
h.	**Upgrade Option: Guestroom Red colored kitchen walls:**	**302**	**Stainless Steel Cover Plates with Black Devices**
i.	**Upgrade Option: Guestroom Headboard wall areas:**	**344**	**Stainless Steel Cover Plates with Black Devices**
j.	**All other locations:**	**Varies**	**White**

k. Color of devices shall match cover plates, unless noted otherwise.

2.5 PENDANT CORD/CONNECTOR DEVICES

A. Description: Matching, locking type, plug and receptacle body connector, NEMA WD 6, Configurations L5-20P and L5-20R, Heavy-Duty grade.

1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.6 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded-copper conductors, with type SOW-A jacket. Green-insulated grounding conductor, and equipment-rating ampacity plus a minimum of 30 percent.
2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.7 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type, dual-service units suitable for wiring method used.

B. Compartmentation: Barrier separates power and signal compartments.

C. Housing Material: Die-cast aluminum, satin finished.

D. Power Receptacle: NEMA WD 6, Configuration 5-20R, gray finish, unless otherwise indicated.

E. Signal Outlet: Blank cover with bushed cable opening, unless otherwise indicated.

2.8 POKE-THROUGH ASSEMBLIES

A. Description: Factory-fabricated and -wired assembly of below-floor junction box unit with multi-channeled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
   1. Size: Selected to fit nominal 3-inch cored holes in floor and matched to floor thickness.
   2. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
   3. Closure Plug: Arranged to close unused 3-inch cored openings and reestablish fire rating of floor.
   4. Wiring: Three No. 12 AWG power and ground conductors; one 75-ohm coaxial telephone/data cable; and one four-pair, 75-ohm telephone/data cable.

2.9 MULTIOUTLET ASSEMBLIES

A. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

B. Raceway Material: Metal, with manufacturer's standard finish.

C. Wire: No. 12 AWG.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install devices and assemblies plumb and secure.

B. Protect devices and assemblies during painting. Install wall plates when painting is complete.

C. Install wall dimmers to achieve indicated rating after derating for ganging as instructed by manufacturer.

D. Do not share neutral conductor on load side of dimmers.

E. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.

F. Adjust locations at which floor service outlets and telephone/power service poles are installed to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

A. Comply with Section 26 0553 "Identification for Electrical Systems."
   1. Switches: Where three or more switches are ganged, and elsewhere as indicated, identify each switch with approved legend engraved on wall plate.
   2. Receptacles: Identify panelboard and circuit number from which served. Use machine-printed, pressure-sensitive, abrasion-resistant label tape on face of plate and durable wire markers or tags within outlet boxes.

3.3 CONNECTIONS

A. Connect wiring device grounding terminal to branch-circuit equipment grounding conductor.

B. Isolated-Ground Receptacles: Connect to isolated-ground conductor routed to designated isolated equipment ground terminal of electrical system.

C. Tighten electrical connectors and terminals according to manufacturers published torque-tightening values. If manufacturers torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Test wiring devices for proper polarity and ground continuity. Operate each device at least six times.

B. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.

C. Replace damaged or defective components.

3.5 CLEANING

A. Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

- END OF SECTION -

- SECTION 26 2813 -

FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Furnish and install fuses and circuit breakers as specified herein and as indicated on the drawings.

B. Acceptable fuse manufacturers are Bussmann, LittelFuse, and Ferraz.

C. Circuit breakers shall be manufactured by the same manufacturer as the equipment within which they are installed.

D. Submittals: Submit short circuit interrupting data for all overcurrent devices. Include UL series combination rating data, where applicable, with equipment submittals. Clearly indicate each rating and/or combination being utilized.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide termination lug quantities to accommodate conductor sizes and quantities shown on the drawings. Increase circuit breaker frame sizes as required.

B. Fuses:

1. Fuses protecting motor branch circuits shall be UL Class RK-5, time-delay, 600- or 250-volt, 200,000 amperes RMS symmetrical interrupting rating, sized at 115% to 125% of motor nameplate full load amperes (Bussmann LPS-RK or LPN-RK).
2. Fuses shall be applied considering upstream devices, in accordance with their UL series combination ratings. All applications of fuses shall be on a single fuse per phase leg basis.
3. Furnish and deliver spare fuses to the Owner as follows:
   a. Three spares for each type and size, in excess of 60 amperes, used for initial fusing.

b. Ten percent or minimum of three spares for each type and size, up to and including 60 amperes, used for initial fusing.

Provide a NEMA -12 spare fuse cabinet with appropriate shelving, and size as required to accommodate spare fuses supplied. Hoffman, Hammond, or as accepted. Provide 1" x 4", laminated, black text on white micarta nameplate with script “SPARE FUSES.”

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fuses:
1. Install fuses in such a manner as to expose manufacturer’s label indicating model number and ratings.
2. Legibly write the design fuse type on the inside of the switch cover with an indelible ink marker.
3. Coordinate installation location of the spare fuse cabinet with the Owner, and install prior to Project Closeout.

3.2 OVERCURRENT SIZE VERIFICATION

A. Confirm maximum overcurrent protective device (MOCP) ratings with mechanical accepted shop drawings for equipment supplied PRIOR TO ORDERING. The Contractor shall adjust the supply circuit breaker and/or fuse ratings to match accepted shop drawing MOCP data per the NEC.

B. Where equipment includes an adjustable speed drive, upstream overcurrent device and feeder size shall be adjusted to match the rated input current to the accepted drive furnished. In no case shall the overcurrent setting be less than 125% of the nameplate load. Refer to the NEC and Division 23 for requirements. Confirm accepted adjustable speed drives to be supplied PRIOR TO ORDERING related overcurrent device(s) and installing underground conduit.

C. Prior to project completion, the Contractor shall verify that MOCP ratings match nameplate data for installed equipment. Correct MOCP device sizes as required by the NEC.

- END OF SECTION -

- SECTION 26 2816 -

ENCLOSED SWITCHES & CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Individually Mounted Switches and Circuit Breakers Used for the following:
      a. Service Disconnect Switches.
      b. Feeder And Equipment Disconnect Switches.
      c. Feeder Branch-Circuit Protection.
      d. Motor Disconnect Switches.

B. Related Sections:
   1. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: For fuses in fusible disconnect switches.
   2. Section 26 0553 - Identification for Electrical Systems.
   3. Section 26 2726 - Wiring Devices: For attachment plugs and receptacles, and snap switches used for disconnect switches.

1.3 SUBMITTALS

A. Submit “Letter of Conformance” in accordance with Section 01 33 00 (01330) indicating specified items selected for use in Project with the following supporting data:
   1. Product Data:
      a. Descriptive data and time-current curves.
      b. Let-through current curves for circuit breakers with current-limiting characteristics.
      c. Coordination charts and tables and related data.
   2. Wiring diagrams detailing wiring for power and control systems and differentiating between manufacturer-installed and field-installed wiring.
   3. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of owners representative and owners, and other information specified.
   4. Field test reports indicating and interpreting test results.

5. Maintenance data for tripping devices to include in the operation and maintenance manual specified in Division 01.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: In addition to the requirements specified in Section 01 45 00 - "Quality Control," an independent testing agency shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907, or shall be a full member company of the InterNational Electrical Testing Association (NETA).
   1. Testing Agency's Field Supervisor: Person currently certified by NETA or the National Institute for Certification in Engineering Technologies, to supervise on-site testing specified in Part 3.

B. Source Limitations: Obtain disconnect switches and circuit breakers from one source and by a single manufacturer.

C. Comply with NFPA 70 for components and installation.

D. Listing and Labeling: Provide disconnect switches and circuit breakers specified in this Section that are listed and labeled.
   1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
   2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Avendra, LLC Preferred Manufacturers:
   1. Disconnect Switches:
      a. None
   2. Fusible Switches:
      a. None
   3. Molded-Case Circuit Breakers:
      a. None
   4. Combination Circuit Breaker and Ground Fault Trip:
      a. None
   5. Molded-Case, Current-Limiting Circuit Breakers:
      a. None

B. Approved Manufacturers:
   1. Disconnect Switches:
      a. General Electric Co.; Electrical Distribution and Control Division (888-437-3765)
      b. Siemens Energy & Automation, Inc. (800-964-4114)
      c. Square D Co.; a Division of Groupe Schneider (888-778-2733)

d. Eaton Corp. Cutler-Hammer Products (800-498-2678)

2. Fusible Switches:
   a. General Electric Co.; Electrical Distribution and Control Division (888-437-3765)
   b. Siemens Energy & Automation, Inc. (800-964-4114)
   c. Square D Co.; a Division of Groupe Schneider (888-778-2733)
   d. Eaton Corp. Cutler-Hammer Products (800-498-2678)
3. Molded-Case Circuit Breakers:
   a. General Electric Co.; Electrical Distribution and Control Division (888-437-3765)
   b. Siemens Energy & Automation, Inc. (800-964-4114)
   c. Square D Co.; a Division of Groupe Schneider (888-778-2733)
   d. Eaton Corp. Cutler-Hammer Products (800-498-2678)
4. Combination Circuit Breaker and Ground Fault Trip:
   a. General Electric Co.; Electrical Distribution and Control Division (888-437-3765)
   b. Siemens Energy & Automation, Inc. (800-964-4114)
   c. Square D Co.; a Division of Groupe Schneider (888-778-2733)
   d. Eaton Corp. Cutler-Hammer Products (800-498-2678)
5. Molded-Case, Current-Limiting Circuit Breakers:
   a. General Electric Co.; Electrical Distribution and Control Division (888-437-3765)
   b. Siemens Energy & Automation, Inc. (800-964-4114)
   c. Square D Co.; a Division of Groupe Schneider (888-778-2733)
   d. Eaton Corp. Cutler-Hammer Products (800-498-2678)

2.2 DISCONNECT SWITCHES

A. Enclosed, Non-fusible Switch: NEMA KS 1, Type HD, with lockable handle.

B. Enclosed, Fusible Switch, 800 A and Smaller: NEMA KS 1, Type HD, clips to accommodate specified fuses, enclosure consistent with environment where located, handle lockable with 2 padlocks, and interlocked with cover in CLOSED position.

C. Enclosure: NEMA KS 1, Type 1, unless otherwise specified or required to meet environmental conditions of installed location.
   1. Outdoor Locations: Type 3R.
   2. Kitchen Areas: Type 4X, stainless steel.
   3. Other Wet or Damp Indoor Locations: Type 4.

2.3 ENCLOSED CIRCUIT BREAKERS

A. Enclosed, Molded-Case Circuit Breaker: NEMA AB 1, with lockable handle.

B. Characteristics: Frame size, trip rating, number of poles, and auxiliary devices as indicated and interrupting rating to meet available fault current.

C. Application Listing: Appropriate for application, including switching fluorescent lighting loads or heating, air-conditioning, and refrigerating equipment.

D. Circuit Breakers, 200 A and Larger: Trip units interchangeable within frame size.

E. Circuit Breakers, 400 A and Larger: Field-adjustable, short-time and continuous-current settings.

F. Current-Limiting Trips: Where indicated, let-through ratings less than NEMA FU 1, Class RK-5.

G. Current Limiters: Where indicated, integral fuse listed for circuit breaker.

H. Lugs: Mechanical lugs and power-distribution connectors for number, size, and material of conductors indicated.

I. Shunt Trip: Where indicated.

J. Accessories: On drawings.

K. Enclosure: NEMA AB 1, Type 1, unless otherwise specified or required to meet environmental conditions of installed location.
   1. Outdoor Locations: Type 3R.
   2. Kitchen Areas: Type 4X, stainless steel.
   3. Other Wet or Damp Indoor Locations: Type 4.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install disconnect switches and circuit breakers in locations as indicated, according to manufacturer's written instructions.

B. Install disconnect switches and circuit breakers level and plumb.

C. Install wiring between disconnect switches, circuit breakers, control, and indication devices.

D. Connect disconnect switches and circuit breakers and components to wiring system and to ground as indicated and instructed by manufacturer.
   1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

E. Identify each disconnect switch and circuit breaker according to requirements specified in Section 26 05 53 (16075) - "Electrical Identification."

3.2 FIELD QUALITY CONTROL

A. Testing: After installing disconnect switches and circuit breakers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
   1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.5 for disconnect switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.

B. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

3.3 ADJUSTING

A. Set field-adjustable disconnect switches and circuit-breaker trip ranges as indicated or as directed in coordination study report.

3.4 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, and abrasions.

- END OF SECTION -

- SECTION 26 2913 -

ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. AC Motor-Control Devices Rated 600 V and Less that are Supplied As Enclosed Units.
      a. Manual Motor Controllers
      b. Magnetic Motor Controllers
      c. Variable-Frequency Controllers
      d. Enclosed Timer Switches
      e. Enclosures

B. Related Sections include the following:
   1. Section 03 30 00 (03300) - Cast-In-Place Concrete.
   2. Section 26 05 00 (16050) - Common Work Results for Electrical: For general materials and installation methods.
   3. Section 26 05 19 (16120) - Low-Voltage Electrical Power Conductors and Cables.
   4. Section 26 05 53 (16075) - Identification for Electrical Systems.

1.3 SUBMITTALS

A. Submit “Letter of Conformance” in accordance with Section 01 3300 indicating specified items selected for use in project with the following supporting data:
   1. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
   2. Maintenance Data: For products to include in the maintenance manuals specified in Division 01.
   3. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.
   4. Qualification Data for Field Testing Agency: Certificates, signed by Contractor, certifying that agency complies with requirements specified in "Quality Assurance" Article below.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain similar motor-control devices through one source from a single manufacturer.

B. Comply with NFPA 70.

C. Listing and Labeling: Provide motor controllers specified in this Section that are listed and labeled.
   1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
   2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

1.5 COORDINATION

A. **Coordinate features of controllers and accessory devices with pilot devices and control circuits to** which they connect.

B. Coordinate features, accessories, and functions of each motor controller with the ratings and characteristics of the supply circuit, the motor, the required control sequence, and the duty cycle of the motor and load.

1.6 EXTRA MATERIALS

A. Furnish extra materials described in Section 01 7843 “Spare Parts and Material” that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents. Deliver extra materials to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved Manufacturers:
   1. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary (888-385-1221)
   2. Allen-Bradley Co.; Industrial Control Group (414-382-2000)
   3. Crouse-Hinds ECM.; Cooper Industries, Inc. Div. (315-477-5531)
   4. Eaton Corp.; Westinghouse & Cutler-Hammer Products (800-386-1911)
   5. General Electric Co.; Electrical Distribution & Control Div. (888-437-3765)
   6. Siemens Energy & Automation, Inc. (800-964-4114)
   7. Square D Co.; a Division of Groupe Schneider (888-778-2733)

2.2 MANUAL MOTOR CONTROLLERS

A. Description: NEMA ICS 2, general purpose, Class A with toggle action and overload element.

2.3 MAGNETIC MOTOR CONTROLLERS

A. Description: NEMA ICS 2, Class A, full voltage, non-reversing, across the line, unless otherwise indicated.

B. Control Circuit: 120 V; obtained from integral control power transformer, unless otherwise indicated. Include a control power transformer with adequate capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.

C. Combination Controller: Factory-assembled combination controller and disconnect switch with or without overcurrent protection as indicated.

1. Fusible Disconnecting Means: NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses indicated. Select and size fuses to provide Type 2 protection according to IEC 947-4-1, as certified by a Nationally Recognized Testing Laboratory.
2. Non-fusible Disconnect: NEMA KS 1, heavy-duty, non-fusible switch.
3. Circuit-Breaker Disconnect: NEMA AB 1, motor-circuit protector with field-adjustable short-circuit trip coordinated with motor locked-rotor amperes.

D. Overload Relay: Ambient-compensated type with inverse-time-current characteristic. Provide with heaters or sensors in each phase matched to nameplate full-load current of specific motor to which they connect, and with appropriate adjustment for duty cycle.

2.4 VARIABLE-FREQUENCY CONTROLLERS

A. Refer to Division 23 specifications for VFD requirements.

2.5 ENCLOSED TIMER SWITCHES

A. Timer switch for spa: Spring wound 0 to 30 minutes, by Tork or Intermatic.

2.6 ENCLOSURES

A. Description: Flush or surface-mounted cabinets as indicated. NEMA 250, Type 1, unless otherwise indicated to meet environmental conditions at installed location.

1. Outdoor Locations: NEMA-3R.
2. Kitchen Areas: NEMA-4X, stainless steel.
3. Other Wet or Damp Indoor Locations: NEMA-4.

2.7 ACCESSORIES

A. Devices are factory installed in controller enclosure, unless otherwise indicated.

B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.

C. Stop and Lockout Push-Button Station: Momentary-break push-button station with a factory-applied hasp arranged so a padlock can be used to lock push button in depressed position with control circuit open.

D. Control Relays: Auxiliary and adjustable time-delay relays.

E. Elapsed Time Meters: Heavy duty with digital readout in hours.

F. Phase-Failure and Undervoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection. Provide adjustable undervoltage setting.

G. Impulse sparkover voltage coordinated with system circuit voltage.

H. Factory mounted with Nationally Recognized Testing Laboratory listed and labeled mounting device.

PART 3 - EXECUTION

3.1 CONTROLLERS

A. Select features of each motor controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, drive, and load; and configuration of pilot device and control circuit affecting controller functions.

B. Select horsepower rating of controllers to suit motor controlled.

C. Use fractional-horsepower manual controllers for single-phase motors, unless otherwise indicated.

D. Use manual controllers for 3-phase motors up to 7-1/2 hp not requiring automatic or remote control.

E. Push-Button Stations: In covers of magnetic controllers for manually started motors where indicated, start contact connected in parallel with sealing auxiliary contact for low-voltage protection.

F. Hand-Off-Automatic Selector Switches: In covers of manual and magnetic controllers of motors started and stopped by automatic controls or interlocks with other equipment.

3.2 INSTALLATION

A. Install independently mounted motor-control devices according to manufacturer's written instructions.

B. Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components, including the pretesting and adjustment of solid-state controllers.

C. Location: Locate controllers within sight of motors controlled.

D. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks conforming to Section 26 05 00 - "Common Work Results for Electrical."

E. Install freestanding equipment on concrete housekeeping bases conforming to Section 03 30 00 - "Cast-in-Place Concrete."

F. Motor-Controller Fuses: Install indicated fuses in each fusible switch.

3.3 IDENTIFICATION

A. Identify motor-control components and control wiring according to Section 26 05 53 "Electrical Identification."

3.4 CONTROL WIRING INSTALLATION

A. Install wiring between motor-control devices according to Section 26 05 19 “Low-Voltage Electrical Power Conductors and Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic control devices where available.

1. Connect selector switches to bypass only the manual and automatic control devices that have no safety functions when switch is in the hand position.
2. Connect selector switches with motor-control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 CONNECTIONS

A. Tighten connectors, terminals, bus joints, and mountings. Tighten field-connected connectors and terminals, including screws and bolts, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.6 FIELD QUALITY CONTROL

A. Testing: After installing motor controllers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Sections 7.5, 7.6, and 7.16. Certify compliance with test parameters.
2. Remove and replace malfunctioning units with new units, and retest.

3.7 CLEANING

A. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean devices internally, using methods and materials recommended by manufacturer.

3.8 DEMONSTRATION

A. Training: Engage a factory-authorized service representative to demonstrate solid-state and variable- speed controllers and train Owner's maintenance personnel.
   1. Conduct training as specified in Section 01 7900 - "Training".
   2. Include training relating to equipment operation and maintenance procedures.

- END OF SECTION -

- SECTION 26 3213 -

DIESEL-ENGINE-DRIVEN GENERATOR SET

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This section of the specification covers the furnishing and installation of a diesel driven, radiator cooled emergency generator with enclosure and automatic transfer switches as specified herein and as indicated on the project drawings.

1.3 APPLICABLE CODES AND STANDARDS

A. All material and workmanship shall comply with the applicable portions of the latest edition enforced of the following codes and standards:

1. National Fire Protection Association NFPA-37, 20 and 110.
2. National Electrical Code NEC (NFPA-70) with local amendments.
3. National Electrical Manufacturers Association (NEMA).
4. NEMA MG1 and MG2 – Motors and Generators.
5. Underwriter's Laboratories Inc. Standards (UL) or Canadian Standards Association (CSA) Listed and Labeled if UL not available.
6. UL 1008 Standard for Safety for Automatic Transfer Switches.
7. International Fire Code (IFC) with local amendments.
8. U.S. Environmental Protection Agency (EPA) Regulations for Non Road Diesel Driven Engines.

1.4 SYSTEM RESPONSIBILITY

A. It is the intent of this specification that the engine generator, and automatic transfer switch be supplied by one manufacturer who shall furnish all wiring diagrams for all equipment which shall constitute the emergency/standby power system.

B. A manufacturer's representative shall conduct a complete system operation test for the Engineer and the Owner's operating personnel. The test shall be certified at 100% operational and installed per their specifications.

1.5 SUBMITTAL DATA

A. Submittal data shall include the following:
   1. Make and model of engine and generator.
   2. Makes and models of switchgear and other major auxiliary equipment, including automatic transfer switch, vibration isolators, and radiator, if included in the bid.
   3. Manufacturer produced dimension drawings of the complete engine generator set clearly showing entrance points for each of the interconnections required.
   4. Manufacturer published kilowatt output curve and published fuel consumption curve.
   5. Unit ventilation and combustion air requirements.
   6. Manufacturer published transient response data of the complete engine generator set upon 50%, 75%, and 100% block load at 1.0 p.f. Data shall include maximum voltage dips versus starting KVA.
   7. Locations and descriptions of the supplier's parts and service facilities within a 50 mile radius of the project site, including parts inventory and numbers of qualified generator set service personnel.
   8. Actual electrical diagrams, including schematic diagrams and interconnection wiring diagrams for all equipment to be supplied.
   9. Drawings showing fuel tank connection points. Manufacturer warranty statements.
   10. Engine altitude duration curve.
   11. EPA Tier 4 compliance certification.
   12. Comply/deviate statement for each specification section paragraph.
   13. Written warranty document.
   14. Copy of standard maintenance contract.

1.6 OPERATION AND MAINTENANCE MANUALS

A. Provide operating and maintenance manuals covering the engine-generator and auxiliary equipment that may require special operating instructions or periodic maintenance.

1.7 WARRANTY

A. Additional requirements per Specification Section 26 0500: Equipment furnished under this section shall be guaranteed against defective parts or workmanship under the terms of the manufacturer's and dealers standard warranty for a period of three years, and shall cover full parts and labor as specified.

1.8 SYSTEM SERVICE CONTRACT

A. The supplier of the standby power system must provide a copy of and make available to the Owner his standard service contract which, at the Owner's options, may be accepted or refused. This contract will accompany any documents, drawings, catalog cuts, specification sheets, and wiring or outline drawings, etc., submitted for approval of the Designing Engineer. The contract shall be for the complete service rendered over a period of one year.

PART 2 - PRODUCTS

2.1 ENGINE GENERATOR SET

A. General:

1. Furnish and install a complete system for emergency power consisting of one diesel engine driven generator set with automatic controls, automatic transfer controls and all accessory items as hereinafter specified and detailed on the drawings. The engine generator set shall be the published and catalogued products of one company. That company shall have sole responsibility for the performance and service of the diesel engine generator set and the accessories. The unit shall be factory assembled and tested as a set, UL2200 listed and EPA Tier 3 compliant.
2. It is essential that the engine generator supplier maintain a local parts and service facility within 50 miles of this installation. The supplier must carry sufficient inventory to cover no less than 80% of the parts required for service within 24 hours and 95% within 48 hours. Further, the supplier shall have factory-trained service representatives to furnish all installation, test, and startup supervision necessary for final approval and acceptance as well as to perform maintenance and repairs on all components as required.
3. Service Conditions:
   a. Ambient Temperature: 0 to 115°F.
   b. Altitude: **1,500** feet.
4. Acceptable Manufacturers (Engine Generator): Caterpillar, Cummins, Kohler, MTU, and Waukesha.

B. Rating:

1. Rating of the diesel engine generator set shall be based on operation of the set when equipped with all necessary operating accessories such as radiator, fan, air cleaners, alternating current generator, exciter, and any attachments required for continuous operation. The generator set shall be rated for continuous standby service at kW, kVA, voltage, phase, and power factor noted on plans. Output shall be Wye connected. Ratings shall be corrected for ambient temperature and altitude. Ratings must be substantiated by manufacturer's standard published curves. Special ratings or maximum ratings are not acceptable.
2. The specified engine generator set shall be for continuous electrical service during interruption of the normal utility source.
3. The unit shall be arranged for automatic unattended and remote starting, complete with all accessories and auxiliaries necessary for normal operation.
4. NFPA 110 ratings: Type 10, Class 12, Level 1.

C. Diesel Engine:

1. The engine shall be water-cooled in-line or vee-type, four-stroke cycle compression ignition diesel. The engine shall meet the specifications when operation on No. 2 domestic burner oil. Diesel engines requiring premium fuels will not be considered. The engine shall be equipped with fuel, lube oil and intake air filters, lube oil coolers, fuel transfer pump, fuel priming pump, and gear-driven water pump.
2. The engine shall be equipped with fuel filter, lube oil and intake air filters, lube oil coolers, and jacket water pump.

3. The engine shall be equipped with the following accessories: Battery charging alternator, lube oil filter, dry type air cleaner, radio suppression, jacket water heater, exhaust silencer, electric gas solenoid(s), and oil drain extension.
4. The engine shall be offered only at a speed and rating no higher than that for which it has been designed. The engine rotative speed shall be standard revolutions per minute (rpm) indicated in catalog data and shall not exceed 1,800 rpm.
5. Rotating or reciprocating parts, or other parts that may present a hazard to operating personnel, shall be insulated or shielded so as to minimize danger in accordance with OSHA regulations.
6. Speed Governing System: The engine governor shall maintain isochronous frequency regulation from no load to full rated load. Steady state operating band shall be $\pm$0.25%. The governor shall be capable of remote speed adjustment at the generator control panel.
7. Overspeed Shutdown Device: The overspeed shutdown device shall be entirely independent of the engine speed governing system, but shall shut the fuel supply should the engine speed exceed 125% of synchronous speed. The overspeed device shall require manual resetting after emergency tripping.

D. Cooling System:
1. The engine shall be furnished with a cooling system having sufficient capacity for cooling the engine when the diesel generator is delivering full rated load in the ambient temperature specified.
2. The engine shall be equipped with a gear driven, centrifugal type water circulating pump and thermostatic valve to maintain the engine at recommended temperature level. The cooling system shall be filled with a 50% solution of permanent type antifreeze (glycol), rated for altitude.
3. The engine shall be equipped with a radiator and blower fan of a type and capacity recommended by the engine manufacturer, frame mounted type. Total airflow restriction from the radiator shall not exceed 0.5" H_2O, at both inlet and outside. Oversize the radiator cooling capacity by 135% above the standard cooling capacity for the selected unit kW size. The oversized cooling capacity is required to offset the static pressure increase based on the up-duct static pressure increase.
4. A unit mounted thermal circulation type water heater shall be furnished to maintain engine jacket water to be 190°F in minimum ambient temperature. Thermostat shall be an integral part of the heater. Provide isolation valves in supply and return lines between jacket heat and engine. The heaters shall be single phase, 60 Hz, 208 Voltage, Single Phase, and shall be as recommended by the engine manufacturer.

E. Exhaust System:
1. A critical exhaust silencer, muffler companion flanges, and flexible stainless steel bellows-type exhaust fitting, properly sized (minimum 36 inches in length) shall be furnished. The silencer shall be designed for unit mounting and constructed of high quality carbon steel to withstand temperatures in excess of 1,100°F. All workmanship shall comply with ANSI/AWS Standards Section D1.3; welding shall qualify under ASME Codes Section IX. Silencer body shall be double wrap laminated steel. Silencer shall be multi-chamber, reactive type, frequency tunes, and non-automotive, high temperature gas processing vessel. Exhaust pipe size shall be sufficient to ensure that exhaust back pressure does not exceed the maximum limitations specified by the engine manufacturer. Condensate traps shall be provided at low points in the piping. Silencer and flexible bellows shall have 150# ASA flanges. Furnish section of exhaust pipe converting engine exhaust outlet(s) to 150# ASA flanges.

2. Exhaust silencer shall provide minimum sound attenuation of 37dB at 500Hz and 35dB at 2KHz with exhaust gas velocity per engine operation at 1,800 rpm. Provide with rain caps or angle-cut horizontal discharges.
3. The complete exhaust system shall be installed and mounted on a custom frame supported by the generator frame by the engine generator supplier. The exhaust system piping shall be routed from within the generator room silencer to the exterior of the building. The termination of the exhaust pipe shall be a location approved by the Owner and that does not allow exhaust fumes to re-enter the building through vent or air intake shaft openings.

F. Fuel System:
1. The fuel system shall be that which is normally used by the diesel engine manufacturer. It shall include a replaceable element fuel filter conveniently located for servicing, fuel pressure gauge, and engine fuel priming pump.
2. A ready supply “package sled tank” shall be skid base mounted to provide an immediate fuel supply to the pump upon engine startup. The tank shall have a minimum capacity indicated by the NFPA 110 “Class” for 24 hours of operation at full load operation.
3. The tank assembly shall be UL 142 listed and compliant with the UFC requirements. The tank shall be of double wall construction and be equipped with a fuel gauge, vent line, 4” full, low fuel contact, and leak detection in secondary containment.
4. Provide lockable, remote filling assembly from the exterior of the building to the package sled tank in the basement generator room. Provide a placard identifying the fuel inlet as the “Generator Fueling Point”.

G. Generator Mounting:
1. The engine generator assembly shall be equipped with factory installed vibration isolators to prevent distortion of alignment between generation alternator and engine. Vibration isolators shall be mounted between the engine generator and fabricated steel skid base, or spring type isolators may be installed between the frame and support pad. Size per the isolator manufacturer’s recommendations.
2. All associated exhaust and fuel piping and control wiring, as well as other control connections to the isolated equipment, shall be made flexible.
3. Isolators shall be installed in accordance with the manufacturer’s provisions of a minimum 90% theoretical isolation efficiency at rated operational RPM, which will afford the greatest reduction in vibration transmissibility.
4. Provide concrete equipment support pad of sufficient mass to prevent equipment from walking. Pad shall enclose the complete floor for the drop over enclosure and extend above the finish grade by 3 inches. That portion of the pad directly under the engine generator, the equipment support pad, shall be isolated from the remainder of the pad by cork or similar material.
5. The equipment support pad shall be sized by a structural engineer registered in the State of Arizona. Submit sealed shop drawings in submittal package.
6. Mounting assembly in its entirety shall comply with Seismic Zone I requirements.

H. Engine Starting System:
1. The engine shall be equipped with a 24V electric starting system designed to crank the engine at a speed which will allow full diesel starting of the engine at the ambient temperature as specified, and shall be in accordance with the requirements of NFPA 110.
2. Storage batteries of the lead-acid type shall have sufficient capacity (minimum 220 ampere hours) for cranking the engine at firing speed for nine 10-second cranking

periods at the ambient temperature specified without being recharged. They shall be of domestic manufacture in plastic containers.

3. Battery charger shall be wall mounted, automatic dual rate, float at 2.20V per cell and equalize at 2.17V per cell with ±1% output from no load to full load and an AC variance not to exceed 10 percent. Charger shall have automatic line compensation, current overload protection, DC voltage regulation, surge suppression, AC power failure relay with remote indicator terminal, DC ammeter, DC voltmeter, fused AC and DC input/output, and battery failure alarm connections. Charger shall be rated 120V AC, 60 Hz input and output sized to provide full recharge from complete discharge in 24 hours. LaMarche, Master or as accepted.

I. Safety Shutdown Controls and Alarms:

1. Controls shall be provided that will function to immediately shut off delivery of fuel to the engine cylinders when actuated by a condition described in NFPA 110.
2. The values at which the controls for low lubricating oil pressure and high water temperature are actuated shall be as recommended by the manufacturer, and the overspeed governor shall be set to actuate at the value specified herein. The low lubricating oil pressure shutdown control shall be provided with a means to make it inoperative during the period of low oil pressure when the engine is started.
3. Provide a remote mounted emergency stop station consisting of a break glass station for emergency engine shutdown. The unit shall include two extra glass rods and be labeled “Generator Emergency Stop.” Equal to Detroit Diesel #A-222654.
4. Each shutdown shall initiate its individual light and sound an alarm within the generator control panel, and shall require manual reset to release each indicating light. Normal startup and shutdown shall not actuate the indicator system.
5. NFPA 110 pre-alarm safeties shall be provided and wired to alarm lights in the generator control panel. Dry contacts for all NFPA 110 alarm signals shall be provided for the remote annunciator panel.

J. Automatic Starting Controls:

1. Starting Motor: The engine shall be equipped with a 24V electric starting system with positive engagement drive and of sufficient capacity to crank the engine at a speed which will start the engine under operating conditions. The starting pinion will disengage automatically when the engine starts. The starting system shall incorporate an automatically reset circuit breaker for anti-butt engagement.
2. Automatic Controls: Fully automatic generator set start-stop controls in the generator panel shall be provided. Controls shall provide shutdown for low oil pressure, high water temperature, overspeed, overcrank, and one auxiliary contact for activating accessory items. Controls shall include a 10 second cranking period following by a 10 second rest period. If the engine has not started in approximately 60 seconds or three cranking tries, the engine starting controls shall lock out and the overcrank signal shall so indicate.
3. Generator Controls: Generator controls and meters shall be panel mounted on the generator and include the following as minimum components:
   a. Voltmeter, 3/4" Digital LCD, 2% accuracy.
   b. Ammeter, 3/4" Digital LCD, 2% accuracy.
   c. Ammeter, phase selector switch.
   d. Frequency meter, 3/4" Digital LCD.
   e. Automatic starting controls.
   f. Panel illumination lights and switch.
   g. Voltage-adjustment rheostat.

h. Engine oil pressure gauge.
i. Engine water temperature gauge.
j. Dry contacts for remote alarm wired to terminal strips.
k. Fault indicators for low oil pressure, high water temperature, overspeed, overcrank, and ground fault current present.
l. Four-position function switch marked "auto", "manual", "off/set" and "stop."
m. Pre-alarm panel with visual and audible warning devices per NFPA 110.
n. Hour meter.

K. Remote Annunciator Panel: Suitable for remote mounting in a flush manner. Panel shall provide audible and visual warning of fault or alarm conditions in the generator set. Points of annunciation shall be provided per NFPA 110 and the NEC. As a minimum, include the following indications:
1. Low oil pressure.
2. Overspeed.
3. Low water temperature.
4. High water temperature.
5. Low fuel.
6. Overcrank.
7. Low battery voltage.
8. High battery voltage.
9. Generating.
10. Ground fault indication (audible and visual).
11. Alarm silencer.
12. Lamp test.

Locate the remote annunciator panel within the Fire Command Center on the Ground Floor Level.

L. Generator Alternator:
1. Type: Alternator shall be four pole, revolving field, 12 lead, reconnectable, of drip-proof construction with amortisseur windings, single bearing, synchronous type built to NEMA standard. Class F insulation shall be used on the stator and rotor, and shall be further protected with 100% epoxy impregnation and overcoat of resilient insulating material to reduce possible fungus and/or abrasion deterioration. The generator shall incorporate reactive drop compensation and shall include a resettable thermal protector for exciter/regulator protection against extended low power factor loads.
2. Rating: The alternator shall have a rating as noted on the drawings at 0.8 power factor, 60 hertz. The generator shall operate at rated voltage and frequency while running at 1,800 rpm, and shall be capable of operation at 125% of rated speed without damaging unit. Alternator rating shall be adjusted to compensate for line harmonics induced by SCR type electronic equipment (i.e., uninterruptible power supplies (UPS), variable frequency drives (VFD's), etc.) Review plans for quantities and KW/Hp ratings prior to bid and adjust alternator size accordingly.
3. Start KVA (SKVA): Alternators operating under a no load condition at rated speed, rated voltage shall be sized for single step load application equal to the calculated load noted on the plans, without incurring a transient voltage dip of more than 25% of nominal rating. For the purpose of SKVA calculation, motor starting loads shall be considered at 6x full

load amps. Oversizing the alternator compared with the rated power output of the engine is permissible to meet specified performance.

4. Alternator-exciter-automatic voltage regulator package shall provide ±2% voltage regulation. Voltage regulation shall apply to any load from no load to rated load (.8 pf lagging to unity) and is defined as the band width within which the unit's output voltage shall be maintained after all transients due to load change have decayed to zero. Steady state voltage regulation shall be ±0.25% and is defined as the band width within which the alternator's output shall be maintained under conditions of any constant load from no load to full load with temperature stabilized.
   a. Regulator: The regulator shall be solid state volts-per-hertz type and provided to match the characteristics of the generator and engine. Provide readily accessible voltage drop, voltage level, and voltage gain controls. Voltage level adjustment shall be a minimum of ±5%. The regulator module shall be generator mounted, shock protected, epoxy encapsulated for protection against vibration and atmospheric deterioration.
5. Radio interference suppression meeting commercial standards shall be supplied.

M. Main Line Circuit Breakers:
1. A generator mounted main line molded case circuit breaker shall be installed as a load circuit interrupting and protection device. It shall operate both manually for normal switching function and automatically during overload and short circuit conditions. Size shall be according to manufacturer's recommendation. Provide quantity as indicated on the One-Line Diagram.
2. The trip unit shall have instantaneous, short time delay, short time pickup, long time delay adjustments, in addition to inverse time delay. Main line circuit breaker(s) on 277/480V wye systems rated at 1,000 amps or more shall include ground fault indication (GFI) only per the NEC. The GFI shall include audible and visual annunciation at the engine generator control panel and remote annunciator. The circuit breaker shall be UL listed.
3. Generator exciter field circuit breakers do not meet the above electrical standards and are unacceptable for line protection.

PART 3 - EXECUTION

3.1 RECEIVING, HANDLING AND STORAGE

A. The Contractor shall be responsible for receiving and unloading the emergency generator set and automatic transfer switch at the project site according to manufacturer's instructions and recommendations. All equipment shall be protected from damage during handling or installation. If equipment is not to be installed immediately upon delivery, it shall be stored in a dry location and protected from extreme temperatures, moisture and accidental damage.

3.2 INSTALLATION

A. The Contractor shall install all equipment in accordance with manufacturer's instructions and recommendations. All equipment shall be completely wired according to manufacturer's wiring diagram, including power and control wiring.

B. The exhaust system shall be installed in accordance with NFPA 37 requirements. Provide approved thimbles when passing through combustible walls or roof.

C. Locate the remote annunciator panel as indicated on the plans. Size conduit per the NEC and provide wiring per manufacturer's wiring diagrams.

D. Provide permanent identification plaque(s) per the NEC. Plaques shall consist of laminated plastic plates with text and building outlines as required. Letters shall be vertical, 1/4-inch high white letters on black background. If required, use multiple lines, each containing as many as 45 letters and/or spaces. Submit sketch, including text for each specific plaque, to the Engineer for review prior to fabrication. Affix plaques to equipment with pop rivets or self-tapping screws at 9" O.C. intervals. Use caution to avoid filings and other metal from falling into the electrical enclosure.

3.3 SYSTEM CHECKOUT AND STARTUP

A. The engine generator supplier shall furnish service for the installation supervision, system checkout, and startup, all at the Owner's convenience.

B. Adjust the transfer switch and generator controls to specified parameters.

C. Where multiple transfer switches are installed, defeat all but one exerciser clock. Set controlling exercise clock per the Owner’s desired time schedule.

D. Insert a copy of the instruction manual and any special tools or testing devices in the cabinet provided within the enclosure.

3.4 TESTING

A. Additional Requirements per Specification Section 26 0500:

1. Dealer/Factory Testing: Before the equipment is shipped from the authorized dealer's place of business, a test log of the generator set showing testing at 100% rated load, continuously, at not less than 1,200 feet altitude, shall be submitted to the Engineer. The test log shall include readings taken at 30-minute intervals for four hours, noting engine oil pressure, water temperature, ambient air temperature and voltage and current of each phase. Voltage and current data shall be verifiable through the use of strip chart or digital recorders. Submit strip chart or spreadsheet copies with test log.
2. Acceptance Testing: At the completion of the installation of the emergency power system, an acceptance test of at least four hours at full load shall be run using resistive load banks. Fuel shall be included in the bid. During this test, all controls and safety devices will be tested. All tests and operations must be made to the complete satisfaction of the Owner and Engineer. Provide four sets of certified test reports to Engineer within two weeks of completion of the test.

3.5 TRAINING

A. A qualified company representative shall provide the Owner's operating personnel with four hours of instruction. Include training on maintenance and operation of the system supplied. The supplier shall permanently affix a 24-hour emergency phone number to both the generator set and the transfer switch.

- END OF SECTION -

- SECTION 26 3623 -

AUTOMATIC TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Furnish and install automatic transfer switch(es) as specified herein and as indicated on the project drawings.

B. The contractor shall be responsible for operational testing and providing on-site support for testing process.

1.3 STANDARDS

A. All material and workmanship shall comply with the applicable portions of the latest edition enforced of the following codes and standards:

1. National Fire Protection Association NFPA-110.
2. National Electrical Code NEC (NFPA-70).
3. National Electrical Manufacturers Association (NEMA).
4. Underwriter's Laboratories Inc. Standards (UL) or Canadian Standards Association (CSA) Listed and Labeled if UL is no available.
5. UL 1008 Standard for Safety for Automatic Transfer Switches.

1.4 SYSTEMS RESPONSIBILITY

A. It is the intent of this specification that the automatic transfer switch be supplied by one manufacturer who shall furnish all wiring diagrams for integration of the automatic transfer switch (es) into the Emergency Systems NEC 700 Legally Required Standby Systems NEC 701, and/or Optional Standby Systems NEC 702. Additional requirements per NEC 517 for Life Safety Branch, Critical Branch, Equipment Branch delayed-automatic and/or manual supply apply as applicable.

B. A manufacturer's representative shall conduct a complete system operation test for the Engineer and the Owner's operating personnel. The test shall be certified as 100% operational and installed per their specifications.

1.5 SUBMITTALS

A. Submittal data shall include the following:
   1. Make and models of each transfer switch included in the bid.
   2. Manufacturer produced dimension drawings of each unique transfer switch clearly showing entrance points for each of the interconnections required and installed clearance requirements.
   3. Manufacturers published data indicating switch mechanism type, controls and programming options, ampere, voltage, number of poles, and withstand ratings.
   4. Locations and descriptions of the supplier's parts and service facilities within a 50 mile radius of the project site, including parts inventory and numbers of qualified service personnel.
   5. Actual electrical diagrams, including schematic diagrams and interconnection wiring diagrams for equipment to be supplied.
   6. Written warranty document.

1.6 OPERATION AND MAINTENANCE MANUALS

A. Provide operating and maintenance manuals covering the transfer switch(es).

1.7 GUARANTEE

A. Provide as per requirements of Division 26 Section "General Provisions".

PART 2 - PRODUCTS

2.1 AUTOMATIC TRANSFER SWITCHES

A. General:
   1. Automatic transfer switches (ATS's) shall be provided with ratings as shown on plans. Switches shall be listed under UL 1008 for use on emergency systems. The transfer switch shall be capable of switching all classes of load and shall be rated for continuous duty when installed in a non-ventilated enclosure constructed in accordance with Underwriter's Laboratories, Inc., Standard UL 508.
   2. Per NEC 700 & 701 ATS's shall include a bypass/isolation feature to allow for complete removal of the automatic switch mechanism for service. The bypass switch mechanism shall have ratings equal to the automatic switch portion of the assembly. The bypass/isolation feature shall be manually operable.
   3. Automatic transfer switches shall be delay transition type.
   4. ATS's shall include a bypass/isolation feature to allow for compete removal of the automatic switch mechanism for service. The bypass switch mechanism shall have ratings equal to the automatic switch portion of the assembly. The bypass/isolation feature shall be manually operable. Acceptable Manufacturers are: Russelectric, ASCO, or as accepted.

B. Construction and Performance:

1. The automatic transfer switch (ATS) shall be double throw, actuated by a dual electrical operator momentarily energized and connected to the transfer mechanism. Transfer time from normal to emergency shall be adjustable. No delay transfer time shall be any greater than 500 msec.
2. The automatic transfer switch (ATS) shall be single throw, actuated by an electrical operator momentarily energized and connected to the transfer mechanism. Transfer time from normal to emergency and emergency to normal shall be 500 msec or less.
3. ATS's shall be a true 4-pole switch supplied with all four poles mounted on a common shaft. The continuous current rating and the closing and withstand rating of the fourth pole shall be identical to the rating of the main poles.
4. ATS's shall be mounted in a NEMA 1 enclosure, unless otherwise indicated. Enclosures shall be fabricated from 12 gauge steel. The enclosure shall be sized to exceed minimum wire bending space required by UL 1008. The enclosure shall include adequate lifting means for ease of installation. The transfer switch shall be completely isolated from the bypass/isolation switch by means of insulating barriers and separate access doors to positively prevent hazard to operating personnel while servicing the automatic transfer switch.
5. The transfer switch shall be capable of transferring successfully in either direction with 7% of rated voltage applied to the switch terminals.
6. The normal and emergency contact shall be positively interlocked mechanically and electrically to prevent simultaneous closing. Main contacts shall be mechanically locked in position in both the normal and emergency positions without the use of hooks, latches, magnets, or springs, and shall be silver alloy protected by arcing contacts and barriers.
7. Interlocked molded-case circuit breakers will not be acceptable.
8. The transfer switch shall be equipped with a safe manual operator designed to prevent injury to operating personnel if the electrical contractor should suddenly become energized during manual transfer. The manual operator shall provide the same contact opening and closing speed as the electrical operator to prevent a flashover from switching to main contacts slowly.
9. If the emergency power source should fail, the switch shall return immediately to the normal source if normal is available; however, it shall be possible to manually switch to the emergency power source for testing purposes even when the normal source is available. All relays, timers, control wiring, and accessories shall be front accessible.
10. The transfer switch shall be equipped with an internal welded steel pocket, housing operations and maintenance manuals. The bypass/isolation switch construction, electrically and physically, shall be identical to the associated automatic transfer switch construction.
11. The combination automatic transfer bypass/isolation switch shall be top and bottom accessible. The ATS assemblies shall be listed for front access.
12. The main contacts shall be visible for inspection without any major disassembly of the transfer bypass/isolation switch. Contact replacement shall not require removal of main power cables.
13. All bolted bus connections shall have Belleville compression-type washers.
14. Provide a fully rated neutral bar with required AL-CU neutral lugs.
15. Control components and wiring shall be front accessible. All control wires shall be multi-conductor, 18 gauge, 600 volt, SIS switchboard type point-to-point harness. All control wire terminations shall be identified with tubular sleeve-type markers.
16. Pilot lights shall be long life LED type.

17. The switch shall be equipped with 90°C rated copper/aluminum solderless mechanical type lugs. Sizes to be coordinated with the feeders noted on the one-line diagram.
18. The transfer switch, complete with timers, relays and accessories, shall be listed by UL in their Electrical Construction Materials Catalog under Standard UL 1008 (Automatic Transfer Switch) and approved for use on emergency systems.
19. When conducting temperature rise tests in accordance with Paragraph 17 of UL 1008, the manufacturer shall include post-endurance temperature rise tests to verify the ability of the transfer switch to carry full rate current after completing the overload and endurance test.
20. The transfer switch shall have a short circuit withstand capability in excess of the protection devices used in conjunction with them. To establish conformance, the manufacturer shall produce certified test reports from an independent testing laboratory to verify that identical samples have been subjected to 3-phase short circuit currents at applicable project AC voltage levels for a minimum of three cycle's duration without contact damage or contact welding and without the use of current limiting fuse protection. Oscillograph traces are to be supplied to verify that the test parameters have been met.
21. The transfer switch, including all parts and supports, shall meet seismic loading equal to their weights multiplied by a force factor, Cp. The directions of force, simultaneously and separately, shall be in any horizontal and vertical planes. The switches shall be capable of normal operation during and after seismic loading. Seismic loading shall not cause false operation. The force factor, Cp, shall be as defined in the International Building Code as amended by the Authority Having Jurisdiction.

C. Sequence of Operation:
1. Engine starting contacts shall be provided to start the generating plant should the voltage of the normal source drop below 70% on any of two phases, or 80% on the third phase, after a non-adjustable time delay of 3 seconds to allow for momentary dips. The transfer switch shall transfer to emergency as soon as the voltage and frequency have reached 90% of rated levels.
2. After restoration of normal power to 90% of rated voltage, an adjustable time delay period of 0-30 minutes shall delay retransfer to normal power until it has had time to stabilize. If the emergency power source should fail during the time delay period, the time delay shall be bypassed and the switch shall return immediately to the normal source.
3. After the switch has retransferred to normal, the engine generator shall be allowed to operate a no load for an adjustable period of time to allow it to cool down before shutdown.

D. Accessories: Each transfer switch shall contain the following accessories:
1. Normal 0- to 3 - second adjustable time delay to override harmless normal dips and outages. Set at two seconds.
2. Adjustable time delay on retransfer to normal (0-30 minutes). Set at 30 minutes.
3. Adjustable engine cool-down time (0-30 minutes). Set at five minutes.
4. Relays which prevent transfer to emergency until voltage of generating plant has reached 90% of rated value and frequency has reached 97% of rated value.
5. To avoid excessive inrush currents on retransfer to normal, an integrally mounted in-phase monitor shall be provided where so indicated on the plans and drawings to prevent transfer or retransfer until the phase angle between the two power sources is within 10 electrical degrees and the frequency differential is within 2 Hz. The monitor shall not require any control wiring to the generator. The monitor shall be bypassed if the load carrying source fails and the alternate power source is available.

6. Two pilot lights to indicated transfer switch position, normal and emergency.
7. Pilot-type indicator lights for both normal and emergency source.
8. Two auxiliary contacts, one opens and one closes after normal power fails for engine starting.
9. Four auxiliary contacts, two normally open and two normally closed, mounted on the same shaft as the main contacts, for remote indicating and/or control.
10. The transfer switch shall include a test switch to simulate normal power failure, pilot lights on the cabinet door to indicate the switch closed on normal or emergency, and four auxiliary contacts (25A at 120V AC) on the main shaft, two closed on normal and two closed on emergency.
11. Manual test switch to transfer to emergency source and back to normal with normal source available.
12. Generator exerciser clock, programmable for hours, days, or weeks between starts, and run time duration. Clock shall maintain historical record of exercises in non-volatile memory.
13. Remote monitoring card: Provide compatible protocol with the Building Management System (BMS). Verify with BMS vendor prior to making submittal

PART 3 - EXECUTION

3.1 RECEIVING, HANDLING AND STORAGE

A. The Contractor shall be responsible for receiving and unloading the automatic transfer switch at the project site according to manufacturer's instructions and recommendations. All equipment shall be protected from damage during handling or installation. If equipment is not to be installed immediately upon delivery, it shall be covered, stored in a dry location, and protection from extreme temperatures, moisture and accidental damage.

3.2 INSTALLATION

A. The Contractor shall install all equipment in accordance with manufacturer's instructions and recommendations. All equipment shall be completely wired according to manufacturer's wiring diagram, including power and control wiring.

B. Coordinate Building Management System (BAS) annunciation of transfer switch(es) signals with BMS system programmer, text and graphical appearance. Confirm the text and alarm information is clear and concise.

3.3 SYSTEM CHECKOUT AND STARTUP

A. The transfer switch supplier shall furnish service for the installation supervision, system checkout, and startup, all at the Owner's convenience.

B. Adjust the transfer switch controls to specified parameters.

C. Where multiple transfer switches are installed, defeat all but one exerciser closet for the system. Set controlling exercise clock per the Owner's desired time schedule.

D. Insert a copy of the instruction manual and any special tools or testing devices in the cabinet provided within the enclosure.

3.4 FIELD QUALITY CONTROL

A. A manufacturer's representative shall conduct a review of the installed transfer switches and provide a letter certifying the installation and field wiring is in conformance with manufacturer's recommendations.

3.5 TESTING

A. Additional requirements to Division 26 Section "General Provisions."

1. Factory Testing: Before the equipment is shipped from the factory, a test of the transfer switch(es) shall be performance to confirm operation satisfactory to the manufacturers design. Provide standard offering of factory testing, but at a minimum, hi-pot and contact resistance testing. Provide a test log signed by the factory certifying technician.
2. Site Operational Testing: At the completion of the installation of the transfer switch(es), a test of transfer switch shall be run to confirm functionality of all project related features. All tests and operations must be made to the complete satisfaction of the owner and Engineer. Upon successful completion of this test, provide a test report.
3. System Integration Testing: At the completion of the UPS installation, provide an acceptance test of the Emergency Power System including generator, transfer switch(es), and UPS's. The test shall be at least one hour at UPS design load shall be run using resistive load banks. During this test, all control and safety devices shall be tested. All tests and operations must be made to the complete satisfaction of the Owner and Engineer. Upon successful completion of this test provide a test report.
4. Test Logs: A test log for each testing phase shall be submitted to the Engineer for review and acceptance. The test log shall consist of:
    a. Time and date for test.
    b. Ambient air temperature and climactic conditions.
    c. List of personnel present including a signature page.
    d. List of test equipment used, including manufacturer, model number, and calibration data.
    e. During the test, readings taken on both normal and emergency sources for times immediately before, during, and after power transfers. Voltage and current data shall be verifiable through the use of strip chart or digital recorders on a per phase basis. Submit strip chart or spreadsheet copies with test log.
    f. During the system test at minimum, confirm complete operation of load shed priority sequence (if any), engine start signals, Building Management System (BAS) annunciation at central location, transfer to emergency, retransfer to normal, transfer time delay normal to emergency and emergency to normal.
5. Test Reports: Once all phases of testing have been completed, provide a composite report including data from all phases, logically tabulated and a summary of the testing process and specific report indicating items tested during the system test. Provide four copies to the Architect within two weeks of completion of the testing.

3.6 TRAINING

A. The contractor shall provide a qualified company representative to instruct the Owner's operating personnel for up to four hours, on site. Include training on maintenance and operation of the system supplied, including any BMS interface/reporting. The supplier shall permanently affix a 24-hour emergency phone number to both the generator set and the transfer switches.

- END OF SECTION -

- SECTION 26 4113 -

LIGHTNING PROTECTION FOR STRUCTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Lightning Protection System for Buildings and Associated Structures

B. Related Sections:
   1. Section 26 0500 – General Provisions
   2. Section 26 0526 - Grounding and Bonding for Electrical Systems

1.3 SYSTEM DESCRIPTION

A. Lightning Protection System to protect entire building.

1.4 SUBMITTALS

A. Product Data:
   1. Submit “Letter of Conformance” in accordance with Section 01 3300 indicating specified items selected for use in project.

B. Product Data for each component specified. Include the following:

C. Shop Drawings detailing lightning protection system. Include air terminal locations, conductor routing and connections, and bonding and grounding provisions. Include indications for use of raceway and data on how concealment requirements will be met.

D. Qualification data for firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include data on listing or certification by nationally recognized testing laboratory (NRTL) or trade association. Include lists of completed projects with project names and addresses, names and addresses of owner's representative and owners, and other information specified.

E. Certification, signed by Contractor, that roof adhesive for air terminals is approved by manufacturers of both the terminal assembly and the single-ply membrane roofing material.

F. Field inspection reports indicating compliance with specified requirements.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who is NRTL listed or who is certified by the Lightning Protection Institute as a Master Installer/Designer.

B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
   1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
   2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

C. Provide UL Master Label.

1.6 SEQUENCING AND SCHEDULING

A. Coordinate installation of lightning protection with installation of other building systems and components, including electrical wiring, supporting structures and building materials, metal bodies requiring bonding to lightning protection components, and building finishes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved Manufacturers:
   1. A-C Lightning Security, Inc. (800-821-5575)
   2. Approved Lightning Protection Co., Inc. (631-643-6327)
   3. Harger Lightning Protection, Inc. (800-842-7437)
   4. Heary Bros. Lightning Protection Co. (800-421-6141)
   5. Independent Protection Co., Inc. (800-860-8388)
   6. Robbins Lightning, Inc. (800-426-3792)
   7. Thompson Lightning Protection Co. (651-455-7661)
   8. West Dodd Lightning Conductor Corp. (219-533-5370)

2.2 LIGHTNING PROTECTION SYSTEM COMPONENTS

A. Comply with UL 96.

B. System Materials: Copper, with solid air terminals, except as otherwise indicated.

C. Air Terminals for Single-Ply Membrane Roof Mounting: Units with bases especially designed for single-ply membrane roof materials.

D. Air Terminal Decorations: Decorative ball, direction vane, and compass set where indicated.

E. Air Terminals for Main Stack: Stainless steel.

F. Ground Rods: Copper-clad steel with a minimum of 27 percent of rod weight in copper cladding.
   1. Diameter: 3/4 inch
   2. Length: 10 feet

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces, areas, and conditions, with Installer present, for compliance with installation tolerances and other conditions affecting performance of lightning protection. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install lightning protection as indicated, according to manufacturer's written instructions.

B. Comply with UL 96A and LPI-175.

C. Conform to the most stringent requirements when more than one standard is specified.

D. Install conductors with direct paths from air terminals to ground connections. Avoid sharp bends and narrow loops. Where indicated, run conductors in nonmetallic raceway, Schedule 40, minimum.

E. Conceal system conductors.

F. Conceal down conductors.

G. Conceal interior conductors.

H. Conceal conductors from normal view from exterior locations at grade within 200 feet of building.

I. Provide notification to Owner's Representative a minimum of 48 hours prior to concealing lightning protection components.

J. Cable Connections: Use approved exothermic-welded connections for all conductor splices and connections between conductors and other components except those above single-ply membrane roofing.

K. Air Terminals on Single-Ply Membrane Roofing: Comply with adhesive manufacturer's installation instructions.

L. Bond extremities of vertical metal bodies exceeding 60 feet in length to lightning protection components.

M. Bond ground terminals to counterpoise conductor.

N. Bond grounded metal bodies on building within 12 feet of ground to counterpoise conductor.

O. Bond grounded metal bodies on building within 12 feet of roof to counterpoise conductor.

P. Bond lightning protection components to grounded metal bodies on building at every 60 feet with intermediate-level interconnection loop conductors.

3.3 CORROSION PROTECTION

A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture, unless moisture is permanently excluded from the junction of such materials.

B. Use conductors with protective coatings where conditions would cause deterioration or corrosion of conductors.

3.4 FIELD QUALITY CONTROL

A. Periodic Inspections: Provide the services of a qualified inspector to perform periodic inspections during construction and at its completion, according to LPI-177.

B. UL Inspection: Apply for inspection by UL as required for UL master labeling of system.

- END OF SECTION -

- SECTION 26 4313 -

SURGE PROTECTIVE DEVICES FOR LOW VOLTAGE SURGE PROTECTION FOR ELECTRICAL DISTRIBUTION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SCOPE

A. The Contractor shall furnish and install the Surge Protective Device (SPD) equipment having the electrical characteristics, ratings, and modifications as specified herein and as shown on the contract drawings. To maximize performance and reliability and to obtain the lowest possible let-through voltages, the ac surge protection shall be integrated into electrical distribution equipment such as switchgear, switchboards, or panelboards.

1.3 REFERENCES

A. SPD units and all components shall be designed, manufactured, and tested in accordance with the latest applicable UL standard (ANSI/UL 1449 3rd Edition).

1.4 SUBMITTALS – FOR REVIEW/APPROVAL

A. The following information shall be submitted to the Engineer:
   1. Provide verification that the SPD complies with the required ANSI/UL 1449 3rd Edition listing by Underwriters Laboratories (UL) or other Nationally Recognized Testing Laboratory (NRTL). Compliance may be in the form of a file number that can be verified on UL's website or on any other NRTL's website, as long as the website contains the following information at a minimum: model number, SPD Type, system voltage, phases, modes of protection, Voltage Protection Rating (VPR), and Nominal Discharge Current (I_n).
   2. For sidemount mounting applications (SPD mounted external to electrical assembly), electrical/mechanical drawings showing unit dimensions, weights, installation instruction details, and wiring configuration.

B. Where applicable the following additional information shall be submitted to the engineer:
   1. Descriptive bulletins

2. Product sheets

1.5 SUBMITTALS – FOR CONSTRUCTION

A. The following information shall be submitted for record purposes:
   1. Final as-built drawings and information for items listed in Section 1.04 and shall incorporate all changes made during the manufacturing process.

1.6 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

D. The SPD shall be compliant with the Restriction of Hazardous Substances (RoHS) Directive 2002/95/EC.

1.7 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of manufacturer's instructions shall be included with the equipment at time of shipment.

1.8 OPERATION AND MAINTENANCE MANUALS

A. Operation and maintenance manuals shall be provided with each SPD shipped.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Eaton Cutler-Hammer

B. Square-D

C. Liebert

D. United Power

E. APT

F. As approved.

G. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features, and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

2.2 VOLTAGE SURGE SUPPRESSION – GENERAL

A. Electrical Requirements

1. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.
2. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 125% of the nominal system operating voltage.
3. The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.
4. Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

	Protection Modes			
Configuration	L-N	L-G	L-L	N-G
Wye	●	●	●	●
Delta	N/A	●	●	N/A
Single Split Phase	●	●	●	●
High Leg Delta	●	●	●	●

5. Nominal Discharge Current (I_n) – All SPDs applied to the distribution system shall have a 20kA I_n rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an I_n less than 20kA shall be rejected.

NSI/UL 1449 3rd Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 3rd Edition VPR for the device shall not exceed the following:		
Modes	208Y/120	480Y/277
L-N; L-G; N-G	700	1200
L-L	1200	2000

B. SPD Design

1. Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.
2. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable SPD modules shall not be accepted.

3. Electrical Noise Filter – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.
4. Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.
5. Monitoring Diagnostics – Each SPD shall provide the following integral monitoring options:
    a. Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.
        1) For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain an additional green / red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode. SPDs that indicate only the status of the L-N and L-G modes shall not be accepted.
        2) For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes.
        3) The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.
    b. Remote Status Monitor – The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.
    c. Audible Alarm and Silence Button – The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.
    d. Surge Counter – The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of 50 ± 20A occurs. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed. The reset button shall contain a mechanism to prevent accidental resetting of the counter via a single, short-duration button press. In order to prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2 seconds in order to clear the surge count total.
        1) The ongoing surge count shall be stored in non-volatile memory. If power to the SPD is completely interrupted, the ongoing count indicated on the surge counter's display prior to the interruption shall be stored in non-volatile memory and displayed after power is restored. The surge counter's memory shall not require a backup battery in order to achieve this functionality.
6. Overcurrent Protection
    a. The unit shall contain thermally protected MOVs. These thermally protected MOVs shall have a thermal protection element packaged together with the MOV in order to achieve overcurrent protection of the MOV. The thermal protection

element shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.

7. Fully Integrated Component Design – All of the SPD's components and diagnostics shall be contained within one discrete assembly. SPDs or individual SPD modules that must be ganged together in order to achieve higher surge current ratings or other functionality shall not be accepted.
8. Safety Requirements:
   a. The SPD shall minimize potential arc flash hazards by containing no user serviceable / replaceable parts and shall be maintenance free. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.
   b. SPDs designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit. Such units shall have any required conductors be factory installed.
   c. Sidemount SPDs shall be factory sealed in order to prevent access to the inside of the unit. Sidemount SPDs shall have factory installed phase, neutral, ground and remote status contact conductors factory installed and shall have a pigtail of conductors protruding outside of the enclosure for field installation.

2.3 SYSTEM APPLICATION

A. The SPD applications covered under this section include distribution and branch panel locations, motor control centers (MCC), switchgear, and switchboard assemblies. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments.

B. Surge Current Capacity – The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:

Minimum surge current capacity based on ANSI / IEEE C62.41 location category			
Category	Application	Per Phase	Per Mode
C	Service Entrance Locations (Switchboards, Switchgear, MCC, Main Entrance)	250 kA	125 kA
B	High Exposure Roof Top Locations (Distribution Panelboards)	160 kA	80 kA
A	Branch Locations (Panelboards, MCC's)	120 kA	60 A

C. SPD Type – all SPDs installed on the line side of the service entrance disconnect shall be Type 1 SPDs. All SPDs installed on the load side of the service entrance disconnect shall be Type 1 or Type 2 SPDs.

2.4 LIGHTING AND DISTRIBUTION PANELBOARD REQUIREMENTS

A. The SPD application covered under this section includes lighting and distribution panelboards. The SPD units shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category B environments.

1. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.
2. SPDs shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.
3. The panelboard shall be capable of re-energizing upon removal of the SPD.
4. The SPD shall be interfaced to the panelboard via a direct bus bar connection. Alternately, an SPD connected to a 30A circuit breaker for disconnecting purposes may be installed using short lengths of conductors as long as the conductors originate integrally to the SPD. The SPD shall be located directly adjacent to the 30A circuit breaker.
5. The SPD shall be included and mounted within the panelboard by the manufacturer of the panelboard.
6. The SPD shall be of the same manufacturer as the panelboard.
7. The complete panelboard including the SPD shall be UL67 listed.

B. Sidemount Mounting Applications Installation (SPD mounted external to electrical assembly)

1. Lead length between the breaker and suppressor shall be kept as short as possible to ensure optimum performance. Any excess conductor length shall be trimmed in order to minimize let-through voltage. The installer shall comply with the manufacturer's recommended installation and wiring practices.

C. Switchgear and Switchboard Requirements

1. The SPD application covered under this section is for switchgear, switchboard, and MCC locations. Service entrance located SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C environments.
2. The SPD shall be of the same manufacturer as the switchgear, switchboard, and MCC.
3. The SPD shall be factory installed inside the switchgear, switchboard, and MCC at the assembly point by the original equipment manufacturer.
4. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.
5. The SPD shall be connected through a disconnect (30A circuit breaker). The disconnect shall be located in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.
6. The SPD shall be integral to switchgear, switchboard, and MCC as a factory standardized design.
7. All monitoring and diagnostic features shall be visible from the front of the equipment.

2.5 ENCLOSURES

A. All enclosed equipment shall have NEMA 1 general purpose enclosures, unless otherwise noted. Provide enclosures suitable for locations as indicated on the drawings and as described below:

1. NEMA 1 – Constructed of a polymer (units integrated within electrical assemblies) or steel (sidemount units only), intended for indoor use to provide a degree of protection to personal access to hazardous parts and provide a degree of protection against the ingress of solid foreign objects (falling dirt).
2. NEMA 4 – Constructed of steel intended for either indoor or outdoor use to provide a degree of protection against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (dirt and windblown dust); to provide a degree of protection with respect to the harmful effects on the equipment due to the ingress of water (rain, sleet, snow, splashing water, and hose directed water); and that will be undamaged by the external formation of ice on the enclosure. (sidemount units only).
3. NEMA 4X – Constructed of stainless steel providing the same level of protection as the NEMA 4 enclosure with the addition of corrosion protection. (sidemount units only)

PART 3 - EXECUTION

3.1 FACTORY TESTING

A. Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of NEMA and UL standards.

3.2 INSTALLATION

A. The Contractor shall install all equipment per the manufacturer's recommendations and the contract drawings.

3.3 WARRANTY

A. The manufacturer shall provide a full ten (10) year warranty from the date of shipment against any SPD part failure when installed in compliance with manufacturer's written instructions and any applicable national or local code.

- END OF SECTION -

- SECTION 26 5100 -

INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Interior Lighting Fixtures
2. Lamps
3. Ballasts
4. Exit Signs
5. Emergency Lighting Units
6. Accessories

B. Related Sections:
1. Section 01 81 13 - Sustainable Design Requirements
2. Section 09 51 23 (09512) - Acoustical Tile Ceilings
3. Section 26 05 00 (16050) - Common Work Results For Electrical.
4. Section 26 56 00 (16520) - Exterior Lighting
5. Section 26 60 00 (16580) - Lighting Accessories: For programmable lighting control systems, time switches, additional photoelectric relays, power relays, and contactors.

1.3 REFERENCES

A. American National Standards Institute (ANSI) Publications:
1. C82.4 “Ballasts for High – Intensity – Discharge and Low Pressure Sodium Lamps (Multiple-Supply Type)”

B. Institute of Electrical and Electronics Engineers, Inc. (IEEE) Publications:
1. C62.41 “Surge Voltages in Low-Voltage AC Power Circuits”

C. National Fire Protection Association (NFPA) Publications:
1. NFPA 70 "National Electric Code"
2. NFPA 101 “Life Safety Code®”

D. Underwriter's Laboratories, Inc. (UL) Publications:
1. 486A “Standard For Wire Connectors and Soldering Lugs for Use with Copper Conductors”
2. 486B “Standard for Wire Connectors for Use with Aluminum Conductors”
3. 924 “Emergency Lighting and Power Equipment”

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

B. Submit “Letter of Conformance” in accordance with Section 01 33 00 (01330) indicating specified items selected for use in project with the following supporting data.
1. For each type of lighting fixture indicated, arranged in order of fixture designation. Include data on features, accessories, and the following:
a. Dimensions of fixtures.
b. Certified results of laboratory tests for fixtures and lamps for photometric performance.
c. Emergency lighting unit battery and charger.
d. Fluorescent and high-intensity-discharge ballasts.
e. Types of lamps.
f. Photometric data.
2. Dimming Ballast Compatibility Certificates: Signed by manufacturer of ballast certifying that ballasts are compatible with dimming systems and equipment with which they are used.
3. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
4. Maintenance Data: For lighting fixtures to include in maintenance manuals specified in Division 01.

1.5 QUALITY ASSURANCE

A. Fixtures, Emergency Lighting Units, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

B. Comply with NFPA 70.

C. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

1.6 COORDINATION

A. Fixtures, Mounting Hardware, and Trim: Coordinate layout and installation of lighting fixtures with ceiling system and other construction.

1.7 EXTRA MATERIALS

A. Furnish extra materials described in Section 01 78 43 (01790) “Spare Parts and Materials” that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Avendra, LLC Preferred Manufacturers:
   1. Subject to compliance with requirements, provide the products indicated for each designation in the Light Fixture Matrix attached at the end of this Section.
      a. None.

B. CFRST LEED Volume Program Manufacturers:
   1. Philips Lighting Company (800.555.0050)
      a. Contractor shall furnish items identified as manufactured by Philips Group Brand Companies, as listed in the Light Fixture Matrix, from the Philips Group Brand Companies only. No substitutions will be approved.
      b. Contact: Kathleen Kenny (813-760-3421)
      c. Products:
         1) Light Fixtures
         2) Lamps

C. Approved Manufacturers:
   1. Subject to compliance with requirements, provide the products indicated for each designation in the Light Fixture Matrix attached at the end of this Section.
   2. 2nd Avenue Design (800-843-1602)
      a. Contact: Jan Zanger (800-544-4879)
   3. Ashley Lighting Inc. (870-483-6184)
      a. Contact: David Burn (703-461-4780)
   4. Challenger Lighting Company (847-717-4700)
      a. Contact: Peggy Hart (301-260-2161 x 13)
   5. Cree LED Lighting Solutionsm (919-287-7700)
      a. Contact: Mark Wanless (708-505-4227)
      b. To obtain special volume pricing and accuracy for Marriott projects, contact:
         1) Wiedenbach-Brown Co., Inc.

            Attn: Buck Buchanan (917-566-4848) or Christine Sturm (800-243-0043 x 353)
   6. ExceLine, a Philips Group Brand (800-334-2212)
      a. Contact: Kathleen Kenny (813-760-3421)
   7. Forecast, a Philips Group Brand (847-622-0416)
      a. Contact: Kathleen Kenny (813-760-3421)

8. General Electric Lighting Company (800-435-4448)
9. Hadco, a Philips Group Brand (800-331-4185)
   a. Contact: Kathleen Kenny (813-760-3421)
10. Insight Lighting Inc. (262.524.2010)
   a. Contact: Heather Reed (301-338-1116)
11. Kichler Lighting (866-558-5706)
   a. Contact: Peggy Hart (301-260-2161 x 13)
12. LBL Lighting, a Generation Brands Company (847-626-6304)
   a. Contact: Joe Krause (301-537-5808)
13. Lightolier, a Philips Group Brand (508-679-8131)
   a. Contact: Kathleen Kenny (813-760-3421)
14. Lyte Poles Incorporated (586-774-5650)
   a. Contact: Kathleen Kenny (813-760-3421)
15. Lumark Lighting, Division of Cooper Industries Company (770-486-4800)
   a. Contact: Mike Larkin (301-953-2020 x 239)
16. Luminis Inc. (954-717-4155)
17. MaxLite (800-555-5629)
   a. Contact: Bill Masi (908-672-1665)
18. MP Lighting (604-708-1184)
   a. Contact: New Design Light (410-712-0239)
19. Neptun Light, Inc. (888-735-8330)
20. Pacific Coast Lighting (800-709-9004)
   a. Contact: Bruce Wowk (301-916-5588)
21. Panasonic (866-292-7292)
22. Philips Lighting Company (800.555.0050)
   a. Contact: Kathleen Kenny (813-760-3421)
23. Progress Lighting (864.599.6000)
   a. Contact: Jason Bak (864-599-6133)
24. Scott Lamp Company (707-864-2066)
   a. Contact: Bruce Wowk (301-916-5588)
25. Stonco Lighting, a Philips Group Brand (800-334-2212)
   a. Contact: Kathleen Kenny (813-760-3421)
26. TCP, Inc. (800-324-1496)
   a. Contact: Kip Sherwood (330-995-1359)
27. Tech Lighting, a Generation Brands Company (847-410-4400)
   a. Contact: To obtain special volume pricing and accuracy for Marriott projects, contact:
      1) Valley Lighting, Linthicum, MD (800-932-6012)
28. Translite Sonoma, a Philips Group Brand (707-996-6906)
   a. Contact: Kathleen Kenny (813-760-3421)
29. Trend Lighting, a McFadden Lighting Company (314 773-1340)
   a. Contact: Rob Bruck (626-480-8880)
30. Trinity Lighting Inc. (870-972-1177)

a. Contact: Heather McCarty (301-788-1290)

31. Unilight (800-361-0472)
    a. Contact: Kim Swanson (301-523-0070)
32. Wide-Lite, a Philips Group Brand (512.392.5821)
    a. Contact: Kathleen Kenny (813-760-3421)
33. Wilshire Manufacturing Company, USA (508-824-1970)
34. Approved Substitution.

2.2 FIXTURES AND FIXTURE COMPONENTS, GENERAL

A. Metal Parts: Free from burrs, sharp corners, and edges.

B. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit re-lamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during re-lamping and when secured in operating position.

D. Reflecting Surfaces: Minimum reflectance as follows, unless otherwise indicated:
   1. White Surfaces: 85 percent.
   2. Specular Surfaces: 83 percent.
   3. Diffusing Specular Surfaces: 75 percent.
   4. Laminated Silver Metallized Film: 90 percent.

E. Lenses, Diffusers, Covers, and Globes: 100 percent virgin acrylic plastic or annealed crystal glass, unless otherwise indicated.
   1. Plastic: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.
   2. Lens Thickness: 0.125 inch minimum, unless greater thickness is indicated.

2.3 FLUORESCENT LAMP BALLASTS

A. General Requirements: Unless otherwise indicated, features include the following:
   1. Designed for type and quantity of lamps indicated at full light output.
   2. Total Harmonic Distortion Rating: Less than 20 percent.
   3. Sound Rating: A.

B. Electronic Ballasts for Linear Lamps: Unless otherwise indicated, features include the following, besides those in "General Requirements" Paragraph above:
   1. Certified Ballast Manufacturer Certification: Indicated by label.
   2. Encapsulation: Without voids in potting compound.
   3. Parallel Lamp Circuits: Multiple lamp ballasts connected to maintain full light output on surviving lamps if one or more lamps fail.

C. Ballasts for Compact Lamps in Recessed Fixtures: Unless otherwise indicated, additional features include the following:

1. Type: Electronic fully encapsulated in potting compound.
2. Power Factor: 90 percent, minimum.
3. Operating Frequency: 20 kHz or higher.
4. Flicker: Less than 5 percent.
5. Lamp Current Crest Factor: Less than 1.7.
6. Transient Protection: Comply with IEEE C62.41 for Category A1 locations.

D. Ballasts for Dimmer-Controlled Fixtures: Comply with general and fixture-related requirements above for electronic ballasts.
1. Compatibility: Certified by manufacturer for use with specific dimming system indicated for use with each dimming ballast.

E. Ballasts for Low-Temperature Environments: As follows:
1. Temperatures 0 Deg F Above: Electronic or electromagnetic type rated for 0 deg F starting temperature.
2. Temperatures Minus 20 Deg F and Above: Electromagnetic type designed for use with high-output lamps.

2.4 HIGH-INTENSITY-DISCHARGE LAMP BALLASTS

A. General: Comply with ANSI C82.4. Unless otherwise indicated, features include the following:
1. Type: Constant wattage autotransformer or regulating high-power-factor type, unless otherwise indicated.
2. Operating Voltage: Match system voltage.
3. Minimum Starting Temperature: Minus 22 deg F for single lamp ballasts.
4. Normal Ambient Operating Temperature: 104 deg F
5. Open-circuit operation that will not reduce average life.
6. Auxiliary, Instant-on, Quartz System: Automatically switches quartz lamp on when fixture is initially energized and when momentary power outages occur. Automatically turns quartz lamp off when high-intensity-discharge lamp reaches approximately 60 percent light output.

2.5 EXIT SIGNS

A. General Requirements: Comply with UL 924 and the following:
1. Sign Colors and Lettering Size: Comply with authorities having jurisdiction.

B. Internally Lighted Signs: As follows:
1. Lamps for AC Operation: Light-emitting diodes, 70,000 hours minimum rated lamp life.

C. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
1. Battery: Sealed, maintenance-free, nickel-cadmium type with special warranty.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically energizes lamp from unit when circuit voltage drops to 80 percent of nominal or below. When normal voltage is restored, relay disconnects lamps, and battery is automatically recharged and floated on charger.

2.6 EMERGENCY LIGHTING UNITS

A. General Requirements: Self-contained units. Comply with UL 924. Units include the following features:

1. Battery: Sealed, maintenance-free, lead-acid type with minimum 10-year nominal life and special warranty.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically turns lamp on when supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps, and battery is automatically recharged and floated on charger.
4. Integral Time-Delay Relay: Arranged to hold unit on for fixed interval after restoring power after an outage. Provides adequate time delay to permit high-intensity-discharge lamps to restrike and develop adequate output.

2.7 LAMPS

A. Fluorescent Color Temperature and Minimum Color-Rendering Index: 3500 K and 85 CRI, unless otherwise indicated.

B. Non-compact Fluorescent Lamp Life: Rated average is 20,000 hours at 3 hours per start when used on rapid-start circuits.

C. Metal-Halide Color Temperature and Minimum Color-Rendering Index: 3600 K and 70 CRI, unless otherwise indicated.

2.8 FIXTURE SUPPORT COMPONENTS

A. Comply with Section 26/27 05 00 (16050) "Basic Electrical Materials and Methods," for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fitting and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy arranged to mount a single fixture. Finish same as fixture.

D. Rod Hangers: 3/16-inch- minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

F. Aircraft Cable Support: Use cable, anchorages, and intermediate supports recommended by fixture manufacturer.

2.9 FINISHES

A. Fixtures: Manufacturer's standard, unless otherwise indicated.

1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects.
2. Metallic Finish: Corrosion resistant.

3. Colors as indicated in Light Fixture Matrix.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fixtures: Set level, plumb, and square with ceiling and walls, and secure according to manufacturer's written instructions and approved submittal materials. Install lamps in each fixture.

B. Support for Fixtures in or on Grid-Type Suspended Ceilings:
1. Recessed lighting fixtures shall be supported independently from the suspended ceiling system. Number 8 gauge galvanized steel wire or approved type hangers from the overhead building structures shall be provided for fixture support.

C. Suspended Fixture Support: As follows:
1. Pendants and Rods: Where longer than 48 inches brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Suspend from cable installed according to fixture manufacturer's written instructions and details on Drawings.

3.2 CONNECTIONS

A. Ground Equipment.
1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Advance Notice: Give dates and times for field tests.

C. Provide instruments to make and record test results.

D. Tests: As follows:
1. Verify normal operation of each fixture after installation.
2. Emergency Lighting: Interrupt electrical supply to demonstrate proper operation.
3. Verify normal transfer to battery source and retransfer to normal.
4. Report results in writing.

E. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until units operate properly.

F. Corrosive Fixtures: Replace during warranty period.

3.4 CLEANING AND ADJUSTING

A. Clean fixtures internally and externally after installation. Use methods and materials recommended by manufacturer.

B. Adjust aimable fixtures to provide required light intensities.

- END OF SECTION -

- SECTION 26 5600 -

EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Exterior Lighting Units with Luminaires
2. Ballasts
3. Lamps
4. Luminaire Support Components
5. Accessories

B. Related Sections:
1. Section 03 30 00 (03300) - Cast-in-Place Concrete.
2. Section 26 05 26 (16060) - Grounding and Bonding for Electrical Systems.
3. Section 26 51 00 (16510) - Interior Lighting
4. Section 26 60 00 (16580) - Lighting Accessories: For programmable lighting control systems, time switches, additional photoelectric relays, power relays, and contactors.

1.3 DEFINITIONS

A. Lighting Unit: A luminaire or an assembly of luminaires complete with a common support, including pole, post, or other structure, and mounting and support accessories.

B. Luminaire (Light Fixture): A complete lighting device consisting of lamp(s) and ballast(s), when applicable, together with parts designed to distribute light, to position and protect lamps, and to connect lamps to power supply.

1.4 SUBMITTALS

A. Submit “Letter of Conformance” in accordance with Section 01 33 00 (01330) indicating specified items selected for use in Project with the following supporting data:
1. For each type of lighting unit indicated, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

a. Materials and dimensions of luminaires and poles.
b. Certified results of laboratory tests for fixtures and lamps for photometric performance.
c. High-intensity-discharge luminaire ballasts.
d. Photometric data.

2. Shop Drawings: Anchor-bolt templates keyed to specific poles and certified by manufacturer.
3. Maintenance Data: For lighting units to include in maintenance manuals specified in Division 01.

1.5 QUALITY ASSURANCE

A. Luminaires and Accessories: Listed and labeled as defined in NFPA 70, Article 100, for their indicated use, location, and installation conditions by a testing agency acceptable to authorities having jurisdiction

B. Comply with ANSI C2.

C. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING OF POLES

A. Package aluminum poles for shipping according to ASTM B 660.

B. Store poles on decay-resistant treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

C. Handle wood poles so they will not be damaged. Do not use pointed tools that can indent surface more than 1/4 inch deep. Do not apply tools to section of poles below ground-line.

D. Retain factory-applied pole wrappings on fiberglass poles until just before pole installation. Handle poles with web fabric straps.

E. Retain factory-applied pole wrappings on metal poles until just before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

1.7 EXTRA MATERIALS

A. Furnish extra materials described in section 01 78 43 (01790) “Spare Parts and Materials” that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Deliver extra materials to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Avendra, LLC Preferred Manufacturers:
1. Refer to Section 26 51 00 for list of approved manufacturers.

B. Approved Manufacturers:

Note: The Light Fixture Matrix can be found with Section 26 51 00.

1. Subject to compliance with requirements, provide the products indicated for each designation in the Light Fixture Matrix attached at the end of this Section.
2. Refer to Section 26 51 00 for list of approved manufacturers.

2.2 LUMINAIRES

A. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

B. Metal Parts: Free from burrs, sharp corners, and edges.

C. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.

D. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

E. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit re-lamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during re-lamping and when secured in operating position. Provide for door removal for cleaning or replacing lens. Arrange to disconnect ballast when door opens.

F. Exposed Hardware Material: Stainless steel.

G. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.

H. Reflecting Surfaces: Minimum reflectance as follows, unless otherwise indicated:
1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

I. Lenses and Refractors: Materials as indicated. Use heat- and aging-resistant, resilient gaskets to seal and cushion lens and refractor in luminaire doors.

J. Photoelectric Relays: As follows:
1. Contact Relays: Single throw, arranged to fail in the on position and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay.
2. Relay Mounting: In luminaire housing.

K. High-Intensity-Discharge Ballasts: Comply with ANSI C82.4. Constant wattage autotransformer or regulating high-power-factor type, unless otherwise indicated.
1. Ballast Fuses: One in each ungrounded supply conductor. Voltage and current ratings as recommended by ballast manufacturer.
2. Single-Lamp Ballasts: Minimum starting temperature of minus 40 deg C.
3. Open-circuit operation will not reduce average life.

4. Noise: Uniformly quiet operation, with a noise rating of B or better.

L. Lamps: Comply with the standard of the ANSI C78 series that is applicable to each type of lamp. Provide luminaires with indicated lamps of designated type, characteristics, and wattage. Where a lamp is not indicated for a luminaire, provide medium wattage lamp recommended by manufacturer for luminaire.

1. Metal-Halide Color Temperature and Minimum Color-Rendering Index: 3600 K and 70 CRI, unless otherwise indicated.

2.3 LUMINAIRE SUPPORT COMPONENTS

A. Description: Comply with AASHTO LTS-3 for pole or other support structures, brackets, arms, appurtenances, base, and anchorage and foundation.

B. Wind-Load Strength of Total Support Assembly: Adequate to carry support assembly plus luminaires at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of 100 mph (160 km/h) with a gust factor of 1.3. Support assembly includes pole or other support structures, brackets, arms, appurtenances, base, and anchorage and foundation.

1. Strength Analysis: For each pole type and luminaire combination, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.

C. Finish: Match finish of pole/support structure for arm, bracket, and tenon mount materials.

D. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.

1. Materials: Will not cause galvanic action at contact points.
2. Mountings: Correctly position luminaire to provide indicated light distribution.
3. Anchor Bolts, Nuts, and Washers: Hot-dip galvanized after fabrication unless stainless-steel items are indicated.
4. Anchor-Bolt Template: Plywood or steel.

E. Pole/Support Structure Bases: Anchor type with hold-down or anchor bolts, leveling nuts, and bolt covers.

F. Steel Poles: Tubing complying with ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psig (317 MPa); one-piece construction up to 40 feet in length with access handhole in pole wall.

1. Grounding Provisions for Metal Pole/Support Structure: Welded 1/2-inch threaded lug, accessible through handhole and listed for copper conductor connection.
2. Shafts: Square, straight.

G. Metal Pole Brackets: Match pole metal. Provide cantilever brackets without underbrace, in sizes and styles indicated, with straight tubular end section to accommodate luminaire.

H. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

I. Concrete for Pole Foundations: Comply with Section 03 30 00 (03300) "Cast-in-Place Concrete."

1. Design Strength: 3000-psig, 28-day compressive strength.

2.4 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Steel: Grind welds and polish surfaces to a smooth, even finish.
   1. Galvanized Finish: Hot-dip galvanize after fabrication to comply with ASTM A 123.
   2. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
   3. Interior: Apply one coat of bituminous paint on interior of pole, or otherwise treat to prevent corrosion.
   4. Polyurethane Enamel: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
      a. Color: Refer to Light Fixture Matrix.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Concrete Foundations: Construct according to Section 03 30 00 (03300) "Cast-in-Place Concrete."
   1. Comply with details for reinforcement and for anchor bolts, nuts, and washers. Verify anchor-bolt templates by comparing with actual pole bases furnished.
   2. Finish for Parts Exposed to View: Trowel and rub smooth. Comply with Section 03 30 00 (03300) - "Cast-in-Place Concrete" for exposed finish.

B. Embedded Poles: Set poles to indicated depth, but not less than one-sixth of pole length below finish grade. Dig holes large enough to permit use of tampers the full depth of hole. Backfill in 6-inch layers and thoroughly tamp each layer so compaction of backfill is equal to or greater than that of undisturbed earth.

C. Install poles as follows:
   1. Use web fabric slings (not chain or cable) to raise and set poles.
   2. Mount pole to foundation with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
   3. Secure poles level, plumb, and square.
   4. Grout void between pole base and foundation. Use non-shrinking or expanding concrete grout firmly packed in entire void space.
   5. Use a short piece of 1/2-inch diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

D. Luminaire Attachment: Fasten to indicated structural supports.

E. Luminaire Attachment with Adjustable Features or Aiming: Attach luminaires and supports to allow aiming for indicated light distribution.

F. Lamp luminaires with indicated lamps according to manufacturer's written instructions. Replace malfunctioning lamps.

3.2 CONNECTIONS

A. Ground equipment.
   1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Ground metal poles/support structures according to Section 26 05 26 (16060) - "Grounding and Bonding for Electrical Systems."
   1. Nonmetallic Poles: Ground metallic components of lighting units and foundations. Connect luminaires to grounding system with No. 6 AWG conductor.

3.3 FIELD QUALITY CONTROL

A. Inspect each installed unit for damage. Replace damaged units.

B. Advance Notice: Give dates and times for field tests.

C. Provide instruments to make and record test results.

D. Tests and Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source, and as follows:
   1. Measure light intensities at night if specific illumination performance is indicated. Use photometers with calibration referenced to NIST standards.
   2. Check intensity and uniformity of illumination.
   3. Check excessively noisy ballasts.

E. Prepare a written report of tests, inspections, observations and verifications indicating and interpreting results.

F. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until units operate properly.

3.4 CLEANING AND ADJUSTING

A. Clean units after installation. Use methods and materials recommended by manufacturer.

B. Adjust amiable luminaires and luminaires with adjustable lamp position to provide required light distributions and intensities.

- END OF SECTION -

DIVISION 27 – TELECOMMUNICATIONS

TABLE OF CONTENTS

Pages

- SECTION 27 0500 -

COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.2 SUMMARY

A. Section Includes:
   1. Contractor Responsibility and Qualification
   2. Reference Standards and Codes
   3. Required Contractor Training
   4. Quality Assurance
   5. Permits, Fees, and Certificates of Approval
   6. Submittals
   7. Product Assurance
   8. Coordination
   9. Pre-installation Conference
   10. Alternates, Substitution and Change Orders
   11. Project Management
   12. Delivery and Storage
   13. Cleaning
   14. Painting

1.3 CONTRACTOR RESPONSIBILITY AND QUALIFICATION

A. The chosen Communications Contractor (here after referred to as Contractor) shall provide a minimum one (1) year warranty on material, installation and workmanship.

B. Contractor shall provide all components, materials, services and labor essential for a complete and functional structured cabling system.

C. The Contractor shall be responsible for complying with all local, state and federal laws and regulations applicable to the work to be performed, although said law, rule or regulation is not identified herein.

D. Examination of building and site shall be the responsibility of the Contractor: Contractors shall examine site and building as required prior to installation to determine any conditions affecting the scope of work. Contact Owner representative for arrangements. All systems and cabling are assumed working and in good condition unless contractor documents exceptions.

E. Contractor shall call for all inspections required. Final payment of this contract will not be made until final inspections have been completed and all deficient items noted have been corrected.

F. Contractor will respect and protect the privacy and confidentiality of Owner, its employees, processes, products, and intellectual property to extent necessary, consistent with the legal responsibilities of the State of Texas and Owner policies.

G. Use of sub-contractors: The Contractor shall inform in writing to Owner's representative and General Contractor about the intention to use sub-contractors and the scope of work for which they are being hired. Owner's representative prior to the sub-contractor's hiring and start of any work must approve the use of sub-contractors in writing.

H. Contractor will be required to provide a sufficient number of technicians for this project to stay on schedule.

I. Owner is often forced to take on high-level projects on short notice. Vendor shall indicate how their company shall respond to high-level projects on short notice..

J. Contractor must have a Registered Communications Distribution Designer (here after referred to as RCDD) on staff and must be available as needed for design discussions and inspections. Identify the design experience of the proposed RCDD.

K. Contractor shall identify the qualifications of their technician. Vendor shall also identify the type(s) of certifications / testing that its technicians go through before and after being hired on by your company.

L. Contractor must identify plan and as-built documentation processes used by your company, such as AutoCAD, Visio, and cable records.

M. Installers: Only technicians certified by equipment manufacturer are approved.

1.4 REFERENCE STANDARDS AND CODES

A. Supervisors and lead installers shall have a working knowledge and understanding of the following documents and codes or their most recent updates, and shall be familiar with the requirements that pertain to this installation. Installers shall be familiar with and have practical working knowledge of the requirements that pertain to this installation.

B. Codes: Comply with applicable sections of the most recent editions and addenda of following for interior and exterior installations. Ensure you are using the latest and most up to date standards regulations applicable. [NOTE: All installations within non-State owned properties shall comply with all applicable codes and regulations adopted by the authorities having jurisdiction.]

1. International Building Code (IBC)

2. National Electrical Code (NEC/NFPA 70)
3. National Electrical Safety Code (NESC IEEE)

C. Standards: Comply with applicable sections of the most recent editions and addenda of the following for installations and testing of communications cabling, connectors, and related hardware: Comply with applicable sections of the following for interior and exterior installations.
1. IEEE Std 1100, Recommended Practice for Powering Grounding Sensitive Electronics
2. ANSI/EIA/TIA-455-50B, Light Launch Conditions For Long-Length Graded-Index Optical Fiber Spectral Attenuation Measurements
3. TIA/EIA TSB-140, Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems.
4. ANSI/TIA/EIA-455-59A, Measurement of Fiber Point Discontinuities Using an OTDR.
5. ANSI/TIA/EIA-455-60A, Measurement of Fiber or Cable Length Using an OTDR.
6. ANSI/TIA/EIA-455-61A, Measurement of Fiber or Cable Attenuation Using an OTDR.
7. TIA/EIA-526-7, Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant – OFSTP-7
8. TIA/EIA-526-14-A, Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant – OFSTP-14
9. TIA/EIA-568-B1.1, Commercial Building Telecommunications Cabling Standard Part 1: General Requirements
10. TIA/EIA-568-B.2-4, Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling Components
11. TIA/EIA-568-B.3-1, Optical Fiber Cabling Components Standard
12. TIA/EIA-569-A-7, Commercial Building Standard for Telecommunications Pathways and Spaces
13. TIA/EIA-570-A-3, Residential Telecommunications Cabling Standard
14. ANSI/CEA S83-596, Fiber Optic Premises Distribution Cable
15. ANSI/TIA/EIA-526-7, Optical Power Loss Measurements of Installed Single Mode Fiber Cable Plant-OFSTP-7
16. ANSI/TIA/EIA-526-14-A, Optical Power Loss Measurements of Installed Multi Mode Fiber Cable Plant-OFSTP-14A
17. ANSI/TIA/EIA-569-A: - Commercial Building Standards for Telecommunications Pathways and Spaces.
18. TIA/EIA-598-B, Optical Fiber Cable Color Coding
19. TIA-604-5-C, Intermateability Standard (FOCIS), Type MPO, FOCIS-5
20. TIA/EIA-606-A,, Administration Standard for Commercial Telecommunications Infrastructure
21. J-STD-607, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
22. TIA/EIA 758, Customer-Outside Plant Telecommunications Cabling Standard.

D. BICSI: Comply with the most current editions of the following BICSI manuals:
1. BICSI -- Telecommunications Distribution Methods Manual
2. BICSI – Installation Transport Systems Information Manual
3. BICSI – Network Design Reference Design Manual
4. BICSI –Outside Plant Design Reference Manual

5. BICSI – Wireless Design Reference Manual
6. BICSI - Electronic Safety and Security Design Reference Manual
7. Infocomm/BICSI – AV Design Reference Manual

1.5 REQUIRED CONTRACTOR TRAINING

A. The Contractor shall be fully conversant and capable in the cabling of low voltage applications such as, but not limited to data, voice and imaging network systems. The Contractor shall at a minimum possess the following qualifications:
   1. Personnel trained and certified in the design of the specified structured cabling system.
   2. Personnel trained and certified to install the specified structured cabling system.
   3. The Designer and Installer shall show proof of current “Certified Installer” of the specified structured cabling system via an updated certificate given after attending the appropriate training course or an on-line re-certification class.
   4. Provide references for the type of installation provided in this specification.
   5. Personnel trained and certified in fiber optic cabling, splicing, termination and testing techniques. Personnel must have experience using an optical light source and OTDR.
   6. Personnel trained in the installation of pathways and support for housing horizontal and backbone cabling.

1.6 QUALITY ASSURANCE

A. Contractor shall identify all types of quality control mechanisms they employ. Please list.

B. Perform work in accordance with contract documents and governing codes and standards.

C. All personnel performing the work of this Section shall be thoroughly familiar with the cabling methods set forth in the latest release of the BICSI TDMM (Building Industry Consulting Services International Telecommunications Distribution Methods Manuals).

D. Contractor’s RCDD shall review all required work prior to commencing. The Contractor’s RCDD shall oversee the installation and will have the end responsibility for the quality of the installation work performed. All submitted designs and or changes to the design shall be approved and signed off by the Contractor’s RCDD.

E. The installed cabling systems shall not generate nor be susceptible to any harmful electromagnetic emission, radiation, or induction that degrades cabling systems.

F. Expansion Capability: Unless otherwise indicated, provide spare positions in wall fields, cross connects, and terminal strips, and space in cable pathways to accommodate twenty (20) percent future growth in campus distribution and riser.

G. Backward Compatibility: The provided solution shall be backward compatible with lower category ratings such that if higher category components are used with lower category components, the permanent link and channel measures shall meet or exceed the lower channel’s specified parameters.

H. Component Compliance: The provided solution’s components shall each meet the minimum transmission specifications listed herein such that no individual component will be less than

specifications for permanent and channel, regardless of the fact that tests for permanent and channel ultimately meet required specifications.

I. Pre-installation inspection: Visually inspect all cables, cable reels, and shipping cartons to detect possible cable damage incurred during shipping and transport.
   1. Test optical fiber cable. Use an optical time domain reflectometer (OTDR) to verify the cable length and locate cable defects, splices, and connector, including the loss value of each.
   2. Test each pair of UTP cable for open and short circuits. Test results to be submitted to Owner.

J. Visibly damaged goods are to be returned to the supplier and replaced at no additional cost to the Owner.

PART 2 - GENERAL

2.1 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.2 SUBMITTALS

A. General:
   1. Bill of materials, noting all lead times in business days.
   2. Optical loss budget calculations for each optical fiber run.
   3. Proposed test forms for fiber backbone, copper backbone and horizontal UTP cable.
   4. Project schedule including all major work components that materially affect any other work on the project.

B. Shop Drawings:
   1. Plan views and elevations of telecommunication spaces showing cabinets, racks, termination blocks, patch panels, wire managers and cable pathways.
      a. Vertical and horizontal offsets and transitions.
      b. Clearances for access above and to side of cable trays.
      c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
      d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.
   2. Plan view and elevations of all raceways (conduits, cable trays, ladder racks, floor ducts, junction boxes, pull boxes, splice boxes, manholes, and all associated supports).
   3. Backbone diagram(s) for fiber and copper telecommunication cables.
   4. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
   5. The telecommunications drawings shall be a separate set and will be identified as Telecommunications (T-drawings).

C. Two indexed sets of manufacturer's technical data for each product including product description, specifications including labeling or listing by an agency acceptable to the Owner, and storage requirements.

D. Firestop design basis documentation that shall include each type of communication penetration, type of building construction being penetrated including the hourly resistance rating of floor, wall, or other partition of building construction into which firestop design will be installed, and firestop device or system proposed for use.

E. Installation Procedures and Material Safety Data Sheets shall be included with products delivered to the job site.

F. All submittals need to be approved by Owner before implementation.

G. Informational Submittals:
   1. Manufacturer's Installation, Start-Up and Adjustment Instructions.
   2. Certificates:
      a. Certify that field tests have been performed and that work meets or exceeds specified requirements.
      b. Certify that factory tests have been performed and that work meets or exceeds specified requirements. Certificates may be based on recent or previous test results, provided material or products tested are identical to those proposed for this Project.
      c. Calibration report of test equipment for fiber and copper. Last calibration date should not be older than 1 year from the 1st day of testing.
      d. Name(s) and copy of certificate of RCDD's.
   3. Field Test Reports. Submit sample cable test reports showing report format and parameters tested.
   4. Operation and Maintenance Data.
   5. Special Warranty: With respect to the installation of Siemon and/or Systimax cabling system, furnish Siemon and/or Systimax Cabling System applications extended warranty.

2.3 PRODUCT ASSURANCE

A. All materials shall be UL and/or ETL approved and labeled in accordance with NEC for all products where labeling service normally applies.

B. Materials and equipment requiring UL 94, 149, or 1863 listing shall be so labeled. A modification of products that nullifies UL labels is not permitted.

C. All materials and equipment provided shall be the standard Commercial-Off-The-Shelf (COTS) products of a manufacture engaged in the manufacture of such products. All materials shall be typical commercial designs that comply with the requirements specified. All materials and equipment shall be readily available through manufacturers and/or distributors. All equipment shall be supplied complete with any optional items required for proper installation.

D. Materials or Manufactures not listed in this Division 27 but are required materials to provide a complete and functioning cable infrastructure system shall have cut sheets and product data included in the material and procedures submittal package.

E. Coordinate the features of materials and equipment so they form an integrated system. Match components and interconnections for optimum future performance and backward compatibility.

2.4 IDENTIFICATION

A. Labels
   1. Shall meet the legibility, defacement, exposure, and adhesion requirements of UL 969.
   2. Shall conform to the requirements specified within ANSI/TIA/EIA-606-A or to the requirements specified by the Owner or the Owner's representative.
   3. Shall be preprinted using a mechanical means of printing (e.g., laser printer).
   4. Where used for cable marking, provide vinyl substrate with a white printing area and a clear "tail" that self laminates the printed area when wrapped around the cable. If cable jacket is white, provide cable label with printing area that is any other color than white, preferably orange or yellow – so that the labels are easily distinguishable.
   5. Where insert type labels are used provide clear plastic cover over label.
   6. Acceptable Manufacturers:
      a. Panduit
      b. Silver Fox
      c. W.H. Brady
      d. Tyco
      e. Avaya
      f. d-Tools
      g. Brothers

PART 3 - GENERAL

3.1 COORDINATION

A. Coordinate arrangement, mounting, and support of communications equipment with Architect or Owner:
   1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
   2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
   3. To allow right of way for piping and conduit installed at required slope.
   4. To allow connecting pathways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for communications items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

E. Contractor shall be responsible for coordination with all trades, to include required scheduling of materials and/or equipment with Owner and/or General Contractor for delivery, storage, and protection of equipment as required.

3.2 PRE-INSTALLATION CONFERENCE

A. Arrange and schedule pre-installation conference prior to beginning any work of this section Communications.

B. Agenda: Clarify questions in writing related to work to be performed, scheduling, coordination, etc. with consultant and/or project manager/Owner representative.

C. All individuals, who will be in an on-site supervisory capacity, shall be required to attend the pre-installation conference. This includes project managers, site supervisor and lead installers. Individuals who do not attend the conference will not be permitted to supervise the personnel that install, terminate, or test communications cables on the project. The Contractor's RCDD that will oversee the installation is required to attend the pre-installation conference.

D. The manufacturer that will be providing the extended warranty is required to have a representative attend the pre-installation conference.

3.3 FIELD QUALITY CONTROL

A. The Contractor shall perform the following field inspections during installation and commissioning:
   1. Visually inspect UTP and optical fiber jacket materials for NRTL certification markings.
   2. Visually inspect cabling placements, pathways and terminations in communications equipment rooms, telecommunications rooms and work area's for compliance with standards and codes.
   3. Visually inspect grounding and bonding for compliance with standards and codes.
   4. Visually inspect all installed cable trays, cable pathways and wall penetrations for compliance with standards and codes.

B. The Contractors RCDD will be responsible for all field inspections and will submit a signed inspection report to Owner.

3.4 ALTERNATES, SUBSTITUTIONS AND CHANGE ORDERS

A. If a proposed alternate material is equal to or exceeds specified requirements, Contractor shall provide manufacturer's specifications in writing for written approval prior to purchase and installation of proposed materials. The proposed material substitution shall not void or change manufacturer's warranty.

B. Contractor shall provide a complete cabling infrastructure according to these written specifications and drawings. If the Owner changes the scope of work to be performed by the Contractor, it shall be in writing. Contractor shall respond to these changes with a complete material list, labor, and taxes in writing presented to the Owner for approval. Contractor shall not proceed with additional scope of work without a signed approval by the Owner.

C. Additional work performed by the Contractor will not be paid by Owner without signed approval of these changes prior to implementing changes. Submit a copy of signed change order upon billing.

3.5 PROJECT MANAGEMENT

A. Contractor shall designate a project manager to act as the single point of contact. Project manager shall oversee all work performed to ensure a quality installation compliant with specifications as outlined in documents (which includes all specifications and drawings). M. D. Anderson will review a copy of the resume of the on-site project managers and each on-site team.

B. The Contractor project manager/supervisor shall attend meetings arranged by General Contractor, architect, Owner's representatives, and/or other parties affected by work of this Division 27.

C. Contractor shall provide weekly written progress reports to General Contractor, architect, Owner representative and other parties affected by work of this Division 27. This progress report must include:

1. Updated time schedule with estimated time of completion. This must be provided in MS Project format, also showing the time baseline.
2. Work performed in the last week.
3. Work planned for upcoming week.
4. Percentage complete of work performed.
5. Indentify potential risks that can impact scope and/or time schedule.

3.6 DELIVERY AND STORAGE

A. The Contractor shall assume custody and responsibility for the items upon delivery and determining that the contents are complete and in satisfactory condition for installation.

B. Delivery, loss, storage, and protection: All materials and equipment delivered and placed in storage shall be stored with protection from the weather, humidity, and temperature variation, dirt, and dust, or other contaminants.

C. Coordinate deliveries and submittals with the General Contractor/Owner to ensure a timely scheduled installation.

D. Contractor shall be responsible for all handling and control of cabling equipment. Contractor is liable for any material loss due to delivery and storage problems.

E. No equipment or materials shall be delivered to the job site more than three weeks prior to the commencement of its installation. Coordinate with General Contractor/Owner on location of storage materials.

3.7 AS-BUILTS

A. Record copy and as-built drawings;

1. Provide record copy drawings periodically throughout the project as requested by the General Contractor or Owner, and at end of the project on CD-ROM. Record copy

drawings at the end of the project shall be in CAD format and include notations reflecting the as built conditions of any additions to or variation from the drawings provided such as, but not limited to cable paths and termination points. CAD drawings are to incorporate test data imported from the test instruments.

2. The as built drawings shall include, but are not limited to block diagrams, frame and cable labeling, cable termination points, equipment room layouts, rack elevations and frame installation details. The as-builts shall include all field changes made up to construction completion:
   a. Field directed changes to cross connect and patching schedule.
   b. Horizontal cable routing changes.
   c. Backbone cable routing or location changes, inclusive outside plant physical pathways (if within scope of this project).
   d. Associated detail drawings.

3.8 LABELING

A. Identify all system components, wiring, and cabling complying with TIA/EIA-606-A.
   1. Horizontal and backbone cables shall be labeled at each end. The cable or its label shall be marked with its identifier.
   2. A unique identifier shall be marked on each faceplate to identify it as connecting hardware.
   3. Each port in the faceplate shall be labeled with its identifier.
   4. A unique identifier shall be marked on each piece of connecting hardware to identify it as connecting hardware.
   5. Each port on the connecting hardware shall be labeled with its identifier.
   6. For backbone cables only:
      a. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.

B. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Furnish electronic record of all drawings, in software and format selected by Owner.

3.9 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, dust, and construction debris and repair damaged finish, including chips, scratches, and abrasions. This includes touching up paint removed for grounding.

B. Contractor shall provide a clean work environment, free from trash/rubbish accumulated during and after cabling installation.

C. Maintain construction materials and refuse within the area of work. Clean the work area at the end of each day.

D. Contractor shall keep all liquids (drinks, Sodas, etc.) off finished floors, carpets, tiles, racks and equipment. If any liquid damage to above finishes or equipment, Contractor shall provide professional services to clean or repair scratched/soiled finishes or damaged equipment at own expense.

3.10 PAINTING

A. Touch up marred and bared surfaces of primed, galvanized, and finish painted equipment, materials, and accessories installed.

B. Restore patched surfaces as close to the original condition and finish as reasonably possible. Where patching occurs in smooth painted surface, extend final paint coat over entire unbroken surface containing patch, after patched area has received two coats of primer and two coats of finished paint.

- END OF SECTION -

- SECTION 27 1000 -

STRUCTURED CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them, including but not limited to the following:
1. Division 07 - Penetration Firestopping
2. Section 27 0000 - Communications
3. Section 27 0526 - Grounding and Bonding for Communications Systems
4. Section 27 0528 - Pathways for Communications Systems
5. Section 27 0543 - Underground Ducts and Raceways for Communications Systems
6. Section 27 0553 - Identification for Low-Voltage Cables
7. Section 27 1100 - Communications Equipment Room Fittings
8. Section 27 1300 - Communications Backbone Cabling

1.2 SUMMARY

A. Section Includes:
1. This section includes the horizontal cabling portion of a structured cabling system (SCS) including:
a. Optical fiber
b. Copper and coaxial cabling
c. Termination and patch cables

B. Provide all horizontal cabling, terminating hardware, adapters, and cross-connecting hardware necessary to interconnect all system equipment including equipment located in communications rooms.

1.3 REFERENCES

A. The publications listed below form a part of this specification. The publications are referred to in the text by basic designation only.

B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.

C. Conflicts:
   1. Refer to section 27 0000

D. Codes and Standards:
   1. ANSI/TIA-568-C Commercial Building Telecommunications Wiring Standard
   2. ANSI/TIA-569-B Commercial Building Standard for Telecommunications Pathways and Spaces
   3. ANSI/TIA-606-A Administration Standard for Commercial Telecommunications Infrastructure
   4. ANSI/TIA-607-A Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
   5. ANSI/TIA-758-A Customer-Owned Outside Plant Telecommunications Infrastructure Standard
   6. ANSI/TIA-1179 Healthcare Facility Telecommunications Infrastructure Standard
   7. National Electrical Code (NEC), based upon year approval by local codes or AHJ
   8. Building Industry Consulting Services International (BICSI) Telecommunications Distribution Methods Manual (TDMM), current edition
   9. Local, county, state and federal regulations and codes in effect as of date of purchase
   10. Equipment of foreign manufacture must meet U.S. codes and standards. It shall be indicated in the proposal the components that may be of foreign manufacture, if any, and the country of origin.

1.4 SUBMITTALS

A. Refer to sections 27 0000 and 27 1300

1.5 QUALITY ASSURANCE

A. Refer to section 27 0000

1.6 DELIVERY, STORAGE, AND HANDLING

A. Refer to sections 27 0000 and 27 1300

B. Storage temperature range: -40°F to 149°F (-40°C to 65°C)

1.7 PROJECT/SITE CONDITIONS

A. Refer to section 27 0000

1.8 WARRANTY

A. Refer to section 27 0000

1.9 MAINTENANCE AND SUPPORT

A. Refer to section 27 1300

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Horizontal Category 6A UTP Cable Plenum-rated
   1. Amp, Belden
   2. Approved alternate

B. Horizontal Category 6 UTP Cable Plenum-rated
   1. Amp, Belden
   2. Approved alternate

C. Horizontal Category 5e UTP Cable Plenum-rated
   1. Amp, Belden
   2. Approved alternate

D. Information outlet components
   1. Amp, Belden -Category 6 Jack
   2. Amp, Belden- Blank
   3. approved alternate

E. 48-Port Patch Panels
   1. Amp, Belden
   2. Approved alternate

F. Wall and Rack Mount 110 Termination Blocks
   1. Amp, Belden
   2. Approved alternate

G. Faceplate for wall-mount telephones
   1. Amp, Belden
   2. Approved alternate

H. Fiber Horizontal Cable Plenum-rated
   1. Amp, Corning
   2. Approved alternate

I. Fiber Connectors, (LC)
   1. Amp, Corning
   2. Owner- approved alternate

J. Fiber Termination Shelves and Cabinets (Rack-Mountable)
   1. Amp, Corning
   2. Owner- approved alternate

K. Fiber Distribution Cabinet (Wall –Mounted)

1. Amp, Corning
2. Approved alternate
3.

L. Fiber adapter panels (6-port)
1. Amp, Corning
2. Approved alternate

M. Patch Cords, Copper:
1. Amp, Belden
2. All Patch Cords Furnished / Installed by Owner
3. Approved alternate

N. Fiber Duplex Patch Cables (Type SM and MM)
1. Amp, Corning
2. All Patch Cords Furnished / Installed by Owner
3. Approved alternate

O. Labeling
1. Refer to section 27 0000

P. Fire stopping
1. Refer to section 27 0000

2.2 ACCESSORIES

A. The Contractor shall:
1. Mount one laminated full-size hard copy in color of an as-built floor plan designating workstation locations, pathways, and communications room locations. Confirm hard copy size with Owner. As-built floor plan shall be scalable, and shall have an identified standard scale.
2. Install the laminated drawings within a protective Plexiglas encasement on the wall of the servicing communications rooms. To ease accessibility the Plexiglas encasement shall be in either flip-down format or file folder format.

2.3 HORIZONTAL CABLING

A. Recognized cabling for providing the signal medium from the work area to the communications room shall include the following:
1. Four-pair Category 6 UTP cable
2. 50 µm multi-mode optical fiber

B. Optical Fiber Requirements – Refer to Section 27 13 00 Communications Backbone Cabling for additional general requirements:
1. Multi-mode fibers shall have dual wavelength capability; transmitting at 850 and 1300 nm ranges.
2. Laser optimized 50 µm ± 2.5 µm core

3. 125 µm ± 1 µm cladding diameter
4. Maximum Fiber Loss: 3.5 dB/km at 850 nm and 1.0 dB/km at 1300 nm
5. Minimum Bandwidth: 200 MHz at 850 nm and 500 MHz at 1300 nm
6. Single mode shall not be used for horizontal cabling.

C. Category 6 UTP Cable Requirements: High performance Category 6 UTP shall adhere to the following:
1. 23/24 AWG solid bare copper
2. Cable jacket shall comply with NEC Article 800 for use as a plenum cable and shall be UL and c (UL) Listed Type CMP (communications multipurpose plenum) where required.
3. Cable shall terminate on an eight-pin modular jack at each outlet. All horizontal cabling shall meet or exceed the ANSI/EIA/TIA-568-C.2 Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted Pair Cabling Components.
4. Cables shall be marked as UL verified with a minimum of Category 6 rating.
5. The cable shall support Voice, Analog Base band Video/Audio, Fax, Modem, Switched-56, T-1, ISDN, RS-232, RS-422, RS-485, 10BASE-T Ethernet, Token Ring, 100Mbps TP-PMD, 100BASE-T Ethernet, 155 Mbps ATM, AES/EBU Digital Audio, 270 Mbps Digital Video, 622 Mbps 64-CAP ATM and emerging high-bandwidth applications, including 1 Gbps Ethernet, gigabit ATM, as well as all 77 channels (550 MHz) of analog broadband video
6. The maximum horizontal cable length for Category 6 copper cable from the termination of the cable in the communications room to the outlet is 295 feet.
7. Cable shall meet or exceed the following electrical characteristics:
8. Cable shall be specified to 250 MHz and shall meet the manufacturer's guaranteed electrical performance and physical specifications as follows:

D. Cabling Method:
1. The Contractor shall:
   a. Provide cabling in accessible spaces, cable tray, (surface and/or enclosed raceway), conduits, and/or J-Hook cable support system. Within consoles, racks, cabinets, desks, and counters, in accessible ceilings spaces and in gypsum board partitions where open cable method may be used. Use UL or ETL listed plenum rated cable in all spaces.
   b. Conceal raceway and cabling except in unfinished spaces as is practical.
   c. Utilize conduits/cable tray as indicated on the drawings.
   d. Route data and voice cables separately in a neat and orderly fashion. No cable ties or wraps shall be used to secure the cables in the runway outside of the communications rooms. Hook and loop fasteners shall be used for any final cable securing needed. Fasteners shall be rated for the area they are used in, (Plenum as required).
   e. Examine pathway elements intended for cable.
   f. Check raceways and other elements for compliance with space allocations, installation tolerances, debris, hazards to cable installation, and other conditions affecting installation. Proceed with installation only after unsatisfactory conditions have been corrected.

E. Application of Media:
1. Horizontal cabling

a. The Contractor shall:
   1) Install cable using techniques, practices, and methods that are consistent with specified data cabling and the installed components and that ensure specified performance levels of completed and linked signal paths, end to end.
   2) Install cables in continuous lengths from communications outlet to specified patch panels for data and termination blocks for voice.
   3) Terminate horizontal voice cables into termination blocks without damaging twisted pairs or jacket.
   4) Terminate horizontal data cables onto 8P8C modular patch panels without damaging twisted pairs or jacket.
   5) Pull cables in smooth and regular motions using methods that prevent cable kinking.
   6) If necessary use approved cable pulling lubricant.
   7) Keep all items protected before and after installation with dust and moisture proof barrier materials/envelopes. If wiring is terminated on patch panels, data, voice jacks prior to painting, carpet installation, and general finish clean up, these jacks shall be placed in a protective envelope to ensure dust, debris, moisture, and other foreign material do not settle onto jacks' contacts. Envelope will be removed on final trim out after other trades have completed their finish work. It shall be the Contractor's responsibility to ensure the integrity of these protective measures throughout the life/installation of the project.
   8) Do not bind cables tightly together with tie or other wraps. Wraps shall slip loosely around cables. Use Velcro wraps instead of cables ties for all bundling in the communications rooms.
   9) Pull cables simultaneously if more than one is being installed in the same raceway/pathway.
   10) Use pulling means; including fish tape, cable, rope, and basket weave wire/cable grips that will not damage media or raceway.
   11) Install open cabling parallel and perpendicular to surfaces or structural members following surface contours where possible.
   12) Do not bend cable greater than a bend radius of 1.00 inch.

b. Cable bundles brought into the communications rooms shall be routed and dressed in such a manner that prior to termination the cables are not subject to damage and misuse such as installers walking on the bundles that are lying on the floor. Cable pulling force shall not exceed 25 pounds of pulling tension or cable manufacturer's recommended pulling tensions.

c. When exiting runway and/or conduit via a means to ensure support of the cable, shall thereafter be supported with approved materials, and space supporting hardware to maintain performance characteristics, or as listed below.

F. Separation of Wires and Cabling Installation Practices:
   1. The Contractor shall:
      a. Comply with NEC / TIA rules for separating unshielded copper communication and data-processing equipment cables from potential EMI sources, including electrical power lines and equipment.
      b. Maintain a minimum spacing of 18 inches from electrical feeders and/or branch circuit wiring.

c. Maintain a minimum spacing of 12 inches from auxiliary systems cabling.

d. Maintain a 1-inch separation where UTP cables must pass perpendicularly to electrical, plumbing, or other wiring, conduit, or piping systems. Use non-conduit bushings, if necessary to maintain separation, which allow for the addition of a reasonable number of cables in the future.

e. Maintain communications pathways away from electrical apparatus such as motor driven equipment and transformers, minimum separation distance of 10-feet is recommended.

f. Provide all necessary installation materials, hardware, tools and equipment to perform insulation displacement type terminations at all data outlets, patch panels, and voice termination materials.

g. Dress and terminate horizontal cables in consistent consecutive order.

h. Arrange cables on patch panels and voice termination hardware in ascending order of room numbers and outlet numbers within rooms.

i. Provide a 3-foot 6-inch service loop for horizontal cables at I/O's. Locate service loop above or below I/O were vertical cable run transitions to horizontal run.

j. Maintain twists in cable pairs to within .5-inch of termination.

k. Group all specialty cables such as the pay phone cables, elevator line, etc which do not have their own termination hardware, in one group, clearly labeled as to cable number and function, in the last positions on the horizontal cabling blocks in each communications room.

l. Limit cable-bending radius for fiber optic cable to 20 times the cable diameter during installation, and 15 times the cable diameter after installation. Follow manufacturer's requirements for copper cable bending radius.

m. Do not leave cables on the floor unprotected or cable bundles hanging from the ceilings. Coil them up in a temporary manner and protect them from damage.

n. Start numbering at the left of the main door to the room and continue in a clockwise direction around the room.

o. The cables within the room will be terminated starting with the cables located to the left of the main door to the room and continue around the room in a clockwise direction.

2. Fiber Optic Cable Installation

a. Fiber optic cable shall be installed in inner duct from near end termination point to far end termination point. Only UL-approved plenum-rated inner duct shall be installed in all plenum areas. Metallic conduit may be used in lieu of inner duct in plenum-rated ceilings if it is bonded and grounded correctly.

b. Only technicians-trained and certified by the product manufacturer shall perform terminations. Terminations shall be made in a controlled environment. Cables may be assembled off -site, although testing must be completed with the cable in its final installed condition. Test optical fiber on the reel for distance and continuity verification before installation.

c. At each location where fiber cable is exposed to human intrusion, it shall be marked with warning tags. These tags shall be yellow or orange in color, and shall contain the warning "CAUTION FIBER OPTIC CABLE". The text shall be permanent, black, block characters, and at least .1875-inch high. A warning tag shall be permanently affixed to each exposed cable or bundle of cables, at intervals of not less than 5 feet. Any section of exposed cable that is less than 5 feet in length shall have at least one warning tag affixed to it.

G. Coaxial Cable Requirements:

1. RG-11 shall be considered if distances are long; designer shall evaluate distance, bandwidth and frequency of operation.
2. Shall consist of a #20 AWG solid-copper center conductor with 95% copper braided shield. The cable shall be UL and (UL) Listed for Fire Safety and ISO 9001 Certified.
3. Characteristic Impedance shall be 75 Ohms at 50 MHz

2.4 TERMINATION HARDWARE

A. Station Hardware
1. Flush mount jacks shall be mounted in a faceplate with back box.
2. Outlets shall not be mounted on temporary, movable, or removable surfaces, doors, or access hatches without prior Owner approval.
3. 8P8C Jack Pin Assignments - Pin connections for voice and data information outlets and patch panels shall match T-568B termination standard under the EIA/TIA 568- A code.
4. Pin assignments at all voice and data panels or connecting blocks shall match pin assignments at the information outlets.
5. Color designation for UTP / F/UTP inserts:
   a. Voice White
   b. Data Blue
   c. WIFI Yellow
   d. POS Orange
   e. CCTV Black

B. Optical Fiber Interconnect Units, Distribution Shelves, and Adapter panels
1. Modular in design and used in fiber optic interconnection and cross-connection.
2. 19-inch rack-mountable
3. Owner approved industry-standard connectors.

C. Optical Fiber Outlets:
1. Modular in design
2. Duplex Type LC fiber optic coupling/adapter

D. Copper patch panels:
1. Copper patch panels shall be rated to match installed cable plant.
2. Horizontal copper cables shall be terminated in eight position/eight conductor (8P8C) modular patch panels with clear distinction between voice and data.
3. The termination block on the patch panel shall support the appropriate applications, including 100 Base-T, 52/155 Mbps ATM, and 1000 BASE-T Gigabit Ethernet, and facilitate cross connection and inter connection using modular patch cords.
4. All Modular jack panels shall be wired to T-568B unless requested otherwise by Owner.
5. The wiring block shall accommodate #23 AWG cable conductors.
6. All modular cross connect panels shall be UL-listed.

E. Work area outlets:
1. 8P8C non-keyed modular outlets for applications up to one Gbps and ANSI/TIA/EIA-568-C compliant for the specified transmission requirements.

2. Part of the UL LAN Certification and Follow-up Program.
3. Universal eight-position jack pin/pair assignments.
4. White in color for voice outlets and blue in color for data outlets.

F. Outlet Faceplates:
1. Match electrical outlets in color and material type.
2. Four-position with blanks inserted in unused ports.

2.5 PATCH CABLES

A. Multi-mode Optical Fiber
1. All Patch Cables are Furnished and Installed by the Owner

B. Copper
1. All Patch Cables are Furnished and Installed by the Owner.

2.6 IDENTIFICATION (LABELING) SYSTEM

A. Refer to sections 27 0000 and 27 1300.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Refer to Section 27 0000

B. Verify the following before proceeding:
1. Conduits, cable trays and pull boxes are properly installed following section 27 0528.
2. Plywood backboards in communications rooms are properly installed in accordance with section 27 11 00. *(Plywood installed by Owner)*
3. Grounding system is properly installed and tested following section 27 0526.
4. All high-pair count copper cables are routed properly and attached.
5. All optical fiber links are terminated and tested.
6. All backbone cabling service loops are installed and protected.
7. Liquid-carrying pipes are not installed in or above voice and data system communications rooms. Do not proceed with installation in affected areas until removed.

3.2 PREPARATION

A. Refer to section 27 0000

3.3 INSTALLATION

A. Refer to section 27 0000

B. All installation shall be done in conformance with ANSI/TIA/EIA-568-C standards, BICSI methods, industry standards and manufacturer's installation guidelines. The Contractor shall ensure that the maximum pulling tensions of the specified distribution cables are not exceeded and cable bends maintain the proper radius during the placement of the facilities. Failure to follow the appropriate guidelines shall require the Contractor to provide in a timely fashion the additional material and labor necessary to properly rectify the situation. This shall also apply to any and all damages sustained to the cables by the Contractor during the implementation.

C. The Contractor shall
   1. Provide shall provide a 1-foot service loop above the access ceiling or cable trays unless specified otherwise. All service loops shall be a minimum of 18 inches in diameter and be accessible for maintenance.
   2. Coordinate loop placement and orientation with the technology consultant. This allows for future changes or expansion without installing new cables.

D. Cabling between communications rooms and workstation locations shall be made as individual “home runs”. No intermediate punch down blocks or splices may be installed or utilized between the communications rooms and the information outlets at the workstation location.

E. All cable must be handled with care during installation so as not to change performance specifications. Factory twists of each individual pair must be maintained up to the connection points at both ends of the cable. There shall never be more than .5 inches of unsheathed Category 6 UTP cable at either the wiring closet or the workstation termination locations.

F. All cabling and associated hardware shall be placed so as to make efficient use of available space. All cabling and associated hardware shall be placed so as not to impair equipment's efficient use of their full capacity.

G. Exposed Cable
   1. All station cabling shall be installed inside walls or ceiling spaces whenever possible.
   2. Exposed station cable will only be run where indicated on the drawings and will only be allowed when no other options exist. Owner must approve all exceptions.

H. Wireless Access Point Cable Requirements
   1. The Contractor shall:
      a. Install one (1) Category 6 Yellow CMP or CMR cable as required from dedicated wireless patch panel(s) in telecommunications room terminated with a modular plug on the WAP location (wired to T568B).
      b. All WAP locations and cables shall be accessible by use of a 6’ ladder.

I. Special Circuits
   1. The Contractor shall coordinate with the Owner on the cable termination plan for special circuits (cables to wireless access point locations, IP security cameras, emergency analog telephone lines (elevators, fire alarms, etc.), service provider special circuits, security circuits, etc.).
      a. WAP’s (wireless access point) and IP security cameras shall be terminated with a 8P8C modular plug at the device end.
      b. Location and termination field description
         1) Room location
         2) Rack-mount or wall mount

3) Termination field type
   a) Specific patch panel ports versus a separate dedicated patch panel
   b) 110-type or M66 blocks
c. Unique identifiers
   1) Segregation and position on equipment rack
   2) Port color-coding
   3) Unique labeling

2. The Contractor shall provide a copy of the finalized plan in writing to the Owner's representative for review and authorization to proceed.

J. All cabling placed above drop ceilings must be supported by J hooks, cable tray or conduit. The Contractor shall permanently affix cable supports to the building structure or substrates and provide attachment hardware and anchors designed for the structure to which attached and are suitably sized to sustain the weight of the cables to be supported. Attaching cable to pipes or other mechanical items is not permitted. Communication cables shall be routed so as to provide a minimum of 18 inches spacing whenever possible from light fixtures, sources of heat and EMI sources. Cabling shall not be attached to ceiling grid wires. Multiple cables are to be dressed every 4-5 feet. Maximum cable sag between cable hooks is 3"-6". Plastic/nylon tie-wraps are not allowed to permanently secure cables inside the Telecommunications Rooms. (See Section 270529 Hangers and Supports for Communications Systems).

K. In the Telecommunications Room (TR), cables shall be combed and dressed with Velcro ties in a manner as to prevent twists, "braiding" and crossed cables in the cable bundle from the telecommunication room entrance to the termination point at the rear of the patch panel. Behind the patch panel, the cable bundle shall be attached to the rear cable support bar, and shall drop out each cable in a neat, cascading manner to prevent crossed and/or interwoven cables to each patch panel port termination point.

L. Identification - The Contractor shall:

1. Label cable terminations on designation strips.
2. Label all cable at each terminating point.
3. Label each port of the work area outlet.
4. Cable identification numbers shall not be duplicated.
5. Labeling convention to be coordinated with Owner.
6. Label data patch panels and voice blocks in the communications rooms to match those on the corresponding voice and data outlets. The font shall be at least .125-inch in height.
7. Where a wireless access point is installed above an acoustical ceiling, label the ceiling grid frame below the access point, displaying the data port number and, if applicable, the access point identification number. Coordinate with the Owner for all access point identification information.
8. All labels shall correspond to as-built drawings and to final test reports.
9. Coordinate with Owner for specifications on labeling of all hardware, cabling, and related equipment prior to any testing.
10. Label each distribution rack, block and other terminating equipment unit and field within that unit within 4 inches from the block or patch panel termination. Keep labels in a neat and orderly lineup.
11. Label each connector and each discrete unit of cable-terminating and connecting hardware within connector fields, in wiring closets and equipment rooms. Where similar

jacks and plugs are used for both communication and data-processing equipment, use a different color for jacks and plugs of each service.

12. Post the cable schedule in a prominent location in each wiring closet and equipment room. List incoming and outgoing cables and their designations, origins, and destinations.
13. Provide electronic copy of final comprehensive schedules for project in software and format selected by Owner.
14. Refer to the following drawing for faceplate labeling:

M. Documentation:
1. All cable inventory data documentation shall be submitted in format coordinated with and approved by Owner so that data can be incorporated into existing databases.
2. Documentation shall include cable identification number, source and destination, type of cable, length of cable and number of pairs or fibers.
3. Complete cross connect documentation is required. It shall include detailed documentation of each pair of all copper backbone cable and strand of fiber.

3.4 FIELD QUALITY CONTROL

A. Refer to section 27 0000

3.5 POST-INSTALLATION TESTING FOR CATEGORY 6 CABLE

A. Contractor shall test each Category 6 cable and each fiber strand of every optical fiber cable prior to acceptance.

B. Contractor shall supply all of the required test equipment used to conduct acceptance tests.

C. Contractor shall submit acceptance documentation as defined below. No cabling installation is considered complete until test results have been completed, submitted and approved.

D. Standards Compliance and Test Requirements:
1. Category 6 Copper Backbone Cabling shall meet ANSI/TIA-568-C.2 Category 6 Horizontal cabling requirements.
2. Optical fiber shall meet ANSI/TIA-568-C.3 Optical Fiber Cabling Components Standard requirements.

E. Cable Test Documentation:
1. Cable test documentation shall be submitted in hard copy and electronic formats. If proprietary software is used, disk or CD shall contain any necessary software application required to view test results. If the results are delivered in a standard format like Excel, Access, CSV files, etc., software to read these files is not required. Electronic reports shall be accompanied by a Certificate signed by an authorized representative of the Contractor warranting the truth and accuracy of the electronic report. Certificate shall reference traceable circuit numbers that match the electronic record.
2. Each test record shall contain the cable ID as follows: “MEDIA TYPE – SOURCE ROOM – DESTINATION ROOM – STRAND/PAIR #”, e.g. MM-MC-HC23-001.
3. Copper: Test reports shall include the following information for each cabling element:

a. Wire map results that indicate that 100% of the cabling has been tested for shorts, opens, miss-wires, splits, polarity reversals, transpositions, presence of AC voltage and end-to-end connectivity.

b. Length, propagation delay, and delay skew relative to the relevant limit. Any individual test that fails the relevant performance specification shall be marked as a FAIL.

c. For Category 6 cabling: Attenuation, NEXT, PSNEXT, Return Loss, ELFEXT, and PSELFEXT data that indicate the worst case result, the frequency at which it occurs, the limit at that point, and the margin. These tests shall be performed in a swept frequency manner from 1 MHz to highest relevant frequency, using a swept frequency interval that is consistent with TIA and ISO requirements. Information shall be provided for all pairs or pair combinations and in both directions when required by the appropriate standards. Any individual test that fails the relevant performance specification shall be marked as a FAIL. Test shall also include mutual capacitance and characteristic impedance

d. Cable manufacturer, cable model number/type, and NVP

e. Tester manufacturer, model, serial number, hardware version, and software version.

f. Cable ID and project name

g. Auto-test specification used

h. Overall pass/fail indication

i. Date of test

j. Name of Technician Performing Testing

F. Cable Test Equipment:

1. Test equipment used under this contract shall be from manufacturers that have a minimum of 5 years experience in producing field test equipment. Manufacturers shall be ISO 9001 certified.
   a. Copper: Fluke DTX Cable Analyzer or submitted and Owner-approved equivalent.
   b. Fiber Optic: Fluke DTX Cable Analyzer or submitted and Owner-approved equivalent.
2. Test equipment for Category 6 UTP shall be UL-verified to meet Level III accuracy as specified in ANSI/TIA/EIA-568-C. The cable installers shall have a copy of this reference in their possession and be familiar with the contents.
3. Test equipment for multimode fiber cabling shall meet the requirements of ANSI/TIA/EIA-526-14-A. The light source shall meet the launch requirements of ANSI/EIA/TIA-455-50B, Method A. The cable installers shall have a copy of these references in their possession and be familiar with the contents
4. Test equipment for single mode fiber cabling shall meet the requirements of ANSI/TIA/EIA-526-7-1998: Optical Power Loss Measurements of Installed Single Mode Fiber Cable Plant-OFSTP-7.
5. The test instrument shall be within the calibration period recommended by the manufacturer.
6. Test instruments shall have the latest software and firmware installed.
7. All test tools of a given type shall be from the same manufacturer, and have compatible electronic results output.
8. Test adapter cables shall be approved by the manufacturer of the test equipment. Adapters from other sources are not acceptable.

9. All test tools of a given type shall be from the same manufacturer, and have compatible electronic results output.
10. Test adapter cables must be replaced after 1000 tests to ensure accuracy.
11. Test equipment must have a dynamic range of at least 100 dB to minimize measurement uncertainty.
12. Test equipment must be capable of storing full frequency sweep data for all tests and printing color graphical reports for all swept measurements.
13. Test equipment must include S-Band time domain diagnostics for NEXT and return loss (TDNXT and TDRL) for accurate and efficient troubleshooting.
14. Test equipment must be capable of running individual NEXT, return loss, etc measurements in addition to auto tests. Individual tests increase productivity when diagnosing faults.
15. Test equipment must include S-Band time domain diagnostics for NEXT and return loss (TDNXT and TDRL) for accurate and efficient troubleshooting.
16. Test equipment must be capable of running individual NEXT, return loss, etc measurements in addition to auto tests. Individual tests increase productivity when diagnosing faults.
17. Test equipment must include a library of cable types, sorted by major manufacturer.
18. Test equipment must store at least 1000 Category 6 auto tests in internal memory.
19. Test equipment must be able to internally group auto tests and cables in project folders for good records management.
20. Test equipment must include DSP technology for support of advanced measurements.
21. Test equipment must make swept frequency measurements in compliance with TIA standards.
22. The measurement reference plane of the test equipment shall start immediately at the output of the test equipment interface connector. There shall not be a time domain dead zone of any distance that excludes any part of the link from the measurement.

G. Cable Test Equipment:
1. Test equipment used under this contract shall be from manufacturers that have a minimum of 5 years experience in producing field test equipment. Manufacturers shall be ISO 9001 certified.
   a. Copper: Fluke DTX Cable Analyzer or submitted and Owner-approved equivalent.
   b. Fiber Optic: Fluke DTX Cable Analyzer or submitted and Owner-approved equivalent.
2. Test equipment for Category 6A UTP shall be UL-verified to meet Level IV accuracy as specified in ANSI/TIA/EIA-568-C.2. The cable installers shall have a copy of this reference in their possession and be familiar with the contents.
3. Test equipment for multimode fiber cabling shall meet the requirements of ANSI/TIA/EIA-526-14-A. The light source shall meet the launch requirements of ANSI/EIA/TIA-455-50B, Method A. The cable installers shall have a copy of these references in their possession and be familiar with the contents
4. Test equipment for single mode fiber cabling shall meet the requirements of ANSI/TIA/EIA-526-7-1998: Optical Power Loss Measurements of Installed Single Mode Fiber Cable Plant-OFSTP-7.
5. The test instrument shall be within the calibration period recommended by the manufacturer.
6. Test instruments shall have the latest software and firmware installed.

7. All test tools of a given type shall be from the same manufacturer, and have compatible electronic results output.
8. Test adapter cables shall be approved by the manufacturer of the test equipment. Adapters from other sources are not acceptable.
9. All test tools of a given type shall be from the same manufacturer, and have compatible electronic results output.
10. Test adapter cables must be replaced after 1000 tests to ensure accuracy.
11. Test equipment must have a dynamic range of at least 100 dB to minimize measurement uncertainty.
12. Test equipment must be capable of storing full frequency sweep data for all tests and printing color graphical reports for all swept measurements.
13. Test equipment must include S-Band time domain diagnostics for NEXT and return loss (TDNXT and TDRL) for accurate and efficient troubleshooting.
14. Test equipment must be capable of running individual NEXT, return loss, etc measurements in addition to auto tests. Individual tests increase productivity when diagnosing faults.
15. Test equipment must include S-Band time domain diagnostics for NEXT and return loss (TDNXT and TDRL) for accurate and efficient troubleshooting.
16. Test equipment must be capable of running individual NEXT, return loss, etc measurements in addition to auto tests. Individual tests increase productivity when diagnosing faults.
17. Test equipment must include a library of cable types, sorted by major manufacturer.
18. Test equipment must store at least 1000 Category 6A auto tests in internal memory.
19. Test equipment must be able to internally group auto tests and cables in project folders for good records management.
20. Test equipment must include DSP technology for support of advanced measurements.
21. Test equipment must make swept frequency measurements in compliance with TIA standards.
22. The measurement reference plane of the test equipment shall start immediately at the output of the test equipment interface connector. There shall not be a time domain dead zone of any distance that excludes any part of the link from the measurement.

3.6 POST-INSTALLATION TESTING FOR OPTICAL FIBER: TESTING SHALL BE PERFORMED ON ALL FIBERS IN THE COMPLETED END-TO-END SYSTEM.

a. Refer to section 27 1300

b. Power Meter and Source Loss Reports: Testing shall consist of a bi-directional, dual wave length end to end test. The system loss measurements shall be provided at 850 and 1300 nanometers for multi-mode fibers and 1310 and 1550 for single mode fibers.

c. Optical Time Domain Reflectometer (OTDR) Reports: Testing shall consist of a bi-directional end to end OTDR trace performed per TIA/EIA 455-61. The system loss measurements shall be provided at 850 and 1300 nanometers for multi-mode fibers and 1310 and 1550 for single mode fibers.

d. The acceptable link attenuation for a multimode horizontal optical fiber cabling system is based on the maximum distance of 295 feet.

e. The horizontal link may be tested using a fixed upper limit for attenuation of 2.0 dB. This value is based on the loss of two connector pairs, one pair at the telecommunications outlet/connector and one pair at the horizontal cross-connect, plus 295 feet of optical fiber cable.

f. A horizontal link in a network with a consolidation point may be tested using a fixed upper limit for attenuation of 2.75 dB.

3.7 CLEANING

A. Refer to section 27 0000

3.8 ACCEPTANCE

A. Once all work has been completed, test documentation has been submitted and approved, and the Owner is satisfied that all work has been completed in accordance with contract documents, the Owner will notify Contractor in writing of formal acceptance of the system.

B. Contractor's RCDD shall warrant in writing that 100% of the installation meets the requirements specified herein.

C. Acceptance shall be subject to completion of all work, successful post-installation testing which yields 100% PASS rating, and submittal and approval of full documentation as described above. Tests with the "* PASS" (asterisk) will not be acceptable. These circuits must be repaired to meet "PASS".

- END OF SECTION -

- SECTION 27 4116 -

NEW BUILDING TELEVISION EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related Sections include the following:

1.	Section 26 0500	General Provisions
2.	Section 26 0501	Scope of Work
3.	Section 26 0502	Temporary & Remodeling Work
4.	Section 26 0519	Low-Voltage Electrical Power Conductors & Cables
5.	Section 26 0520	Low-Voltage Open Wiring Systems
6.	Section 26 0526	Grounding & Bonding of Electrical Systems
7.	Section 26 0533	Raceways & Boxes for Electrical Systems
8.	Section 26 0543	Underground Ducts & Raceways for Electrical Systems
9.	Section 26 0544	Underground Pull Boxes & Handholes
10.	Section 26 0548	Vibration & Seismic Controls for Electrical Systems
11.	Section 26 0553	Identification for Electrical Systems
12.	Section 26 0800	Commissioning of Electrical Systems
13.	Section 26 0801	Electrical Systems Testing Requirements
14.	Section 26 0802	Electrical Systems Prefunctional Checklists
15.	Section 26 0803	Electrical Systems Sample Functional Procedures
16.	Section 26 0913	Power System Metering - Feeders
17.	Section 26 0923	Lighting Control Devices – Relay Panel Basic System
18.	Section 26 0925	Lighting Control Devices – Digital Occupancy & Daylight Management System
19.	Section 26 2213	Low-Voltage Distribution Transformers
20.	Section 26 2300	Low-Voltage Switchgear
21.	Section 26 2412	Service Entrance Switchboards
22.	Section 26 2416	Panelboards
23.	Section 26 2500	Enclosed Bus Assemblies
24.	Section 26 2660	Lighting Accessories
25.	Section 26 2726	Wiring Devices
26.	Section 26 2813	Fuses
27.	Section 26 2816	Enclosed Switches & Circuit Breakers

28. Section 26 2913 Enclosed Controllers
29. Section 26 3213 Diesel-Engine-Driven Generator Set
30. Section 26 3623 Automatic Transfer Switches
31. Section 26 4113 Lightning Protection for Structures
32. Section 26 4313 Surge Protective Devices for Low Voltage Surge Protection for
33. Electrical Distribution Systems
34. Section 26 5100 Interior Lighting
35. Section 26 5600 Exterior Lighting
36. Section 03 3000 Cast-In-Place Concrete

1.2 SUMMARY

A. Provide all labor, materials, necessary equipment, testing, commissioning, documentation, and start up services required to deliver a complete master antenna & RF distribution system.

B. The intent of this specification is to provide a complete RF TV distribution system operable at frequencies from 5 MHz to 860 MHz.

C. The distribution system shall provide for reception of the Owner's provided free to guest(FTG) and pay per view (PPV) television signals provided and installed by a vendor to be determined later.

D. The system shall be furnished complete and operational in every way in order to meet the prevailing project requirements including those stipulated in SBBC Discipline and System Design and Criteria Standards. Items shall include, but not be limited to the following (except for items specifically indicated as "NIC ITEMS" (Not in Contract):
   1. Guest room cabling to all televisions including all coaxial and cat 6 data cable
   2. Public and back of house cabling to all television locations including coaxial and Cat6 data cable
   3. All backbone riser cabling to all closets servicing television locations
   4. All required distribution amplifiers rated to 860 MHz
   5. All passive devices rated to 1000 MHz
   6. Complete system design including RF levels for all TV locations
   7. System grounding

E. The specifications herein described and defined are the result of years of experience with MATV/RF Distribution projects within the hospitality Industry. These standards are based on the work of ANSI/TIA/EIA as reflected by BICSI, and specifications previously developed with various FTG and PPV operators. This document reflects specific reference to those standards and/or additions to the industry standards. The specified equipment and materials have been tested and determined to be the most appropriate for the purpose of the project. Only the Specified items are acceptable under the terms of this specification. Anything not specifically mentioned here is to be done according to the referenced standards.

F. The Contractor and or Communication Systems installer or trade sub contractor/Vendor recognizes by provision of a bid price for the specified TV system, that he has consulted or requested any technical clarifications thru the Owners technology consultant. The contractor

and the RCDD of record is understood to have a minimum of 5 years design experience with RF systems in similar Hotel buildings.

G. The provision of a bid is recognition of the bidder that he has reviewed, understands, and is compliant with the bid and project requirements.

H. The purpose of this document is to provide the RF systems designer and contractor a set of technical and installation and testing requirements for work to be completed in this Hotel building that will encompass future FTG-PPV and other interactive Rf based systems to be determined later. These specifications are intended to be a living document which shall be periodically updated to reflect Owners decisions, technology enhancements and evolving SBBC standards and practices.

1.3 SUBMITTALS

A. Submit shop drawings, design drawings and product data in accordance with section 01340 and 16010.

1. Complete shop drawings, design drawings and submittals for all listed and or proposed products will be submitted for the Owners Technology Consultants written approval. Any Manufacturers and/or products that are listed are done in order of Owner preference. Manufacturer names with “no exception” means that no other manufacturer’s product is accepted without written approval from the Owner. Any list provided is not intended to be complete and comprehensive. Any catalog numbers contained in this document are for informational reference purposes. It is the bidder’s responsibility to check the latest manufacturer’s data for any updated part numbers.

B. Product Data Submittal: Submit features, ratings, and performance of each component specified for each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, for materials and cable proposed. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1. For cabling, include the following installation data for each type used:
   a. Type of cable used
   b. Nominal OD.
   c. Minimum bending radius.
   d. Maximum pulling tension.

C. Include dimensioned plan and elevation views of telecommunications equipment rooms, labeling each individual component. Show equipment rack assemblies, method of field assembly, workspace requirements, and access for cable connections.

D. For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.

E. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
2. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.

F. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
   1. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
   2. Cabling Administration Drawings.
   3. Wiring diagrams to show typical wiring schematics including the following:
      a. Workstation outlets, jacks, and jack assemblies.
      b. Patch cords.
      c. Patch panels.
      d. Fiber-optic boxes.
      e. Distribution racks.
      f. Terminal racks.

G. Design: Include complete RF design including all amplifiers, passive devices and expected RF levels to be achieved at each television location.

H. Qualification Data: Include company qualifications, factory training certifications for Installer and all test equipment to be used.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

C. Grounding: Comply with ANSI-J-STD-607-A.

D. Source quality-control test reports.

E. Field quality-control test reports.

F. Submit under provision of Section 01410, “Regulatory Requirements”.

G. Install complete grounding system under provisions of National Electrical Code Section 250.

H. Ensure all work complies with the most current BICSI (Building Industry Consulting Service International) and TIA/EIA (Telecommunication Industry Association/Electronics Industry Association) Standards.

I. Source Limitations: Obtain all products except cables through one source from a single manufacturer.

J. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

K. Comply with NFPA 70, "National Electrical Code."

L. The installation shall be provide in a workmanlike manner, with all parts securely installed and secured according to accepted standards for structured cabling and as approved by the Owners technology consultant.

M. All materials shall be new and free of defects and shall be installed using the manufacturer's latest standard design. All materials shall carry the UL label or shall be manufactured according to that agency's standards where such standards have been established.

N. All electrical and conduit work for high voltage electrical construction shall be performed by the electrical contractor.

1.5 QUALIFICATIONS OF CONTRACTOR/INSTALLER

A. Installer Qualifications: Cabling installer must have on staff personnel certified by BICSI.

1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings, and field testing program development] by an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of a BICSI Certified or equivalent Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
3. Testing Agency's Field Supervisor: Person currently certified by BICSI as an RCDD to supervise field quality-control testing.

B. Applicants must fully meet the requirements established in this division to be qualified for project approval. Applicants must include sufficient written information clearly identifying their ability to meet these qualifications.

C. The Owner reserves the right to reject any and all applicants and to waive any irregularities in its project award process. Applications which contain false or misleading statements or which provide information or references that are not valid will be rejected.

D. All work associated with communications systems are to be done under the direction of a “full service” communications contractor. Full service shall refer to a contractor that has sufficient in house staff to meet the criteria set in these requirements. All cable-pulling, terminations, testing, etc. shall be done directly by the communications contractor.

E. If during construction it is found that due to design error or existing pathway limitations, distance limitations are exceeded, or any other standards requirement violated, and the contractor has not notified the Owner in writing of their concerns, prior to the installation of cable, it is the responsibility of the contractor to make all necessary corrections to meet the ANSI/TIA/EIA design guidelines.

F. Qualification Data: For Installer**,** technician, installation supervisor, and field inspector. The Contractors must meet the following qualifications to be eligible to install the video network

1. Contractor must provide proof of ownership of the required test equipment.
2. Contractor must show proof of ownership of termination equipment for all cabling systems.
3. Contractor must maintain an office within 50 miles of the job site.
4. Contractor must have at least five (5) years prior company experience in installing and repairing Television/RF systems and equipment and related work.
5. The contractor must have a local telephone number for contact throughout the construction and warranty period.

G. Contractor Professional Experience:
   1. Indicate total years of company experience in the Southern California Area
   2. Provide a list of at least five (5) projects with similar or greater scope. The list must include a description of the types of services provided and the name, title, address, and telephone number of a person with each customer who may be contacted for references.
   3. Specify the current geographic area serviced.
   4. Specify the number of Contractor technicians who will be available to perform work and total years of experience, resumes, certifications, specialized training of each technician.
   5. Describe the nature and scope of any other technical services the Contractor is qualified to perform.

H. Other Contractor Requirements:
   1. The Contractor will secure, pay for, and comply with all permits and certificates that may be required by local, state and federal laws and ordinances.
   2. Contractor must provide their technicians with transportation, tools, and equipment appropriate to the work to be performed. The Owner or GC will not provide or loan any tools and or equipment.

I. Contractor Services to be provided
   1. Contractor must complete all work in full conformance with the most current applicable standards for electrical and telecommunications wiring and the terms and conditions governing the maintenance of complete warranty coverage where applicable.
   2. Contractor must perform all required functional testing of wiring circuits.
   3. Contractor must reinstall, restore or reconnect any and all communications or non-communications equipment which may have been moved or temporarily disconnected as a result of authorized system installations, modifications, adds, moves and changes or other work. Upon completion of the work, Contractor personnel will clean up and restore the work place and associated equipment rooms to there original condition ensuring that the terms and conditions of warranty coverage remain in force. When any work is being performed in occupied areas the work site must be cleaned daily.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install equipment frames and cable trays until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and work above ceilings is complete.

1.7 COORDINATION

A. Coordinate layout and installation of TV and data communication cabling with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.
   1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
   2. Record agreements reached in meetings and distribute to other participants.
   3. Adjust arrangements and locations of distribution frames and cross-connect and patch panels in equipment rooms and wiring closets to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Outlet Assemblies: Five of each type for every 250 outlets shown on plans, but no less than one.
   2. Splitters: one of each type.
   3. Amplifier's: One.

1.9 GUARANTEE

A. Provide a written three (1) year guarantee, signed by the contractor, due on the date of final acceptance.

B. Include the following provisions:
   1. Guarantee all equipment and the installation to be free of faulty workmanship.
   2. Guarantee all components, including solid-state devices, to be free of defects for a period of three (1) years from date of final acceptance.
   3. Guarantee must provide maximum 24 hour response time for on site service or problems.

1.10 FUNCTION

A. The television distribution system shall provide signals to each television receiver outlet on each channel at levels not less than +6 dBmv and not in excess of +10 dBmv. The difference in signal level between the lowest and highest channel at each outlet shall not exceed 3.0 dB. Any and all line booster amplifiers and/ or line equalizers required to meet this specification shall be furnished by the Contractor whether indicated on the riser diagram, or not.

B. The carrier-to-noise (C/N) ratio of the overall system shall be 46 dB minimum, measured at the most remote outlet from the main amplifier or the lowest tap, whichever provides the lowest signal. The method of measuring shall be by the utilization of a field strength meter with carrier-to-nose measuring capability.

C. System internal echoes shall be below visibility on a cross-hatch or bar generator pattern inserted at the proper level into the system's initial amplifier and displayed at any receiver outlet.

D. All passive devices, splitters, directional couplers, tap-offs, attenuators and terminating resistors shall be specified by the manufacturer for use in the RF band 5-1000 MHz,

E. Minimum isolation between any two outlets in the system shall be not less than 32dB.

F. The system shall be suitable for continuous operation 24 hours a day. As installed, the system shall assume input frequencies of 5-860MHz provided by others.

PART 2 - PRODUCTS

2.1 CABLES

A. All cables shall be 75ohm nominal impedance coaxial cable, flexible or semi-rigid, of foamed polyethylene dielectric. Coaxial cables shall be quad shield and be certified sweep tested by the manufacturer for frequency range of 5 MHz to 3000 MHz. Certification of sweep test shall be furnished for approval prior to acceptance.

B. All coaxial cables shall be suitable for use with standard connectors and taps.

C. Station cable: Will be RG6 Quad shield plenum or riser rated as required by code. The cable will be pulled in a home run configuration from the outlet to the closest IDF closet or as indicated on the plans.

D. The RG6 station cable shall not be used in cable runs in excess of 160 feet. When runs exceed 160 feet the contractor shall use RG11 cable to compensate for loss. The contractor is advised that several runs are likely to exceed 160' on this project

E. Trunk cable: The contractor shall use .500 hardline for the RF trunk cable where required by design and signal loss calculations. Trunk cable is defined as those cables used to transport signal from the amplifier or amplifiers to the television tap-offs located in the various IDF Closets. Under no circumstance will any cable smaller than RG11 be used as trunk cable. The contractor is responsible to make this final determination of the appropriate cable based on the completed and approved design drawings. The contractor shall utilize the appropriate plenum or riser rated type.

2.2 AMPLIFIERS

A. DISTRIBUTION PREAMPLIFIERS
1. Distribution amplifiers will be bi-directional type and rated for 5-860MHz operation.
2. Amplifiers will be provided with amplified sub-band return and all required forward and return path pads and equalizers need for proper operation.
3. The system distribution amplifiers shall be Blonder Tongue BIDA series with minimum 43 db gain or approved equal

B. HEADEND AMPLIFIERS
1. All headend equipment other than any required launch or Bridger amplifiers are provided by others.

2.3 MODULATOR

A. Provided by others

2.4 SPLITTERS

A. Shall be 1000MHz rated

B. Blonder Tongue or approved equal.

2.5 TAPS

A. Taps are defined as the units in the trunk line to which the station cable is connected. Configurations may include single and/or multiple tap-offs.

B. Taps are to be 2,4 and 8 port type rated to 1000MHz

C. Tap-offs units shall be back-matched and shall exhibit a VSWR not worse than 1.5 looking into the receiver outlet over the frequency range of 5 Mhz to 1000 Mhz.

D. Taps shall be Blonder Tongue CRT or SRT series.

PART 3 - EXECUTION

3.1 INSTALLATION STANDARDS

A. Comply with BICSI TCI, TIA/EIA-568-B.1, TIA/EIA-568-B.2, TIA/EIA-568-B.3, and TIA/EIA-569-A

3.2 EXAMINATION

A. Examine pathway elements intended for cables.
   1. Verify proposed routes of pathways. Check raceways, cable trays, and other elements for compliance with space allocations, clearances, installation tolerances, hazards to cable installation, and other conditions affecting installation. Verify that cabling can be installed complying with EMI clearance requirements.
   2. Prepare wall penetrations and verify that penetrations of rated fire walls are made using products labeled for type of wall penetrated.
   3. Identify plan to support cables and raceways in suspended ceilings. Verify weight of individual types and sizes of cables. Verify that load capacity of cable support structures is adequate for each pathway.
   4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools

B. Wiring Method: Install cables in a homerun configuration from the outlet location to the closest IDF closet. Use J hooks and other appropriate means of attachment when raceway and or cable tray does not exist.

C. Cable Installation:
   1. Install exposed cables parallel and perpendicular to surfaces or exposed structural members and follow surface contours where possible.
   2. No splices and or tap offs are allowed in the ceiling space.
   3. Pulling Cable: Do not exceed manufacturer's written recommended pulling tensions. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable

between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.

4. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
5. Secure and support cables at intervals not exceeding 48 inches
6. Outdoor Coaxial Cable:
   a. Outdoor connections shall be installed in enclosures complying with NEMA 250, Type 4X. Connectors shall be corrosion resistant with properly designed O-rings to keep out moisture.
   b. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches (915 mm).

D. Wiring within Wiring Closets and Enclosures:
1. Mount splitters, taps, amps and other devices on Owner provided backboards.
2. Group connecting hardware for cables into separate logical fields.
3. Train conductors to terminal points with no excess.
4. Use lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

3.3 INSTALLATION REQUIREMENTS

A. All Head-end work including satellite equipment, antennas, dishes processors and modulators shall be provided and installed by the owner's vendor.

B. Coaxial cables, except where run in conduit, shall be supported at minimum intervals of 4 feet. No supporting devices which might cause "cold-flow" deformation of the cable (such as square top staples) are permitted. Coaxial cable shall be run separate from other systems, and if run parallel to other systems there shall be a minimum of 6" separation.

C. Where coaxial cable is buried, it shall be carried in minimum 2" P.V.C. conduit, type A, in unbroken lengths. Cable runs are not to exceed 300' with out a hand hole. All buried cables shall be 24″ below soil line and a protective shield furnished on the side of the building 7' above the soil line and 12″ below the soil line. Cable clamps shall be of black nylon material. No other material is acceptable.

D. Bends in coaxial cables shall be minimum radius of 4″ in RG11U type cable, and minimum 3″ radius in RG6U type cable.

E. All electrical powered equipment shall be properly grounded to a common ground point utilizing a minimum #12 AWG insulated copper wire. All connections will be home run.

F. Following completion of installation, the contractor shall perform all necessary amplifiers level adjustments and perform required tests to assure compliance with these specifications, and furnish a listing of all headend outlet signal level readings to the Owner prior to final acceptance. Following such final tests and adjustments, the contractor, in the presence of the owner shall conduct a complete proof-of-performance test and the contractor prior to final acceptance shall correct any and all deficiencies.

G. The Contractor shall supply Shop Drawings of the complete system showing all duct banks and electrical room tie points and devices locations as well as devices used.

H. Owner reserves the right to perform periodic inspections during installation of the MATV system, and final inspection must be approved and signed off by the Owner.

3.4 COMMISSIONING AND ACCEPTANCE

A. Above The Ceiling Pathway Inspection - This inspection shall be called for prior to any cable pathways being concealed by ceilings. This inspection shall include:
1. Proper pathway installation techniques
2. Fire sleeves and caulking

B. Testing Verification - This shall include determining that all cables have been tested and pass to Owners satisfaction and that all as-built and written documentation have been submitted.

C. Training and Demonstration - Training of Hotels engineering department shall be provided as requested. Training will cover the location nomenclature, documentation structure and contents, documentation maintenance procedure, a "walk through" for location and labeling orientation.

D. Final Acceptance - Acceptance will be made by the Owner on the basis of the following being completed.
1. All required documentation must have been delivered to Owner engineering Department for written approval. Including test results and As-Built drawings.
2. Owner's and systems operators verification that system is capable of working as intended, verification of the completion of the Walk Thru Check List Items, observations of the project, and any necessary corrections based on test results having been completed.
3. The Contractor shall furnish all necessary mechanics, and test instruments and equipment, to demonstrate the operation of the systems required during a Final Walk Thru.

- END OF SECTION -

- SECTION 27 5100 -

DISTRIBUTED AUDIO-VIDEO COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The General Project Conditions and Supplementary General, Conditions are hereby made a part of this Section as fully as if repeated herein.

1.2 SUMMARY

A. General

1. The Gaslamp Hotel's Audio Visual and distributed Sound system work is defined as a design assist project, The contractor is responsible to furnish all engineering, labor, materials, apparatus, tools, equipment, transportation, temporary construction and special and occasional services to make complete, a working audio visual and sound system as shown on the project drawings and described in these specifications.
2. The successful contractor is required to visit the project site and take great care in reviewing all available plans, specifications and investigating, measuring and documenting all site conditions in order to satisfy themselves to the extend and difficulty level of the work.
3. The contractor shall demonstrate by specified tests that all components and the completed systems meet the specifications to the satisfaction of the Owner.
4. The contractor shall coordinate and seek the owner's approval regarding the exact placement of all devices including speakers, control plates, connection points, monitors and power screens.

B. Work Included:

1. All wiring and cabling required for complete A/V and Distributed Sound system shall be included.
2. All speakers, amplifiers, digital signal processors, controllers, switchers, room combiners, volume controls, custom face plates, brackets, back boxes and miscellaneous hardware required for complete systems
3. All specialized system receptacles, and faceplates as required.
4. All miscellaneous equipment and materials as required according to the layouts shown on the Drawings and described in the Specifications.
5. All design coordination required for internal and external backing and support systems required for all fixed projection equipment and loudspeakers. (Actual backing and support structures are provided by the General)

C. Related Work:
1. All electrical power, conduit and house grounding requirements are provided by the electrical contractor.
2. All Secondary safety wires for all fixed system equipment shall be provided and installed by the A/V Sound contractor.

D. Additional information:
1. For additional information regarding these systems audio visual and distributed sound systems contact: Robert Bohan- Ultimate Communications 714-484-3101 (rbohan@ucomsys.com).

1.3 SUBMITTALS AND SCHEDULES

A. The contractor shall provide complete product submittals and shop drawings in accordance with the requirements of this specification and the general conditions.

B. Within ten (10) calendar days of the receipt of the Notice to Proceed the Contractor shall prepare for review by the Owner's Representative, a proposed submittal and shop drawing schedule which shall include, but not limited to, the following:
1. Proposed index of submittals and shop drawings for all items described herein.
2. Specific testing procedures for the A/V and sound systems including the following tests:
a. Performance tests on all individual system components after installation.
b. Performance tests on subassemblies and complete assemblies, including all racks.
c. Performance tests on the systems as a whole.
3. Submission dates for test results described herein.
4. Installation dates and durations for the installation of wire and cable.
5. Delivery date(s) for all system equipment to the job site.
6. Completion dates of the field installation.
7. Submission dates of operating and maintenance manuals and aids-to-use charts.
8. Dates for inspections. Performance simulation tests shall be arranged prior to final Acceptance date.
9. In the event the Contractor wishes to deviate from the schedule once it is established and approved, he may do so only after receiving written approval from the General Contractor or Owner's Representative.
10. Shop drawings shall be submitted for review on all items that require assembly by the Contractor including, but not limited to all:
a. Panel layouts including all of the panels indicated schematically in the rack and equipment Rooms.
b. Loudspeaker enclosures.
c. Supporting brackets for the suspension and support of fixed systems components, such as but not limited to speakers, projectors, etc. Submit drawings showing the proposed means of support and attachment to structure of fixed systems components.
d. Receptacle cover plates and labeling scheme.
e. Remote control consoles.
f. Equipment.

g. Provide scaled drawings showing plans and sections of the room along with an elevation showing the speaker locations.

h. In addition, contractor shall submit in compliance with the following:

1) A complete list of equipment and materials proposed for system, with catalog cuts, technical data, manufacturer's specifications and detail drawings.

2) A complete set of detailed scaled drawings of all racks, consoles and cabinets with designations, dimensions, color, operating controls, instrument wiring and schematic diagrams of all circuits.

3) Shop drawings shall show interfaces to equipment furnished by other contractors.

i. Each submittal shall be bound and shall contain an index organized vertically by assembly and item number and horizontally by columns. The first assembly shall be the major head end equipment. The left most column shall be the item number; next shall be the description, followed by the applicable specification section number, followed by the specified item, which is followed by the submitted item.

j. Each submittal shall contain product data sheets or catalog cut sheets for each item listed in the index. These shall be arranged in the same order as the index and if more than one item is shown, the submitted items shall be highlighted or marked with an arrow. The product data shall be sufficiently detailed to allow the Engineer to evaluate the suitability of the product and to allow other trades to provide necessary coordination.

k. Drawings that are specific to this .specification section shall be included in the submittal. "A" size, (8.5"x11"), and "B" size, (11"x17"), shall be bound into the manual. Larger drawings shall be folded and inserted into transparent envelopes that are bound into the manual.

11. Operating and Servicing Manuals, Record Drawings:

a. Deliver three copies of operating and servicing manual. Each complete manual shall be bound in a flexible binder and all data shall be typewritten or drafted.

b. Each manual shall include all instructions necessary for proper operation and servicing of system and shall include complete 2 wire circuit diagrams of system, a wiring destination schedule for each circuit leaving console and each rack, a schematic diagram of each amplifier and other components,

c. Provide as-built drawings, indicating location of equipment, conduit, cable runs and other pertinent information.

d. Samples shall be submitted for review on the following items:

1) Labels for wire and cable identification.

2) A/V receptacles.

C. Test results shall be submitted for review for the following as specified herein:

1. Performance tests on individual audiovisual components.

2. Performance tests on completed component sub-assemblies including all racks, consoles and enclosures.

3. Performance tests on the complete system.

1.4 QUALITY ASSURANCE

A. Unless otherwise stated, all electrical, electronic and optical equipment shall be products of firms regularly engaged in the manufacture of electrical, electronic or optical equipment. The

equipment shall be the latest model or type offered which meets the applicable specifications at the time of the submittal. Discontinued items replaced by newer models or versions are prohibited and should not be submitted for review.

B. Quality of workmanship and fabrication of all equipment and components which are custom fabricated shall be comparable to professional equipment produced by specialized manufacturers of the trade involved and shall be verified by inspection. Only skilled craftsmen of the profession required shall be utilized for all aspects of the fabrication and installation of the system.

C. All materials and products shall be new and of professional quality. No used materials shall be installed.

D. A design sound analysis of the sound system shall be prepared and the systems installation and electro-acoustical testing shall be carried out under the direction of this contractor. The contractor shall maintain responsibility for proper sound levels through out the building and shall adjust the speaker counts accordingly at bid time as they see fit.

1.5 WARRANTIES - ALL EQUIPMENT

A. A one-year warranty shall be provided in writing covering all components and systems including materials and workmanship. This obligation is limited to exclude conditions of misuse.

B. The Contractor shall submit, in writing, provision during the warranty period of one year for availability of service personnel within twenty-four hours of call and for exchange of faulty components within seven days. This service requires assurance of commitment by the subcontractors and suppliers of all components.

1.6 FIRST YEAR MAINTENANCE

A. The Contractor shall include in his cost a complete service agreement, for first year of operation: The contractor shall
   1. Establish a maintenance program and coordinate the maintenance of the system with the owners building engineer.
   2. Perform a complete system survey, including critical electronic and optional measurements, on a bi-annual basis.

1.7 DESCRIPTION OF THE A/V AND SOUND SYSTEMS

A. Functional Descriptions
   1. Hotel Back Ground Music System: The Hotel Back Ground Music System provides back ground music and paging throughout the hotel areas as indicated on the project plans.
   2. The background ground music system will be fed from multiple music sources provided by the Owners vendor to be determined at a later date. The music sources will be remotely selectable as shown on the plans.
   3. All required equipment for a complete system is the responsibility of this contractor. The background music system will provide coverage to all of the areas shown on the project plans, including.
      a. The Hotel Lobby and Hotel entry
      b. All Restaurant and Dining areas.

c. All Guest elevators and lobby areas
d. All Pre-function spaces and Public area corridors
e. The Spa, Fitness and Pool areas
f. All Public restrooms
g. All Ball rooms and Meeting Rooms

4. Ball rooms and Meeting: The Ball rooms and meeting rooms provide locally selectable music, line and microphone sources at each room or divisible room. The systems will be provided with the following functionality.
   a. The ability to use separate or mix all rooms where divisible air walls are present
   b. Allows selection of house music sources and local line and microphone feeds from the individual key pads shown on the project plans.
   c. Allows volume control from each key pad shown.
   d. Include all required Digital signal processing equipment, speakers, amplifiers and mixers
   e. Include all miscellaneous cable and hardware
5. Spa Sound System: The Spa Sound System provides locally selectable music in the Spa area and within the individual treatment rooms. The system will be provided with the following functionality.
   a. Allows selection of music sources from the individual key pads shown on the project plans.
   b. Allows volume control from each key pad shown.
   c. Provides connection of a guests own music source
   d. Include all required speakers, amplifiers and mixers
   e. Include all miscellaneous cable and hardware
   f. All other music sources are provided by the owner.

B. All systems shall be provided and installed with all necessary cabling interconnection and wiring to provide fully functioning systems. The governing overall requirements are complete and functioning systems in every way.

C. A requirement shown in any part of this section shall have the same effect as if it were included in all parts.

1.8 CONTRACTOR QUALIFICATIONS

A. The work specified herein, and in each of the allied sections, shall be accomplished by a single Audio Visual Systems Specialty Contractor experienced in the design, fabrication, installation and warranty contract management of systems such as those described in each section. This specialty Contractor shall have complete responsibility for the systems described herein and shall be the single contract point for the Architect, and the Owner with respect to all work specified herein.

B. The bidder shall, prior to the bid award, in accordance with the Instruction to Bidders, submit at least the following information to verify that the bidder has the necessary experience and qualifications to perform the specified work:
   1. A detailed brochure describing its capabilities in terms of facilities, personnel, experience background, examples of similar installations.

2. Information identifying any and all local agents and/or subcontractors who will assist in the work in their role in the project.
3. Evidence that he has acquired all the necessary licenses and approvals to perform the specified work.
4. Information on how and by whom it will fulfill the requirements of the warranty period.
5. This submittal must justify in the judgment of the Architect and the Owner that the Contractor has the capability to manage and install a project of this size and scope and that he is capable of the necessary business and technical arrangements for this installation and the pursuant warranty service.

C. The Contractor shall have on his staff a qualified project sound engineer. This person shall:
1. Have at least five (5) years of experience with similar electronic & optical specialty systems or other educational experience or a background as approved by the Architect and the Owner.
2. Observe at all times a good working relation with the Architect's and Owner's representatives, and cooperate with engineers and technicians assigned by the Owner, who are charged with the operation and maintenance of the system.
3. Provide all technical liaisons between the Contractor, the Architect, the General Contractor, and the Owner. This shall include participation in meetings and conferences. He will be required to be present at the job site for final inspection, approve the operating and maintenance manuals and provide the specified instruction to designated members of the Owner's staff.
4. Be responsible for supervision of all technical work which .is part of the contract. This supervision includes the following:
a. Preparation of all construction drawings from information within the specifications and the drawings. He shall approve and sign all shop drawings.
b. Supervision of shop fabrication and field installation work to assure conformance with the contract drawings, the specifications, and the approved shop drawings to assure workmanship of the highest quality. He shall oversee the testing of all assemblies and sub-assemblies prior to delivery to the job site.
c. Take a leading role in the specified testing of the completed installation to assure himself for the Contractor that all specifications are met. Work with and assist the Owner in his final acceptance of the system.

1.9 EQUIPMENT APPROVAL

A. The Contractor shall submit to the Owner’s Representative all proposed equipment for review and approval. The Contractor shall provide manufacturer's cut sheets and independent test data in order to demonstrate that the proposed equipment meets the design and performance standards.

PART 2 - PRODUCTS

2.1 GENERAL

A. Material and equipment specified herein have been selected on the basis of acceptable quality and performance and have been coordinated to function as components of the specified system. Where a particular material, device, equipment or system is specified directly, the

current manufacturer's specification for the same is a part of these specifications, as if completely elaborated herein.

B. All equipment shall be capable of sustained proper operation within an ambient temperature range of 0 degrees to 40 degrees C.

C. Unless otherwise stated, all equipment and components shall be products of firms regularly engaged in the manufacturer of projection, electronic or curtain equipment and components.

D. All manufacturers' stock equipment and component labeling and console designations will be in English. All systems nomenclature, signage and custom labeling pertaining to routine system operation shall be either on the equipment itself or on descriptive drawings, charts or diagrams.

E. The equipment listed below, consists of a representative of major equipment for the project. The contractor will integrate into the system design and provide any additional materials, components, wiring, programming, etc., to complete a functional system operating as described within the specifications and as indicated on the Drawings.

2.2 REPRESENTATIVE EQUIPMENT LIST

A. The Contractor shall be responsible for providing equipment, materials, labor, etc to comply with the functional descriptions required at each room and area. The list below is a representation of the type of equipment anticipated. It is not a comprehensive list nor is it intended to be exclusive to the manufacturer listed.

1. HOTEL MUSIC AND PAGING SYSTEM:

a.

Description .		Products
1)	DSP	Symetrix
2)	Background music system	FSR BMS-2
3)	Equalizers	Bogen or equal
4)	Power Amplifiers	Crown, QSC or equal
5)	Data switch	Cisco
6)	Speakers	Tanoy, QSC, JBL, Atlas
7)	Equipment Racks	Middle Atlantic, Atlas Soundolier
8)	System Cabling	Plenum rated cable or as required

2.3 SYSTEM GROUNDING

A. Grounding:

1. All wiring enclosures, terminal cabinets, outlets, frames of cabinet racks and other enclosures shall be grounded and such grounding shall be done in compliance with requirements of local Electrical Code and as specified herein.
2. Chassis of amplifiers, power supplies, etc., shall be grounded by bonding to control cabinet.
3. All circuits shall be grounded as recommended by manufacturer of equipment to which they are connected unless otherwise specified.

2.4 ELECTRONIC RECEPTACLES

A. Audio Video and Microphone receptacles shall be as depicted on the drawings, they shall be equipped with mounting brackets for floor boxes or as required for the stainless steel plates shown on Drawings. Each plate shall be engraved with its receptacle function and be provided in the appropriate color to match electrical.

2.5 CONDUCTOR/CABLES

A. Provided as required acceptable products are Belden, West Penn or approved equal

2.6 KEYS AND LOCKS

A. Contractor shall provide keys and locks for all cabinets and equipment; Keys shall be delivered to the owner at the conclusion of the project.

2.7 TRAINING

A. Provide a minimum of sixteen (16) hours of training on the Audio Visual and Sound systems to the owners building engineer or his designated personnel. If desired by the owner, video tape the training session and provide a copy to the owner for later review, reference and to train new employees on the operation of the systems.

2.8 NOT USED

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
   1. The following installation requirements shall govern the design, fabrication and installation of the system(s) specified herein. In case of a discrepancy between these overall system standards and the individual equipment item specifications, the more stringent standard shall govern:
   2. The equipment specified shall be installed according to standards of good engineering practice and the conditions specified herein.
   3. Workmanship on the installed systems shall be of professional quality, best commercial practice and accomplished by persons experienced in the techniques and standards of the particular industries involved.
   4. The project plans and specifications describe required performance. The specifications with the contract drawings indicate a general design; it is the intention of the specifications that the Contractor will supply from his background of experience and knowledge the necessary supporting details; for example, the implementation of specific components into functioning sub-systems.
   5. In general, the drawings show dimensions, positions, and kind of construction and the specifications describe materials, qualities and methods. Any work called for on the drawings and not mentioned in the specifications, or vice versa, shall be performed as though fully set forth in both. In case of differences between the drawings and the

specifications, the decision of the Owner shall govern. Work not particularly detailed, marked or specified, shall be construed to be the same as similar parts or areas that are detailed, marked, or specified.

6. Control panels and A/V plates shall be designed to reduce chances of human error and controls shall be natural and consonant with normal operator expectations.
7. The total design of the system shall simplify the operator's task and insure maximum performance and reliability while minimizing possibilities for human error and providing a comfortable environment for the operator during operation.

B. The Conduit System:

1. It is intended that the A/V system shall be an open wire system however any custom boxes, sleeves, miscellaneous conduit and coring shall be provided by the A/V Contractor.

C. Wiring and Cabling:

1. During installation both ends of all single wires or cables shall be marked with consecutive approved number markers, and a careful running log kept of route and terminations. After attachment or terminations these markers shall be accessible and readable for identification. A detailed wiring diagram shall be furnished with these numbers shown.
2. Extreme care must be taken to physically segregate and separate all high level lines from lower level lines.
3. Control cables and power distribution wiring shall not be installed adjacent to signal cables. Power distribution cabling shall be on the opposite side from signal wiring in equipment enclosures and shall be uniformly located throughout the installation.
4. Cables shall be grouped and bundled by type and routed from source to termination in a uniform manner throughout all equipment housings. Care shall be taken not to break the insulation or deform the cable by harness supports. Cables shall not change relative, position in a cable group throughout a cable route.
5. The Contractor shall employ the latest installation practices and materials. Coaxial connectors shall be crimp-on. Audio/Video wires shall be crimp-on or terminated on crimp on lugs.
6. Audio and control cable ends shall be neatly formed and shrinkable tubing applied where necessary to secure the insulation against fraying or reveling.
7. All cabling or system interconnection which passes through fire walls shall be suitably sleeved and sealed.
8. The Contractor shall be responsible for supplying any additional conduit which may be required to complete the system installation in accordance with the specification.

D. Equipment Room Arrangements:

1. The general layout for these rooms is indicated in the drawings. The Contractor shall prepare and submit a detailed layout for approval by the Owner. This drawing shall include, but not be limited to, the racks, the operator's console and monitoring station, the lighting system and the fire suppression/extinguishing system.

E. Rack Layout and Assembly:

1. The equipment rack or racks shall be installed in the Equipment Rooms in the configuration shown in the drawings. The plan shall allow for an absolute minimum of 30 inches, preferably 36 inches of clear space between the racks.

2. Great care shall be exercised to keep low level signal line separated from the AC power lines and from high-level signal lines. This shall be observed both in rack layout and in mechanical support or passage within the Equipment Rooms.
3. Wherever signal lines entering the Equipment Rooms must be connected into the racks, the use of intermediate terminal strips shall be used. This will also facilitate the testing of maximum increments of the systems in the Contractor's shop.

F. System Grounding:
1. A grounding diagram shall be provided by the electrical contractor and shall be submitted for approval in the form of a shop drawing.
2. The "spider" concept shall be employed to avoid ground loops and inductive coupling.
3. The systems shall be hum free, stable and free of oscillation with the earth ground temporarily disconnected.
4. The earth ground shall be made at only one point in the .system as indicated and shall be in accordance with the National Fire Protection Association 70-1990, paragraphs 250-74 Exception No.4, 250-75 Exception and 384-2 Exception.
5. The grounding method shall insure that the system is free of the following problems under any mode of operation:
   a. RF oscillation, pickup and interference.
   b. Distortion.
   c. Crosstalk.
   d. Signal Leakage.
   e. Very high frequency feedback.
   f. Audio Hum.
6. Major wiring ducts or trays in the Equipment Rooms shall be grounded to the conduit system.

3.2 OVERALL SYSTEM PERFORMANCE TESTING AND REQUIREMENTS

A. High quality laboratory instruments are essential for verification and calibration of a complete audiovisual system.

B. Specific Tests:
1. General:
   a. Tests shall include, but not be limited to those listed below in order to verify that the system meets all the design requirements.
   b. All tests shall be fully recorded and a neat copy presented for review and inclusion in the system manual.
   c. The Contractor shall pre-assemble and test as much of the system as possible in his own facility before delivery to the project.
2. Performance Tests on the Individual Components:
   a. Perform in Contractor's facility.
   b. Verify that the manufacturer's specifications are met.
   c. Measure the impedance and verify the acoustical output and freedom from rattles and distortion of all loudspeakers.
3. Performance Tests on Completed Component Sub-assemblies:
   a. Perform in Contractor's facilities.

4. Performance tests on the Complete System:
   a. Verify that all wiring is correctly and completely installed. Verify that there are no short circuits between conductors within any cable, or from cable to cable. Verify the integrity of each conductor, i.e., that each conductor is not open circuited. In addition, the correct polarity of each connector, including those patch panels, shall be verified and the color-coding scheme shall be recorded and included in the documentation provided to the Owner.
   b. Verify that the entire system performance is in accordance with the design requirements.
   c. All equipment items shall be 100 percent tested for correct functional operation.
   d. All these tests, and any others that the Contractor may wish for his own satisfaction, shall have been performed and successfully achieved before inspection by the Owner is requested. The Owner may request repetition and demonstration during inspection of certain of these tests or other critical tests if problems become apparent. If specifications are not met, further inspections by the Owner will be at the Contractor's expense.

3.3 SUBSTANTIAL COMPLETION, INSPECTIONS AND ACCEPTANCE

A. Substantial Completion Inspection:
   1. Prior to the Substantial Completion Inspection, the Contractor shall file a written notice when all of the aids to use, have been submitted for approval, all of the tests described in paragraph 3.2, above, are complete and the systems are ready for the Substantial Completion Inspection.
   2. The Owner’s Representative shall perform a Substantial Completion Inspection of the systems and may request repetition or demonstration of any or all of the tests described, above, or other critical tests, if problems become " apparent and the specifications are not met. After the Substantial completion Inspection, written notice that the systems meet the criteria set forth in the General Conditions for substantial Completion, along with a list of items for the Contractor to correct will be issued.
   3. In the event that the systems are found not to be Substantially Complete, all of the Owner's costs including consulting fees, travel and living expenses in connection with subsequent inspections or corrective work may be borne solely by the Contractor. This includes new problems that arise during the course of the subsequent inspections.

B. Acceptance Inspection:
   1. After the Owner has certified Substantial completion of the systems and the Contractor has filed written notice that the corrections ordered, have been completed, an Acceptance Inspections shall be scheduled.
   2. The Owner shall perform an Acceptance Inspection of the systems and may request repetition or demonstration of any of all of the tests described above, or other critical tests if problems become apparent and the specifications are not met.
   3. In the event that the corrections have not been completed to the satisfaction of the Owner, or new problems arise at the time of the Acceptance Inspection, all of the Owner's costs including consulting fees, travel and living expenses in connection with subsequent inspections or corrective work may be borne solely by the Contractor.

C. Acceptance:

1. After inspections and tests indicate that the entire Audio Visual system and auxiliary systems as specified herein and indicated on the drawings are in total compliance with same, the systems will be ready for acceptance to be issued.
2. Acceptance of the system shall be accomplished as described in the General Conditions.

- END OF SECTION -

DIVISION 28 – ELECTRONIC SAFETY & SECURITY

TABLE OF CONTENTS

Pages

- SECTION 28 0000 -

ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.2 SUMMARY

A. Provide all work as detailed in the Contract Drawings as a turn-key installation including all material, labor, programming, as-built documentation, warranties, taxes, freight and permits. Only items and requirements specifically stated to be provided under another section shall not be a requirement for this section of the work.

B. The end product by which the security contractor is to produce shall be a complete, operational and functional integrated security system.

C. Systems and Equipment
   1. Provide the following systems and equipment:
      a. Security Management System (SMS)
      b. Closed Circuit Television (CCTV) System
      c. Equipment and Racks
      d. Wire and Cable

D. Coordination
   1. Coordinate the installation of the security system with the following related systems provided by others:
      a. Door Hardware
      b. Fire Alarm
      c. Elevator
      d. Electrical
      e. Telecom

1.3 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the Contract Documents.

1.4 QUALITY ASSURANCE

A. Contractor Qualifications

1. All work specified herein shall be the responsibility of a single electronic security systems integration contractor. Bidders shall document a minimum of five years' experience in the fabrication, assembly and installation of systems of similar complexity as specified herein. The documentation shall include the names, locations and points of contact for at least three installations of the type and complexity specified herein. The bidders shall provide a brief overview of each system detailing what SMS and CCTV system was used; the amount of equipment installed; and certify that the system has been in operation for a minimum of 24 months.
2. The contractor shall have a service facility and organization with staffing capable of providing comprehensive maintenance and service to the specified systems within 24 hours after being called.
3. The Contractor shall provide in-house engineering and project management capabilities consistent with the requirements of the work. The Contractor shall have a project manager and field supervisor in place which oversees the entire project till completion of the project. The assigned project manager will be responsible for coordination, scheduling, manpower, functional performance testing (FPT) etc. of the project. The Contractor's field supervisor shall be present during the full duration of the project to oversee field installations and to coordinate with other trades to ensure progress on the project.
4. The Contractor shall provide factory certified technicians to work on and service any hardware and or software installed on the project as part of this integrated system.
5. The Contractor must be familiar with local codes and contract conditions pertaining to this project.

B. Product Standards

1. All materials installed on this or any other project must be new and the latest specification and version from the manufacturer.
2. All products installed shall be what is depicted in these specifications or approved equal.

1.5 SUBMITTALS

A. General:

1. All submitted data shall be specific to this project and identified as such. Generic submittal data will not be accepted.
2. Submit transformer and amplifier locations for review.

B. Product Data:

1. Manufacturers descriptive literature, illustrations and installation instructions for all components included within this project indicating compliance with applicable referenced standards, size, dimensions, model number, electrical characteristics, support requirements, connection requirements and all applicable information verifying that submitted components comply with Contract Documents.

C. Record Documents:

1. Identify transformer and amplifier locations on the record drawings.
2. Manufacturer's warranty form in which manufacturer agrees to repair or replace components that fail in materials or workmanship within specified warranty period.

D. Operation and Maintenance Data:

1. Operation Data: Include manufacturer’s installation and operating instructions.
2. Maintenance Data: Servicing requirements, inspection data, preventative maintenance schedule, exploded assembly views, replacement part numbers and availability, location and contact numbers of service depot.

E. LAN/WAN Network Devices:

1. All LAN/WAN Networked Devices shall require an additional submittal to identify the MAC Address of the Contractor provided device, the location to be installed and the port configuration needed for communication. The expected turn around time for this data to be provided back to the contractor is 3 weeks.

F. FPT Documentation

1. All FPT Documentation shall require an additional submittal to ensure the accuracy of the detailed devices to be tested and their programming in the SMS. The expected turn around time for this date to be provided back to the contractor is 3 weeks.

1.6 DELIVERY, STORAGE AND HANDLING

A. Equipment and components shall arrive on-Site properly protected and undamaged with containers, packaging and labels intact.

B. Store, handle and protect materials and equipment in accordance with Manufacturer's recommendations.

C. Provide additional protection during handling as necessary to prevent breaking scraping, marring, or otherwise damaging products or surrounding areas.

D. Protect all equipment and components that are to be installed within this project from theft, vandalism, and exposure to rain, freezing temperatures and direct sunlight.

E. Protect installed equipment and components from damage and prevent use by unauthorized persons.

1.7 EXTRA MATERIALS

A. Spare Parts
   1. The Contractor will maintain a spare parts inventory to resolve any critical component failure within 24 hours of the incident. Critical components shall be:
      a. Card Readers
      b. Motion Detectors
      c. Door Position Switches
      d. CCTV Cameras
      e. Power Distribution Unit Components (any and all components)

1.8 WARRANTY

A. Warranty
   1. The Contractor shall warranty the completed work for a period of two years, from the date of system acceptance, to be free of defect in design, workmanship or material.
   2. System acceptance is defined as the completion of all functional performance testing and the resolution of all punch list items.

B. Warranty Service
   1. In the event that defects in the materials and/or workmanship are identified during the warranty period, the contractor shall provide all labor and materials to correct the deficiency.
   2. All service work shall be performed by factory certified technicians.
   3. All warranty service shall include the replacement of all parts and or components as required to restore normal system operation. If parts or components need to be repaired, a loaner will be supplied and installed until the part or component can be repaired and reinstalled.
   4. Immediately following a warranty service request, the Contractor shall provide written documentation to the Owner which details the service work completed, cause of trouble and any outstanding work required to restore a complete and normal system.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.2 SECURITY MANAGEMENT SYSTEM (SMS)

A. Acceptable Manufacturer
   1. Bosch security

2.3 ACCESS CONTROL

A. All Guest room, Public and Back of House access controlled doors are Owner provided

2.4 CLOSED CIRCUIT TELEVISION (CCTV) SYSTEM

A. System Description
   1. The CCTV system will be Bosch BVMS or approved equal
   2. The system will be housed in the Hotel Security office

B. Video Standards
   1. The CCTV system shall be high resolution IP based
   2. Adjust all cameras to produce proper video with no blooming, streaking or noticeable lag.
   3. When displayed, the video signal shall be uniform and consistent in quality.
   4. Provide phase lock camera synchronization to the power zero crossing or provide camera manufacturer's specification for synchronization. Synchronize each camera to ensure roll-free switching. Use an oscilloscope or other synchronization tools as necessary to ensure precise synchronization of all CCTV Cameras.
   5. Provide ground isolation transformers as required to eliminate hum bars and ground loops.

C. CCTV Programming Standards
   1. Cameras on the CCTV system shall be programmed to include the Building Acronym, Room Number and brief description of the area.
      a. Example: "Camera 7 Lobby Entry"

D. Equipment Requirements
   1. Digital Video Recorders
      a. The DVR shall capture video images for the CCTV cameras and record them to internal and external hard drive storage.
      b. The DVRs shall be the newest and the latest specification and version from the manufacturer.
      c. The DVR shall provide for 10 second pre-alarm and 30 second post-alarm motion recording.
      d. The Contractor shall program all camera inputs for video motion
      e. Specifications (NO EXCEPTIONS)
         1) Camera Inputs: 32
         2) Recording Rate: Communicate with UTPD for direction
         3) Storage Capacity: 30 Days online Storage with 32 cameras at medium resolution 70 percent of the time
         4) Storage: Internal RAID 5 disk array with a minimum of 3.0 TB
         5) Mount: 19" Rack Mounted
      f. Acceptable Manufacturers
         1) Bosch BVMS
   2. CCTV Cameras, Housings and Mounts
      a. CCTV Cameras shall be 1/3 or 1/4 inch CCD, high resolution, and accept C or CS lens mounts.

b. Provide backlight compensation for interior cameras with views that include exterior glass.

c. Provide cameras with super-dynamic or wide dynamic CCDs where extreme light levels changes may occur. Field Verify these locations prior to installation.

d. Wiring to all cameras shall pass from the back-box through the mount and into the housing. Exposed wiring of any kind shall not be acceptable.

e. Provide sun shields for camera housings in exterior locations exposed directly to sunlight.

f. Provide weather resistant camera housing for all exterior locations.

g. Provide lightning protection for power, control and video cables for all exterior cameras.

h. Field verify the exact camera location, position and mounting with the architect and owner prior to installation.

i. Field verify and confirm camera views with the owner prior to final installation and adjust camera positions and lens requirements as required

j. All Cameras installed to have a minimum 3 year manufacturer warranty

k. PTZ CCTV Camera
   1) Video output: BNC Composite Video
   2) Power: 24V AC
   3) Mount: See Drawings
   4) Acceptable Manufacturers - Bosch or equal

l. Exterior Fixed Dome CCTV Camera
   1) Image Device: 1/3 inch format, color CCD
   2) Resolution: 480 lines horizontal
   3) S/N ratio: Greater than 48 db
   4) Sensitivity: .7Lux/Fl.2
   5) Video output: BNC Composite Video
   6) Lens Mount: C/CS
   7) Power: 24V AC
   8) Mount: See Drawings
   9) Acceptable Manufacturers - Bosch or equal

m. Interior Fixed Miniature Dome CCTV Camera (All interior locations)
   1) Image Device: 1/3 inch format, color CCD
   2) Resolution: 480 lines horizontal
   3) S/N ratio: Greater than 48 db
   4) Sensitivity: .5Lux/Fl.2
   5) Video output: BNC Composite Video
   6) Power: 24V AC
   7) Mount: See Drawings
   8) Acceptable Manufacturers and Models
      a) Bosch

n. Lens
   1) All lenses to be varifocal
   2) All cameras and lenses to be color

3) All lenses to be auto iris

3. Fiber Optic Transmission Equipment
   a. Provide Fiber Transmission Equipment
   b. All video transmission equipment will be able to distribute 16 cameras over one device
   c. Single Mode unless otherwise noted
   d. Rack Mounted for 19" Racks
   e. Acceptable Manufacturer and Models
      1) International Fiber Systems, Inc. - VT71630-R3 and VR71630-R3

2.5 WIRE AND CABLE

A. Minimum Specifications
   1. All wire and cable shall be Underwriter's Laboratories (UL) approved for its intended application, shall meet all national, state and local code requirements for its application, and shall meet or exceed manufacturers' recommendations for the components connected.
   2. Provide Plenum or Riser rated cable as required by code.
   3. All wire and cable shall meet individual system or subsystem manufacturer specifications.
   4. Wire and cable shall comply with the applicable requirements of the National Electrical Code (NEC), latest edition, in regards to cable construction and usage.
   5. Insulation shall be rated for a minimum of 300 volts
   6. Patch Cables
      a. All patch cables shall be pre-manufactured.
      b. The length of all patch cables shall be long enough to route neatly through cable management systems and to be dressed in neatly.
      c. All patch cables shall have owner standard ends.

B. Minimum Wire Types and Sizes
   1. Low Voltage Power Cable
      a. 18AWG, twisted, stranded, insulated, and jacketed
      b. Increase conductor gauge to be consistent with circuit current ratings and manufacturer's recommendations.
   2. Card Reader Cable
      a. 20 AWG, stranded, individually shielded twisted pairs, insulated and jacketed
   3. Alarm Point Monitoring Cable
      a. 20 AWG, twisted, stranded, insulated, and jacketed
   4. Control Point Cable (Non-power)
      a. 20 AWG, twisted, stranded, insulated, and jacketed
   5. Control Point Cable (Low Voltage Power)
      a. 18 AWG, twisted, stranded, insulated, and jacketed
   6. Composite Cable
      a. All Composite cable shall meet all of the above requirements. There shall not be a drain that is over the entire composite cable bundle, it shall be limited to the reader cable only.

7. Data Cable
   a. Amp Cat6 or approved equal
8. Coaxial Cable
   a. RG-59/U with a minimum center conductor of 20AWG solid, bare copper and overall bare copper braided shield shall be used for cable runs less than 1000 feet.
   b. RG-6/U with a minimum center conductor of 18 AWG solid, bare copper and overall bare copper braided shield shall be used for cable runs less than 1500 feet.
   c. Coaxial cables with copper coated steel center conductors will not be acceptable.
   d. Acceptable Manufacturers
      1) Belden
      2) Southwest Wire
      3) West Penn Wire
      4) Or UTPD approved equivalent

PART 3 - EXECUTION

3.1 PROJECT MEETINGS

A. Contractor shall be required to attend Project Meetings as scheduled by the Owner. The Contractor representative shall be the Security Project Manager.

3.2 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's specifications and published recommendations.

C. Wiring
   1. Run wire with conduit, exposed above accessible ceilings, below accessible floors, in floor cable trays and in riser rooms.
   2. Utilize cable trays whenever possible.
   3. All cabling shall be installed per Owner's requirements.
   4. All wireways shall be per construction documents. If the construction documents do not detail a wireway, it is the responsibility of the security contractor to provide their own wireway.
   5. Provide plenum cable when ran thru Plenum areas.
   6. Provide code compliant fire proofing techniques for all penetrations of fire rated partitions and slabs.
   7. Fasten cables throughout cable paths securely to building structure every 10 feet at minimum.
   8. Cable runs shall be continuous from device location to the final point of termination.
   9. Provide grommets and strain relief material where necessary to avoid abrasion of wire and excess tension on wire and cable.

10. Coaxial Cable
    a. All Coaxial Cable runs shall have a service loop of 20 feet to compensate for any final field modification. The cable shall be bundled and wrapped neatly in the above ceiling.
    b. All Coaxial Cable shall never be subjected to a bend less than a 6 inch radius
    c. Coaxial Cable connectors shall consist of three piece crimp connectors.
11. Component Connections
    a. The following components must be labeled utilizing an approved labeling device with the above mentioned device naming standards:
    b. Card Readers – Both in the field and in the panel where it terminates. Field Labeling shall be affixed to the bottom, if not applicable on the inside edge, of each device.
    c. Cameras – Both in the field and where it terminates. Field Labeling shall be affixed to the camera above the ceiling, if not applicable the top edge of housing.
    d. All other previously listed security devices shall be labeled on the cable where it terminates to the device and where the cable terminates to the security controller or power supply.
    e. Prepare wire ends for attachment to components in accordance with manufacturer recommendations.
    f. Wire nuts shall not be an acceptable means of connecting wire and cable. All connections shall be made by crimp connection only.
    g. Connections shall be labeled with the above mentioned device naming standards.
    h. Controller Connections
    i. Contractor shall not connect any Istar controller to the SMS outside of UTPD Technical Services Component's normal business hours. All initial system activations shall be performed and tested prior to implementation on the production environment.

3.3 SYSTEM ACCEPTANCE

A. Functional Performance Testing (FPT) requires that an authorized representative of the Owner review all security technology components to assure they are properly installed, functional, and integrated into the technology infrastructure.

B. Functional Performance testing shall begin when the following conditions exist:
    1. All CCTV Cameras and DVRs are 100%
    2. All critical and high priority devices are 100%

C. All FPT documentation shall utilize Functional Performance Testing Documentation provided by the contractor.
    1. The Contractor shall provide two weeks advance notification to the Owner for scheduling of the Initial FPT.
    2. The Contractor shall provide four copies of recorded drawings and four copies of completed FPT Documents before the FPT process is to start.
    3. The Contractor shall provide in ACAD an electronic version of the recorded documents before the FPT process is to start.

D. The Contractor shall provide the Field Supervisor and a Certified Technician during the FPT process for adequate support during the testing process.
   1. The Contractor shall staff the Monitoring Station to acknowledge alarms during the testing.
   2. The Contractor shall accompany the Owner in the field to assist in the functional demonstration of security devices.
   3. The Contractor shall supply two radios, to allow for efficient communication between the FPT personnel.

E. Punchlist is developed and distributed by the Owner
   1. The Contractor shall produce documentation to demonstrate the punchlist has been completed and the installation is at Final Completion.

F. Once the system is accepted, the devices are then placed in the view of Police Communication Center for monitoring and dispatch. Once system acceptance has been established by the Owner, that date will be the beginning of the warranty period.

G. The Owner reserves the right to suspend and/or terminate testing at any time when the system fails to perform as specified.

- END OF SECTION -

- SECTION 28 3000 -

FIRE ALARM AND DETECTION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SYSTEM ABBREVIATIONS AND DEFINITIONS

A. ADA – Americans with Disabilities Act.

B. AHJ – Authority Having Jurisdiction – City of Phoenix Fire Department.

C. Approved – Unless otherwise stated, materials, equipment or submittals approved by the Owner, Architect, Engineer, or AHJ.

D. Central Processing Unit (CPU) – The central computer of a point addressable control system.

E. Concealed – Where used in connection with installation of piping or conduit and accessories, shall mean, “Hidden from sight” as in shafts, furred spaces, in soffits or above suspended ceilings.

F. Contractor – The Company awarded the prime contract for this work and any of its subcontractors, vendors, suppliers, or fabricators.

G. Engineer – Aon Fire Protection Engineering.

H. Exposed – Where used in connection with installation of piping or conduit and accessories, shall mean “visible” or “not concealed.”

I. FACP – Fire Alarm Control Panel.

J. FM – FM Global.

K. FM Approved – Materials or equipment approved by FM Global and included in the most recent edition of the FM Global Approval Guide.

L. Furnish – Supply materials.

M. Install – Install materials, mount, and connect equipment or assemblies.

N. NFPA – National Fire Protection Association.

O. Owner – Marriott International, Inc.

P. PACE – Point Addressable Central Equipment.

Q. UL – Underwriter's Laboratories, Inc.

R. UL Listed – Materials or equipment by Underwriters Laboratories and included in the most recent edition of the UL Fire Protection Equipment Directory.:

1.3 SUMMARY

A. This Section includes the following:

1. Furnish and install, unless otherwise indicated, items required for a complete fire alarm and supervisory system as outlined in these specifications. The work includes the following:

   a. Provide a new state-of-the-art addressable, fire alarm control panel (FACP) system for Marriott Courtyard and Residence Inn at Luhrs City Center in Phoenix, Arizona. The new addressable fire alarm system is required to be capable of providing protection for the entire building and must be UUKL Listed. Point addressable sub control panels and power supplies are required to be located in electrical closets and report all devices in all buildings by point ID to the main fire alarm control panel in the Fire Command Center. One remote annunciator is required to be mounted in the hotel lobby at the front desk.

   b. A smoke control panel is required to also be provided in accordance with the Aon Fire Protection Engineering Fire Life Safety Report, and the City of Phoenix requirements.

   c. All equipment provided is required to be addressable: carbon monoxide (CO) detectors, addressable smoke detectors, addressable manual fire alarm stations, addressable heat detectors, addressable duct detectors, strobes, and speakers. Addressable monitoring modules are required to be provided for waterflow switches, and valve supervisory devices. Control relays are required for door holders. All control panels must be powered by a dedicated emergency power circuit and shall be protected by smoke detection.

   d. System smoke detectors with sounder bases are required in all guestrooms.

   e. New strobe power panels where necessary, must meet the power requirements for the visual indicating circuits. All strobe power panels are to be connected to the 120-volt emergency power on a dedicated circuit breaker. New notification power supplies where necessary in electrical closets are to be protected by smoke detection.

   f. All notification risers are required to be installed in 2-hour construction as required in NFPA 72.

   g. A point addressable control system, addressable initiating devices, signaling devices, indicating devices, sensors, annunciators, relays, software, accessories and other materials and equipment for a complete operating system.

   h. Provide an emergency one-way voice evacuation system to operate on each floor of the building. Speakers are required to operate at 70 volts, both speakers and strobes are to be white. All new notification risers must meet NFPA 72 survivability requirements.

   i. This system is required to be capable of prerecorded digital voice messaging and tone alert, and live voice announcements by zone and throughout the building.

j. Monitoring of the automatic sprinkler system, fire pumps, jockey pumps, and building suppression systems.

k. Monitoring of the emergency generator for run, fail, and low fuel level conditions and pump malfunction status and other supervisory signals required by NFPA 20 and the fire protection specifications.

l. Connect to the smoke-control system to provide monitor and control functions in accordance with International Building Code (IBC), and the Aon Fire Protection Engineering Fire Life Safety Report.

m. All initiating device signaling line circuits controlling, monitoring, or supervising the mechanical smoke control system are required to be installed in continuous raceways as defined by the National Electrical Code.

n. Provide a digital dialer panel to transmit common alarm; common trouble, and supervisory signals to a UL listed central station.

o. Connect and coordinate the new fire alarm system with the elevator controls for elevator recall and shunt trip capabilities.

p. Detailed terminal-to-terminal alarm system shop drawings, wiring diagrams, and battery calculations for all components (voltage drop calculations not to exceed 10% per notification appliance circuit), sequence of operation, and operating and maintenance instructions.

q. An on-site, factory-trained technician to supervise the installation acceptable to the Owner.

r. An on-site Supervision Contractor.

s. A network annunciator is required at the front desk.

t. Submit shop drawings and product data submittals to Aon Fire Protection Engineering and the City of Phoenix Fire Department for approval.

u. A complete test of the system upon completion of installation to assure the Owner's Representative, Aon Fire Protection Engineering, and the Authority Having Jurisdiction that the system is operational. This test must take place prior to final acceptance test.

v. A one-year job site warranty of all materials and labor furnished under this section.

w. As-built drawings. The Contractor will be required to provide as-built drawings on disk/CD in AutoCAD format, in addition to required reproducible and blue line drawings.

1.4 RELATED WORK

A. Section 21 1313 Wet-Pipe Sprinkler Systems.

1.5 REFERENCES

A. International Building Code (IBC), 2006 Edition, with City of Phoenix Amendments.

B. International Fire Code (IFC), 2006 Edition, with City of Phoenix Amendments.

C. Marriott Fire Life Safety Standards.

D. National Electrical Code (NEC), 2011 Edition.

E. National Fire Protection Association 72 (NFPA 72) – "National Fire Alarm Code®," 2013 Edition.

F. National Fire Protection Association 101 (NFPA 101) – "Life Safety Code®," 2012 Edition.

G. National Fire Protection Association 720 (NFPA 720) – "Standard for the Installation of Carbon Monoxide (CO) Warning Equipment in Dwelling Units," 2005 Edition.

H. Underwriter's Laboratories, Inc. (UL) 268, "Standard for Smoke Detectors for Fire Protective Signaling Systems," Latest Edition.

I. Underwriter's Laboratories Inc. (UL) 268A, "Standard for Smoke Detectors for Duct Application," as amended, Second Edition, March 31, 1993, with revisions through April 15, 1994.

J. Underwriter's Laboratories Inc. (UL) 1971, "Standard for Signaling Applications for the Hearing-Impaired," First Edition, June 30, 1992, with revisions through May 2004.

1.6 SUBMITTALS

A. General:

1. The Owner's Representative and the Engineer will review all submittals for conformance with the specifications. If submittals, upon review by the Owner's Representative, are found not to conform to the requirements of this specification, the Contractor is required to resubmit with modifications. The Contractor is responsible for extra expenses for the subsequent review(s) of the rejected submittals necessitated by the Contractor's failure to make the requested modifications. Such extra fees may be deducted from payments by the Owner to the Contractor. Approval of the submittals by the Owner's Representative shall, in no case relieve the Contractor of the responsibility to meet the requirements of the specifications.
2. All equipment is required to be installed in accordance with the manufacturer's recommendations and the UL listing limitations. Compatibility listing requirements for fire alarm systems and smoke detectors are required to be met. The Contractor will provide evidence, with the submittal, of listings of all proposed equipment and combinations of equipment.
3. Prior to the start of installation, the Contractor is to obtain and submit copies of all permits, licenses, certificates, and approvals necessary to conduct the work.

B. Equipment List/Product Data:

1. Prior to installation, but within 30 days of the date of commencement specified in the Notice to Proceed, the Contractor is required to submit a minimum of five (5) copies (three (3) for the Owner's Records, one (1) for the Engineer's records, and one (1) to return to the Contractor) of a detailed equipment list, identifying types, models and quantities of all materials, devices and equipment proposed. This submittal includes manufacturer's data sheets showing the types and models of all equipment, devices, material, and wire proposed. Evidence of UL listings must be submitted with the data sheets. Where devices furnished by the Contractor involve work by another Contractor or Subcontractor, submit additional approved data sheets and shop drawing copies to that Contractor or Subcontractor.
2. Submit full sets of product submittals bound in protective binders. All data sheets are to be original manufacturer's literature, or be clearly legible if reproductions are provided. When a data sheet shows more than one (1) product, the proposed product must be clearly indicated by arrows or other suitable means.
3. Product submittals are required with shop drawings for complete review by the Owner's Representative.

C. Provide complete field software data, including all password codes, point numbers, point descriptions, English messages, event-control descriptions, and sequence of operation. All data file programs are to be provided to the Owner's Representative and the Engineer.

D. Shop Drawings

1. Prior to installation, but within 30 days of the date of commencement specified in the Notice to Proceed, the Contractor is required to submit a minimum of five (5) copies (three (3) for the Owner's records, one (1) for the Engineer's records, and one (1) to return to the Contractor) of shop drawings to the Owner's Representative for approval.
2. The shop drawings include, at a minimum, the following information:
    a. Sequence of operation for fire alarm equipment.
    b. List of all point numbers and point descriptions.
    c. Building floor plans drawn to scale, showing device locations; complete wiring and schematic diagrams, including number, size and type of conductors and conduit for both existing and new, wire color codes, and field terminations; control panel layouts, including all modules, circuit terminals and interconnections, overall cabinet dimensions, and panel front layouts; complete riser diagrams indicating wiring sequence for all devices and control equipment. Drawings shall show proposed layout and anchorage of equipment and appurtenances and equipment relationship to other parts of the work, including clearances for maintenance and operation. Prepare shop drawings at a minimum scale of 1/8-inch equals 1 foot for plans and 1/4 inch equals 1 foot for details. All shop drawings are to be provided with the manufacturer's logo clearly printed on each drawing.
3. Provide substantiating calculations, including calculations for determining secondary power supply requirements and voltage drop calculations. Battery calculations shall list the type of devices and modules, quantities, unit, and extended amperage draw for quiescent and alarm conditions, total amperage draw, and battery amp/hour rating. Battery recharging period shall be included with the calculations. For design criteria, the battery amp/hour-rating listed by the manufacturer shall be de-rated by 20 percent.
4. Voltage drop calculations: The voltage drop calculations shall list the distance and current draw of each notification appliance and the formula used and shall not exceed 10 percent visual notification devices per circuit.
5. Prior to purchase or fabrication of any material, approval in writing shall be obtained from the Owner's Representative, the Engineer, and the City of Phoenix (in that order). Any installation conducted prior to receiving written approval shall be the Contractor's responsibility.
6. Submittals must include shop drawings and product data sheets. Partial submittals are not acceptable and will be returned to the contractor un-reviewed.

E. The costs incurred by the Engineer to review additional submittals resulting from an initial rejection are the responsibility of the submitting contractor. The Owner will back-charge the Contractor for the Engineer's cost for additional review(s).

F. Submittals rejected by the Owner's Representative and the Engineer are required to be corrected and resubmitted within fourteen (14) days of the review letter date.

G. After the Owner's Representative and the Engineer have approved the submittals, then the submittals are required to be submitted to the City of Phoenix for approval prior to fabrication.

H. Final Inspection and Test

1. The Contractor is to make arrangements with the Owner, Architect, and Engineer for final inspection and witnessing of the final acceptance tests. The Owner, Architect, and the Engineer will witness the final inspection.
2. Perform all tests and inspections required by the referenced codes and standards, the AHJ, and the Owner.
3. When the Engineer visits the job site for final inspection and tests after being advised by the Contractor that the work is complete and ready for test, if the work has not been completed or the final acceptance tests are unsatisfactory, the Contractor is responsible for the Engineer's extra time and expenses for reinspection and witnessing the retesting of the work. Such extra fees will be deducted from payments by the Owner to the Contractor.
4. Upon completion of final inspections and tests, as required by appropriate NFPA Standards, submit copies of Standard Contractor's Material and Test Certificate.

I. Product Data: For each type of product indicated, demonstrate compliance with specified attributes.

1.7 QUALITY ASSURANCE

A. The fire alarm system manufacturer is required to maintain a fully staffed branch office including application engineers, drafters, and technical service personnel within the Phoenix area.

B. All technical service personnel are required to be regularly employed by the fire alarm system manufacturer.

C. All electrical installation of the fire alarm system, including wire installation and terminations, is required to be performed by the electricians in the employ of the installing Contractor.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials
1. Delivery of all materials and equipment to the job site is to be scheduled to assure compliance with the predetermined construction schedules.

B. Storage of Materials, Equipment, and Fixtures
1. Contractor is responsible for storage of materials on job site, including furnishing of any storage facilities or structures required.

C. Handling Materials and Equipment
1. Contractor is responsible for on-site handling of materials and equipment.

1.9 WARRANTY

A. The Contractor is required to guarantee all materials and workmanship for a period of one (1) year beginning with the date of final acceptance of the entire project by the owner. The Contractor is responsible during the design, installation, testing and guarantee periods for any damage caused by his (or his subcontractors') work, materials, or equipment.

B. The Contractor is required to provide a one (1) year written guarantee against defects in material and workmanship furnished under this Contract. The costs of such guarantee will be

part of the purchase price. The guarantee commences when the Owner's Representative accepts the system and installation in writing.

C. The guarantee is required to include all necessary material, travel, labor, and parts to replace defective components or materials at the job site. The Contractor is required to commence repair of any "in guarantee" defects within 24 hours of notification of such defects.

D. The Contractor is required to make allowances in his guarantee to cover diagnosis of system defects that might ultimately be the responsibility of others to correct. When this occurs, the Owner's Representative and other affected trades are required to be notified.

E. The warranty includes all necessary factory and field software required to perform the specified tasks. This item does not include software installed at the system acceptance unless the defective software was installed at the direction of the system manufacturer.

F. The Contractor is required to include, as part of the one (1) year warranty, a test and inspection of the entire fire alarm system at least one (1) month prior to the expiration of the one-year construction warranty. The Contractor is required to provide a written report of any deficiencies and repair any of the deficiencies. The test and report must conform to the certification as described in NFPA 72.

1.10 JOB CONDITIONS

A. Maintain the premises free from accumulation of waste materials or rubbish caused by this work to the Owner's standard for cleanliness. Finished flooring is required to be protected from damage and cleanup will be the responsibility of the Contractor.

1.11 EMERGENCY SERVICE

A. The Contractor is required to provide emergency repair service for the fire alarm system within four (4) hours of a request for such service by the Owner during the warranty period. This service is required to be available on a 24-hour per day, seven-day per week basis.

1.12 TRAINING

A. The Contractor is required to conduct two (2) training sessions of four (4) hours each, to familiarize the facility personnel with the features, operation, and maintenance of the fire alarm system. The Owner will schedule training sessions at a mutually agreeable time to the Contractor and the Owner.

1.13 PERMITS AND FEES

A. Pay for all permits, fees, and charges required for this work.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. All components are to be used in accordance with the manufacturer's recommendations and its UL listing and/or FM approval.

B. The naming of manufacturers in the specifications is not be construed as eliminating the materials, products or services of other manufacturers and suppliers providing approved equivalent items.

C. The substitutions of materials or products other than those named in the specifications are subject to proper approval of the Owner granted in writing.

2.2 MANUFACTURERS

A. Products for this project are to be of the latest design; obsolete or discontinued products will not be acceptable. All equipment supplied is required to be UUKL listed for required function.

2.3 INSTALLATION

A. All wire and cable is to be new and UL listed and/or approved for use in fire alarm signal systems per NEC, Section 760. All new wire is to be solid conductors of copper, minimum size of as referenced on the drawings.

B. Manufacturer's recommended wire type and gauge are required to be used. If the fire alarm manufacturer specifies wire from a specific manufacturer(s), this wire is required to be used unless the fire alarm manufacturer indicates in writing that other wire manufacturers are considered equal.

C. All wiring is required to be appropriately color-coded, and permanent wire markers are to be used to identify the terminations for each circuit at the control panel.

D. Splices are to be kept at a minimum. Splices are required to be made in outlet boxes, junction boxes, and pull boxes.

E. All conduit, junction boxes, pull boxes and fittings are required to conform to the following:
   1. Conduit
      a. Conduit is to be 3/4-inch minimum and be rigid steel conduit in wet areas, electric metallic tubing, and flexible conduit in conformance with NEC.
      b. Conduit exposed to weather is to comply with NEC.
      c. All fittings are to be listed and approved for the specific conduit.
      d. For threaded rigid steel conduit do not use threadless or compression-type fittings.
      e. All EMT conduit fittings are to be steel or malleable iron "concrete-tight" or "rain-tight" couplings and connectors, compression, set screw, or stainless steel multiple-locking type. Do not use indentation type of fittings.
   2. Junction and Pull Boxes
      a. Are required to be installed in accordance with the NEC, state or local codes.

b. Provide galvanized sheet steel junction and pull boxes, with screw-on covers and of types, shapes, and sizes to suit each respective location and installation.

c. Boxes exposed to weather, moisture, at or adjacent to water or steam connections, at sprinkler waterflow switches and supervisory switches are required to be corrosion-resistant, cast-metal weatherproof outlet boxes of types, shapes, and sizes, including depth of boxes with threaded conduit ends, cast-metal face plates with spring-hinged waterproof caps suitable for each application, including face plate gaskets and corrosion-resistant fasteners.

d. Each box is to be large enough to accommodate required splices and conduit in accordance with the NEC.

e. Sectional boxes are not to be used.

f. Boxes are required to be painted red or otherwise designated for identification as part of the fire alarm system.

3. Field Terminal Cabinets (FTC)

a. Are required to be UL listed for use in electrical wiring systems.

b. Minimum size is to be 12 inches by 12 inches by 4 inches deep with a hinged lockable cover or a plate cover attached by tamper-resistant screws.

c. Terminal strips are to be numbered and a list of all terminations is to be permanently affixed to the inside cover of all terminal cabinets.

d. Terminal cabinets are to be identified as part of the fire alarm system on the outward face of the cabinet

F. All wiring components are to be UL listed. Wiring methods are required to conform to NEC, Section 760.

2.4 CONTROL EQUIPMENT

A. Point Addressable Central Equipment (Fire Alarm Control Panel):

1. The point addressable UL Listed central equipment (PACE) is required to be wall-mounted. The PACE is to be equipped with locked enclosures having removable access panels for servicing of electronic components. The PACE is required to be completely pre-wired requiring only the connection of incoming field wiring and the plugging in of accessory modules such as additional memory, printer interface boards, etc. All controls and displays are to be mounted at heights allowing easy accessibility. The PACE must include, but not be limited to, the following major components, some of which may be physically separate from the main cabinet:

a. Central processing equipment.

b. Normal AC power supplies.

c. Data transmission equipment.

d. Mass data storage.

e. Fire alarm system printer.

f. Emergency power supplies.

g. Operating terminal (OPT).

2. The central processing unit (CPU) must be a "mini" or "micro" computer, UL listed for fire alarm use. (Use of non-UL listed computers is strictly forbidden.) The main memory system is required to be adequately sized to provide display, printout, and control of 150% of the actual alarm and command points as described herein and indicated in the specifications. All basic alarm and control software is required to be included. The CPU

is required to be completely field programmable and all data entered is to reside in the system.

3. The CPU is to be equipped with a non-volatile main memory system of EPROM, battery protected RAM, bubble type, or EEPROM memory system. The mass storage for all English descriptors, English language operator's messages. The mass storage means are to be equipped with all necessary control hardware.
4. Normal operating power for the PACE is required to be a dedicated 120 VAC, single-phase, 60 Hz supplied from the building circuit distribution power panel. Power supply is required to be dedicated to the system. Transfer from normal to emergency power or restoration of normal power is required to be automatic. In addition, the CPU is required to be provided with an emergency battery standby power system, which is required to operate the system for 24 hours in the standby mode and 15 minutes in alarm mode.
5. The system-operating terminal (OPT) includes, at a minimum, control function keys, digital display window programming keys, and key-operated lockout capability. The time is required to be permanently displayed on the OPT and must be visible at all times. The OPT must allow the operator to perform the following minimum tasks:
    a. Inquire point status.
    b. Start or stop equipment manually.
    c. Test and reset equipment manually.
    d. Bypass system functions or features during manual system tests.
        1) Automatic extinguishing systems.
        2) Fan shut down.
        3) Central station signal transmission.
    e. Initiate control event sequences.
    f. Manually request “logs” of system status.
    g. Acknowledge status changes.
    h. Silence audible signals.
6. The PACE is required to be intelligent, with its own microprocessor and memory, and is to be UL listed independently as a fire alarm control unit.
7. The PACE is required to supervise each individual device on an Intelligent Loop circuit such that trouble, normal, alarm, and supervisory outputs are individually annunciated. Provide a minimum of 20% expansion pre-programmed per Addressable Loop.
8. The PACE is required to provide general-purpose inputs for monitoring such functions as low battery or AC power failure. The PACE will provide tamper protection and commandable outputs, which can operate relays or logic level devices.
9. The PACE is required to provide all power necessary for the devices connected to it.
10. It must be possible to command, test, alarm reset, and alarm silence from the PACE.
11. All alarm notification appliance circuits (e.g., audibles, strobes) are required to provide 25% or greater spare capacity to add future additional notification devices.
12. The PACE must be provided with a UL 864 listed printer. The printer is required to provide a hard copy record of all alarms, change of status, control by event information and emergency file English descriptions for the point in alarm, acknowledgments, and other system activity. The printer must be completely supervised by the CPU for any condition, which would prevent proper operation.

2.5 VOICE COMMAND PANEL

A. Provide a UL listed (864) audio-type paging/evacuation control panel. The control panel is to be modular in design, electrically supervised, and may be an integral part of the fire alarm control panel. The audio panel is to include, but not be limited to, the following modules and functions:

1. The paging microphone module is to provide one-way voice communication. This includes a panel-mounted, coil cord, handheld microphone with “push-to-talk” switch.
2. Preamplifiers and/or mixer control modules with separate volume level controls for alert and evacuation tone generators, three (3) channels with 30 to 100-watt amplifier(s).
3. Speaker circuit zones selector switch modules and Class B supervised speaker circuits to be activated individually or in any combination. An “all call” feature is required to be provided to allow all zones to be paged simultaneously.
4. Prerecorded voice message modules are to be capable of transmitting prerecorded messages throughout the building. The text of the message is to be of the manufacturer’s standard design and presented to the Owner, Engineer, and AHJ for approval prior to installation. The Owner may require the message in English and other languages.
5. Audio amplifiers are required to be provided centrally. The power amplifiers are to be sized to provide required speakers, plus 20 watts per floor expansion. All amplifiers must be electrically supervised and be UL listed for fire alarm signaling use.
6. Batteries for 24 hours of standby and 15 minutes of alarm are to be provided. Primary power is to be from the emergency electrical panel that is connected to the generator.

B. A dedicated audio communication control switch panel shall be provided and permit selective zone paging.

C. Tone signaling is to be capable of transmitting to the fire floor, floor above, and two floors below, elevators, stairs, and throughout the building.

2.6 REMOTE TRANSPONDER PANELS

A. Remote transponder (RT) panels are required to be provided. The cabinets are to be semi-flush mounted with a locking door or cover.

B. The RT panels must accommodate all specified alarm input points, supervisory input points, command points, and allow a 20% expansion of connected points. All assemblies within the RT panels are to be modular to allow for expansion and servicing of equipment. All power supplies, standby power, motherboards, and terminal strips are to be included to accommodate specified future expansion so that expansion can be accomplished by simple installation of circuit boards and wiring to remote devices.

C. A smoke detector is required at the RT panel.

D. Normal system power is to be provided by a 120 VAC connection at each RT location. A standby power supply is required to be provided at each RT cabinet location, which operates the system for 24 hours upon a loss of normal AC power. Emergency power is required to recharge the unit to normal capacity within 48 hours of restoration of normal power. One (1) emergency power supply unit may power more than one (1) RT cabinet if all such cabinets are at one (1) location. The loss of AC or DC power at any RT panel is required to cause a distinct “power failure” signal.

E. The RT is required to accommodate the following major components:
   1. Initiating circuit modules for Class B electrically supervised initiating circuits.
   2. Signal circuit modules for notification appliances on an electrically supervised Class B notification appliance circuit.
   3. Power supplies.

2.7 POINT ADDRESSABLE SYSTEM SOFTWARE

A. As part of the base system installation, provide all executive system software to include, but not be limited to the following:
   1. Basic alarm processing programs.
   2. Control by event programs.
   3. System point scanning routines.
   4. Password control routines.
   5. Emergency file display routines.
   6. Printer routines.
   7. Smoke detection sensitivity reports.

B. Provide as part of other system all preparation and installation of data file including, but not limited to, the following:
   1. Zone descriptions.
   2. Control by event sequences.
   3. Emergency file statements.
   4. Print statements.
   5. Password installation.

C. Point/zone descriptions are required to consist of English language statements, which adequately define the point or zone. The use of abbreviations must be limited to commonly used fire alarm system abbreviations.

D. System emergency file statements are to be assigned to individual points/zones to assist the operator response to an emergency condition. The emergency file is to consist of English language statements, which adequately define the desired action. The use of lookup tables is expressly forbidden.

2.8 ALARM INITIATING DEVICES

A. Manual fire alarm stations are to be provided where required by code. The manual fire alarm stations are to be cast metal type or Lexan red with raised or depressed lettering. Manual fire alarm stations are to be single-action. Operation of a manual fire alarm station is to cause its contacts to lock-in until manually reset and visually indicate an actuation (i.e., depressed lever, shattered glass). Each station is to be individually addressed at the central control panel. Stations that rely on wires from auxiliary contacts to the panel, do not meet this requirement.

B. Waterflow switches and valve tamper switches are required to be provided by the fire protection contractor but wired and adjusted under this section by the alarm contractor. The waterflow switches will contain a suitable, adjustable retard device; be of the vane type; and actuate upon flow from a single sprinkler. Waterflow switches will be housed in a substantial metal housing with gasketed cover. The switch will actuate within 90 seconds after the inspector's test valve is

opened. Initial setting of new waterflow switch activation is required to be 45 seconds. Addressable point monitoring devices are required to be provided to monitor waterflow switches. The wiring from the monitored device to the point-monitoring device is to be a (Style B) electrically supervised circuit. The point monitoring device is required to send an individual address to the fire alarm control panel.

C. Point addressable smoke detectors are required to be provided as required by these specifications, IBC, NFPA 72, and AHJ policy.

D. Photoelectric smoke detectors are to be provided with integral LEDs to indicate detectors in alarm. The detectors are to operate on the signaling line circuit and be listed under UL Standard 268, latest edition. Line transient and RFI protection is to be built into the detector. Concealed detectors are to have a remote indicator light or LED. There must be provisions for mounting a control relay in the base of the detector.

E. Duct-mounted smoke detectors are required to be provided with approved duct housings mounted on the exterior of the duct and have perforated sampling tubes extended across the width of the duct. Each mounted concealed detector is required to have a remote indicator light and a remote test and reset switch. Provide programmable relays for fan shutdown and control.

F. Guest room smoke detectors are to be provided as required by the IBC, NFPA 72, and the AHJ Policy. Guest room smoke detectors are to have built-in sounders. These detectors are to be powered and monitored by the fire alarm panel for a supervisory signal identifying the dwelling unit. Dwelling units having more than one smoke detector are required provide notification operation in the unit.

G. Heat detectors are to be provided, as required by the IBC, NFPA 72, and AHJ policy. The heat detectors are required to be a combination of fixed and rate-of-rise rate compensated. The heat detectors are to be self-restoring and contain an integral LED to indicate detectors in alarm.

H. CO detectors are to be provided where required by code. The CO detectors are to have built-in sounders. These detectors are to be powered and monitored by the fire alarm panel for a supervisory signal identifying the dwelling unit or location.

I. General

1. Each device is required to be field set and assigned a unique address. Devices, which take their address from their position in the circuit, are unacceptable because if devices are later added or removed, existing addresses, descriptors, and commands must be reprogrammed.
2. Additional devices must be capable of being added to the circuit from any point in the circuit and without affecting any existing device's address or function.

2.9 NOTIFICATION APPLIANCES

A. Visual alarm units are required to be provided where indicated in the specifications. The visual alarm units are to contain a strobe light source and sturdy clear lens. Standard finish is white with the word “FIRE” imprinted near a clear lens. All visual units are to operate on 24 VDC polarized power to allow for supervision. Visual unit placement is required to be in accordance with the NFPA and UL Standard 1971. All visual units are to be mounted in accordance with NFPA 72 (2007 Edition) and ADA.

B. Guest rooms for persons with hearing impairments are required to be provided with visible and audible alarm-indicating appliances, activated by both the in-room smoke detector and the building fire alarm system. Visual alarm units must also be provided for all accessible public, and common-use areas, including toilet rooms, bathing facilities, hallways, and lobbies. The visual alarm units are to contain a strobe light source and sturdy clear lens. Standard finish is white with the word “FIRE” imprinted on a clear lens. All visual units are to operate on 24 VDC polarized power to allow for supervision. Visual units are to be in accordance with the ADA and UL Standard 1971.

C. Emergency voice alarm-signaling speaker units are required to be provided where indicated in the specifications. The speakers are to be white in color, UL listed for fire alarm system use, and have multi-tap matching transformers providing individual audio power settings from ¼ watt to at least 2 watts per speaker. Mounting is to be flush in finished areas and surface in unfinished areas. Initially, speaker taps are to be set at a minimum of ½ watt for all power calculations. Sound level is required to be clearly heard 75dB at the sleeping pillow or 75 dB at 10 feet, using an A-weighted scale, from the device for evacuation alarm signaling, tone signaling and voice paging in all normally occupied areas.

D. Visual alarm units also be provided where indicated in the specifications. The visual alarm units are to contain a strobe light source and sturdy clear lens. Standard finish is white with the word “FIRE” imprinted on a clear lens. All visual units are to operate on 24 VDC polarized power to allow for supervision. Visual units are required to be in accordance with the ADA and UL Standard 1971.
   1. Water and moisture sealed.
   2. Metal housing.
   3. Multi-tap selection.
   4. Screw terminals for in-out wiring.
   5. The color of the unit is required to be white.

2.10 CONTROL DEVICES

A. Provide control relays/contacts for fire alarm system equipment sequencing where indicated. The control relays/contacts are to be 24-volt DC low voltage type, each with number of contacts as required and housed in metal enclosure. The contacts are to be rated as required for continuous duty.

B. Power supplies used for operation of control relays, contacts, step-down relays or similar applications are required to be supervised by the fire alarm system for trouble conditions.

C. Addressable point control devices are to be used to provide all required control functions. Control relays connected to unsupervised circuits are to be located within 3 feet of the controlled device.

2.11 REMOTE ANNUNCIATORS

A. The remote liquid crystal display (LCD) annunciator is required to include, at a minimum, control function keys, digital display window, programming keys and key-operated lockout capability. The time is to be permanently displayed on the LCD and visible at all times. The LCD is to be supervised by the network controller, backlit, and display a minimum of two (2) lines with 80 alphanumeric characters. The LCD annunciator is to be equipped with an internal sounder that

may silence locally. A remote annunciator is required to be located in the hotel lobby at the front desk.

PART 3 - EXECUTION

3.1 SYSTEM OPERATION

A. The addressable fire alarm and supervisory system is to perform the following functions:
   1. Continuous monitoring of the status of all fire alarm and supervisory signal initiating devices.
   2. Continuous monitoring of all electrically supervised fire alarm initiating, supervisory and notification appliance circuits.
   3. Continuous monitoring of all addressable modules.
   4. Operation of elevator controls as required.
   5. Operation of all audible and visual signals as indicated.
   6. Operation of the smoke control system as indicated.
   7. Operation of all required HVAC controls as indicated.
   8. Operation of all magnetic door holders.
   9. Transmission of a common alarm, trouble, and supervisory signal to the UL listed central station.

B. Upon change in status of any device on the system, the CPU is required to:
   1. Activate audible and visual status change indicators and display the system point number, point description, and message associated with the point on the system's operator terminal.
   2. Permanently record the change in status, time, date, point description, and message associated with the point on the printer.

C. Activation of any manual fire alarm station, waterflow switch, smoke detector, suppression system, supervisory valve or other fire alarm initiating device is required to cause the following functions to occur:
   1. Activate audible and visible status change indicators and display the system point number, point description, and message associated with the point on the system's operator terminal, and remote annunciator.
   2. Permanently record the change in status, time, date, point description, and message associated with the point on the printer.
   3. Activate the audible and visible notification appliances and transmit a pre-recorded message throughout the zone of alarm as required by the life safety report.
   4. Activate the smoke control system, HVAC system fans, dampers, and other mechanical equipment.
   5. Release all doors normally held open by door-control devices.
   6. Transmit a fire alarm signal to the approved central station.

D. Activation of any duct smoke detector, sprinkler supervisory valve, or other fire alarm supervisory device is required to cause the following functions to occur:

1. Activate audible and visible status change indicators and display the system point number, point description, and message associated with the point on the system's operator terminal, and at a remote annunciator located in the mechanical office.
2. Permanently record the change in status, time, date, point description, and message associated with the point on the printer.
3. Transmit a supervisory alarm signal to the approved central station.

E. Removal of any devices, wiring disarrangement, or system component failure is required to display on the operator's terminal, the change of status, time, date, point description on a point by point basis, and the message associated with the point and transmit a trouble signal to the fire alarm control panel.

F. When any point in the system returns to normal, the CPU is required to:
1. Activate audible and visual indicators and display point identification, time, date and message.
a. Acknowledgment of "system return to normal" will display the time, date, point identification and message. The acknowledgment will also silence all audible indicators associated with the point at the CPU.

3.2 SYSTEM INSTALLATION

A. The Equipment Manufacturer is required to furnish on-the-job supervision for the proper installation of devices in cooperation with, or as may be required by, other trades. This supervision includes the following:
1. Specific on-site instructions to others on mounting and installation of each type of device by physically observing the mounting of one (1) or more of each type of device, as required, to assure that the installer is properly instructed in the work.
2. Supervision as required by others to properly perform alarm installation work.
3. A complete test of the system, certifying that all devices have been activated and that the devices and systems have performed in accordance with the requirements of this specification.
4. Install, test, troubleshoot, and correct all system software provided under this specification. This includes, but is not limited to, actual keyboard entry, reprogramming required to meet this specification, and any other tasks associated with the system software.
5. Attend other related testing, including fire alarm system, fire pump, fire sprinkler system, etc. which involves the operation of the fire alarm control panel.

B. All work is required to be installed or relocated as indicated and in accordance with the manufacturer, unless otherwise specified.
1. Control Panel
a. The control panel and its components are required to be mounted so that no part of the enclosing cabinet is less than 12 inches or more than 78 inches above the finished floor. All manually operable controls are to be at least three (3) feet and less than five (5) feet above the finished floor. The panel is required to be installed to comply with the requirements of UL 864.
2. Smoke Detectors
a. Smoke Detectors are to be mounted on the ceiling not less than 4 inches from the side wall to the near edge, or if side wall, between 4 inches and 12 inches down from the ceiling to the top of the detector.

b. Smoke Detectors are to be located at least three (3) feet from diffusers of air handling systems. Installation of smoke detector heads must not occur during construction. Devices mounted during construction are required to be replaced at the contractors' expense.

3. CO Detectors
   a. CO Detectors are to be mounted centrally in any room or areas containing fuel-burning appliances. The detector is to be installed on the ceiling not less than 4 inches from the side wall to the near edge, or if side wall, between 4 inches and 12 inches down from the ceiling to the top of the detector.
4. Duct Smoke Detectors
   a. Duct-mounted smoke detectors are required to be provided with approved duct housings mounted on the exterior of the duct, and have perforated sampling tubes extended across the width of the duct. Each mounted concealed detector is to have a remote indicator light and a remote test and reset switch. Provide programmable relays for fan shutdown and control. Installation of smoke detector heads must not occur during construction. Devices mounted during construction are required to be replaced at the contractors' expense.
5. Manual Fire Alarm Station
   a. The manual fire alarm stations are required to be mounted at 48 inches at the pull handle above the finished floor.
6. Wall Mounted Visual Signal Appliances
   a. Visual signal appliances be wall mounted at 80 inches above the finished floor or 6 inches below the ceiling, whichever is lower. For purposes of installation, the bottom of the visual portion or lens of the fixture is to be used for mounting reference.
7. Ceiling Mounted Visual Signal Appliances
   a. Visual signal appliances are to be mounted on ceilings at 10 feet or less above the finished floor. The effective intensity of visual signal appliances ceiling mounted between 10 and 30 feet above the finished floor are required to be reduced to comply with NFPA 72. Visual signal appliances must not be ceiling mounted to exceed 30 feet above the finished floor. For purposes of installation, the bottom of the visual portion or lens of the fixture is to be used for mounting reference.
8. Wall Mounted Audible Signal Appliances
   a. Where ceiling heights permit, wall-mounted appliances are to have their tops at 90 inches above the finished floor or 6 inches below the ceiling.
9. Combination Wall Mounted Audible and Visual Signal Appliances
   a. The location of audible/visual signal appliances is to comply with visual signal appliance mounting requirements. Unless otherwise noted, all notification appliances are to be ceiling mounted.
   b. At all locations, notification appliances are to be placed symmetrical to existing lighting fixtures, sprinkler heads, and exit signs.

C. Contractor is to furnish all material and labor to provide a complete and functional system, which operates in accordance with the requirements of this specification. This includes the following:
1. Conduit, raceway and wiring systems as indicated herein, and throughout the specifications, and shown in the specifications.
   a. All wiring is to be appropriately color-coded, and permanent wire markers are to be used to identify the terminations for each circuit at the control panel.

b. Strap or bundle all cables and wires inside equipment enclosures and terminal cabinets, parallel to the enclosure sides.

c. Splices are to be kept at a minimum. Splices are to be made in outlet boxes, junction boxes, and pull boxes. All fire alarm electrical box covers are to be red with white letters “FA.”

d. All penetrations in walls are required to be filled with UL fire-stopping material capable of maintaining the fire-resistance of the fire barriers.

e. All ceiling tiles damaged during construction must be replaced to match existing.

f. Painting of all exposed conduit, raceway, access panels, etc., and repairing or patching surfaces to match existing finish.

g. All coring and sleeving required. Core drilling is required to be performed by qualified personnel to minimize damage. All rebar is to be located before drilling. The Contractor is to repair any damage that occurs because of core drilling.

D. Pay for and obtain all permits, approvals, fees, and charges required for this work.

3.3 TEST/FIELD QUALITY CONTROL

A. The final alarm acceptance test is to be coordinated with the Owner and the Engineer. A letter certifying that the installation is complete and fully operational is required to be forwarded to the Owner and the Engineer.

B. The Contractor, the Engineer, and an authorized representative from each supplier of equipment are required to attend the final acceptance test to make necessary adjustments. The final test includes, but is not limited to:

1. A test of the complete system for grounded, open, and shorted circuits.
2. A test of each alarm-initiating device for functions specified and for the required alarm actions.
3. A test of the system for electrical supervision.
4. A test to verify that the emergency power source is capable of operating the system for specified periods.
5. A test to verify that alarm signals will operate under specified trouble conditions.
6. A test to verify that the system will operate under specified trouble conditions.
7. A test to verify that the system will perform all specified tasks.
8. A test to verify that all required system actions function properly.

C. A minimum of ten (10) days will be required for these tests. Tests will comply with NFPA 72 and the IBC. A written document will be required as proof of compliance.

D. If the system requires a retest by the Engineer, all costs for the retest are the responsibility of the Contractor.

E. The Contractor is required to pay all overtime pay required by the Authority Having Jurisdiction for witnessing the acceptance test.

F. Contractor shall be present at other related tests, including but not limited to, automatic sprinkler and fire alarm system.

3.4 TRAINING

A. Provide training of Owner's personnel in the proper operation procedures. The training program for the Owner's personnel includes the following:

1. Operations and Maintenance Manuals in binder, containing complete operating instructions, outlining step-by-step procedures required for system start up, operation, and shut down, including the manufacturer's name, model number, service manual, parts lists, and brief description of all equipment and their basic operation features. Complete maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, trouble-shooting guide, and as-built drawings (11x17) sheets of the complete system, including wiring layout, equipment layout, device labels, and simplified wiring and control diagrams of system. Six (6) Operations and Maintenance Manuals are to be submitted and approved prior to conducting the training course.
2. Two (2) 4-hour training sessions for operating personnel. The sessions are to cover proper operating and response procedures. These instructions are to be sufficient to enable an untrained person to properly operate the system.
3. Provide software manuals containing listings of all points, event programs, basic programming and instructions, and software troubleshooting information.

3.5 AS-BUILT DRAWINGS

A. Before acceptance of work and final completion, the record set of prints is to be used to prepare "As-Built" drawings in AutoCAD, reflecting any and all changes and deviations made to the fire alarm system. The drawings are required to indicate, at a minimum, the following:

1. As-built physical routing of wires to devices, including junction box locations.
2. As-built riser diagram showing the zoning of signaling line circuits and notification circuits.
3. As-built panel wiring diagrams of the fire alarm control panel(s).
4. Floor plan showing each alarm-initiating device, notification appliance, control and monitoring point with their respective address identification number (i.e., an address of (5-24) for the 24th device on the addressable circuit 5).

B. Upon completion of the work, two (2) sets of blueline record drawings are required to be submitted to the Engineer for review.

C. Upon the Engineer's review and acceptance of the record drawings, and before final approval, one (1) set of record drawings, one (1) copy on CD, and three (3) additional sets of blueline record drawings are required to be delivered to the Engineer.

D. Provide a complete set of "as-built" data sheets for all equipment connected to the system.

E. Provide an address list showing, for each device, the address, device type, location, and field custom message.

F. Provide a copy (on disk) of the software used to program the system.

G. Provide a hard copy printout showing the programmable options and how each option is implemented in the system.

H. Provide a completed test form that complies with NFPA 72 and NFPA 720, signed and dated by the fire alarm system manufacturer or his agent.

I. Provide NFPA 72 and NFPA 720 completion certificate, signed by the Authority Having Jurisdiction.

J. All items of this section are required to be provided prior to final payment request.

3.6 SPARE PARTS

A. All spare parts shall be directly interchangeable with the corresponding components of the installed systems.

B. Contractor is required to furnish a listing, in duplicate, of all spare parts and accessories, which the manufacturer recommends to be stocked for proper maintenance of system.

3.7 SERVICE CONTRACT

A. A separate test and inspection type service proposal is required to be submitted at the time the installation cost proposal is presented. The service contract is required to include the following:
   1. Performance of a test and inspection of the fire alarm system annually during which the Contractor is required to:
      a. Test the operation of each waterflow alarm device in the alarm system by opening the inspector's test valve, test alarm and trouble transmitters, and visually inspect each device as it is tested.
      b. Test the operation of each supervisory valve switch by opening the valve and verifying the receipt of a signal within the first two (2) revolutions of the hand wheel or within one-fifth of the travel distance, and visually inspect each device as it is tested.
      c. Remove any dirt or dust and make any minor adjustments or calibrations, which are apparent from inspection or testing of the device.
   2. Perform a semi-annual test of the entire smoke detection system and manual fire alarm system.
   3. Emergency service, including all parts and labor, during the guarantee period is to be included in the system purchase price.

B. Service Definitions
   1. Emergency Services: Emergency service is a special request for assistance from the Owner, which necessitates a special trip or labor. A request to advance a regularly scheduled test and inspection trip is not emergency service.
   2. Quoted Rates: Quoted rates refer to the labor rates quoted on the bid form or to adjusted rates, which are required to be supplied to the Owner at the beginning of each new contract term. In absence of this contract, the rates are to be the Contractor's currently published billing rates.

C. A written test and inspection report is to be submitted to the Owner at completion of every periodic system test and inspection visit.

3.8 SAFETY

A. All work is required to be performed in compliance with the Occupational Safety and Health Act of 1970 and the Construction Safety Act Standards.

B. Contractor is required to attend all job safety meetings.

- END OF SECTION -

DIVISION 31 – EARTHWORK

TABLE OF CONTENTS

- SECTION 31 0200 -

GENERAL PROVISIONS FOR EARTHWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Extent of Civil earthwork development work is shown on Drawings and in schedules, typically.
   1. The work includes, but is not limited to:
      a. Site Clearing
         1) Refer to Civil Drawings.
         2) Protecting existing vegetation to remain.
         3) Removing existing vegetation.
         4) Clearing and grubbing.
         5) Stripping and stockpiling topsoil.
         6) Removing above- and below-grade site improvements.
         7) Disconnecting, capping or sealing, and removing site utilities.
         8) Erosion Control
         9) Storm Water Protection
         10) Disconnecting, capping or sealing, and abandoning site utilities in place.
            a) Refer also to Civil Drawings.
      b. Earth Moving
         1) As indicated in Civil and/or landscape Drawings for, but not limited to;
            a) Preparing subgrades for slabs-on-grade, walks, pavements, turf and grasses and plants as indicated on Civil and landscape Drawings.
            b) Excavating and backfilling for buildings and structures.
            c) Drainage course for concrete slabs-on-grade.
            d) Subbase course for concrete walks and pavements.
            e) Subbase course and base course for asphalt paving.
            f) Subsurface drainage backfill for walls and trenches.
            g) Excavating and backfilling trenches for utilities and pits for buried utility structures.
         2) Grading
         3) Excavation

4) Fill
5) Soil Treatment
6) Trenching and Backfilling

c. Dewatering

B. Specifications and/or information in Civil Drawings shall govern over these specifications.

1.3 RELATED REQUIREMENTS

A. Section 01 5000 "Temporary Facilities and Controls" for temporary utility services, construction and support facilities, security and protection facilities**,** and temporary erosion- and sedimentation-control measures.

B. Section 01 7300 "Execution" for field engineering and surveying.

C. Division 01 Section pertaining to construction site cleaning.

D. Section 02 3200 “Subsurface Investigation”.

E. Section 02 4116 “Structure Demolition”.

F. Section 31 3116 “Termite Control”.

G. Section 32 0200 “General Provisions for Exterior Improvements”.

H. Section 32 1316 “Decorative Cement Concrete Paving” for integral colored site concrete including, but not limited to concrete bands between brick paving.

I. Section 33 0200 “General Provisions for Utilities”

1.4 REFERENCES

A. “Phoenix Building Construction Code”, International Building Code 2006, with City of Phoenix administrative provisions and amendments.

B. American Society for Testing and Materials (ASTM)

C. American National Standards Institute (ANSI)

D. Standard Specifications for Public Works Construction, latest edition for applicable jurisdiction/agency

E. Department of Transportation, latest publications for applicable jurisdiction/agency

F. Geotechnical Report, refer to Section 02 3200 “Subsurface Investigation”

G. Uniform Standard Specifications for Public Works Construction, Sponsored and Distributed by the Maricopa Association of Governments, 2013 Revision to the 2012 Edition, Arizona (MAG)

1.5 DEFINITIONS

A. Refer to Civil Drawings.

1.6 SUBMITTALS

A. General: Submit in accordance with Section 01 3300.

B. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

C. Product Data: For each type of the following manufactured products required:
   1. Materials specific to scope of work.

D. Samples for Verification: For the following products, in sizes indicated below:
   1. Materials specific to scope of work.

E. Shop Drawings: For the following products, in sizes indicated below:
   1. Dewatering plans, sections, elevations, etc.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:
   1. Classification
   2. Laboratory compaction curve

C. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by Earth Moving operations.
   1. Submit before Earth Moving begins.

D. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
   1. Use sufficiently detailed photographs or videotape.
   2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

E. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.8 MATERIAL OWNERSHIP

A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.
   1. Refer to Civil Drawings.

1.9 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

B. Pre-excavation Conference: Conduct conference at Project site

1.10 DELIVERY, STORAGE AND HANDLING

A. Refer to Civil Drawings.

1.11 PROTECTION

A. The contractor shall notify UNDERGROUND SERVICE ALERT (USA) at 1-800-227-2600 at least two days prior to starting work and shall coordinate all work with utility company representatives.
   1. Refer to Civil Drawings.

B. **Shoring**: Obtain required permits prior to commencing certain types of hazardous activity, as specified in applicable standards for the project.
   1. Refer to Civil Drawings.

C. **Potholing:** Prior to commencing the work, the Contractor shall pothole all existing utilities at all crossing points and points of connection.
   1. Refer to Civil Drawings.

D. **Dewatering**: Provide for the disposal of surface and subsurface water, which may accumulate in open excavations, unfinished fills, or other low areas.
   1. Refer to Civil Drawings.

E. **Utilities**:
   1. Refer to Section 33 0200 “General Provisions for Utilities”

F. **Slopes:** Repair and reestablish damaged or eroded slopes, elevations or grades and restore surface construction prior to acceptance.
   1. Refer to Civil Drawings.

G. Stormwater Management Plan (SWMP): Project is required to be permitted by the City of Phoenix in accordance with Phoenix City Code for Discharges of Storm Water Runoff which includes a SWMP and a Grading and Drainage Checklist which shall be prepared for the site.
   1. Refer to Civil Drawings.

1.12 PROJECT CONDITIONS

A. Utilities:
   1. Refer to Civil Drawings.
   2. Refer to specific documents herein referenced, including but not limited to; Uniform Standard Specifications for Public Works Construction.
   3. Refer to Section 33 0200 “General Provisions for Utilities”.

B. Excavation:
   1. Refer to Civil Drawings.
   2. Refer to specific documents herein referenced, including but not limited to; Uniform Standard Specifications for Public Works Construction.

C. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during Earth Moving operations.
   1. Refer to Civil Drawings.
   2. Refer to Section 01 5526 “Traffic Regulation”
   3. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   4. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

D. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
   1. Refer to Civil Drawings.

E. Utility Locator Service: Notify applicable utility locator service for area where Project is located before site clearing.

F. Do not commence site clearing operations until temporary erosion- and sedimentation-control measures are in place.
   1. Refer to Civil Drawings.

G. Protection zones as/ when indicated in Drawings
   1. The following practices are prohibited within protection zones:
      a. Storage of construction materials, debris, or excavated material.
      b. Parking vehicles or equipment.
      c. Foot traffic.
      d. Erection of sheds or structures.
      e. Impoundment of water.
      f. Excavation or other digging unless otherwise indicated.
      g. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
   2. Do not direct vehicle or equipment exhaust towards protection zones.
   3. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

H. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

I. After determining location of underground utilities, perform work in a manner which will avoid possible damage.
   1. Hand excavate, as required.

1.13 SAFETY DURING CONSTRUCTION

A. The Contractor shall assume complete and sole responsibility for all job site conditions during the course of project construction, including but not limited to; safety of all persons and property.
   1. This requirement shall be established to apply continuously and not be limited to normal working hours.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Refer to Civil Drawings

2.2 MATERIALS

A. Refer to Civil Drawings.

B. Refer to specific documents herein referenced, including but not limited to; Uniform Standard Specifications for Public Works Construction.

2.3 DEWATERING PERFORMANCE REQUIREMENTS

A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.
   1. Refer to Civil Drawings.

B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning dewatering. Comply with water- and debris-disposal regulations of authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas within scope of work for compliance with requirements and conditions affecting installation and performance.

3.2 PREPARATION

A. Refer to Civil Drawings.

B. Refer to specific documents herein referenced, including but not limited to; Uniform Standard Specifications for Public Works Construction.

C. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by Earth Moving operations, dewatering, etc.

D. Protect and maintain erosion and sedimentation controls during Earth Moving operations.

E. Protect subgrades and foundation soils from freezing temperatures and frost.
   1. Remove temporary protection before placing subsequent materials.

F. Protect and maintain benchmarks and survey control points from disturbance during construction.

G. Protect existing site improvements to remain from damage during construction.
   1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.3 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Refer to Civil Drawings.

B. Refer to Division 01 sections specifying Temporary Facilities and Controls.

3.4 EXISTING UTILITIES

A. Refer to Civil Drawings.

B. Refer to specific documents herein referenced, including but not limited to; Uniform Standard Specifications for Public Works Construction.

C. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place as indicated in Civil Drawings.
   1. Arrange with utility companies to shut off indicated utilities.

D. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Architect and Owner in accordance with Civil Drawings and division 1 in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Architect's written permission.

E. Excavate for and remove underground utilities indicated to be removed.

F. Removal of underground utilities shall be coordinated with Civil Drawings and also with, but not limited to;

1. Applicable fire suppression, plumbing, HVAC, electrical, communications, electronic safety and security and utilities sections.
2. Section 02 4116 "Structure Demolition"

3.5 CLEARING AND GRUBBING

A. Refer to Civil Drawings.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to depth indicated on Drawings in a manner to prevent intermingling with underlying subsoil or other waste materials.
   1. Refer to Civil Drawings

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
   1. Refer to Civil Drawings

3.7 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.
   1. Refer to Civil Drawings.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
   1. Refer to Civil Drawings.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

B. Separate recyclable materials produced during site clearing from other nonrecyclable materials.
   1. Store or stockpile without intermixing with other materials and transport them to recycling facilities.
   2. Do not interfere with other Project work.
   3. Refer to Section 01 7400 "Cleaning And Waste Management

3.9 DEWATERING Refer to Civil Drawings.

B. Refer to specific documents herein referenced, including but not limited to; Uniform Standard Specifications for Public Works Construction.

C. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

D. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

3.10 EXCAVATION, GENERAL

A. Refer to Civil Drawings.

B. Refer to specific documents herein referenced, including but not limited to; Uniform Standard Specifications for Public Works Construction.

C. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered.
1. Refer to Civil Drawings.

D. Classified Excavation: Excavate to subgrade elevations.
1. Refer to Civil Drawings.

3.11 PREPARATION

A. Final Grades
1. Refer to landscape and Civil Drawings

3.12 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 -inch (25 mm). unless required otherwise by;
1. Refer to Civil Drawings.

3.13 EXCAVATION FOR WALKS AND PAVEMENTS

A. Refer to Civil Drawings.

B. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.14 EXCAVATION FOR UTILITY TRENCHES

A. Refer to Civil Drawings.

B. Refer to Section 33 0200 “General Provisions for Utilities”.

3.15 EXCAVATION FOR ELEVATOR CYLINDER

A. Drill well hole plumb in elevator pit to accommodate installation of elevator-cylinder assembly. Coordinate with applicable requirements for diameter and tolerances in;
   1. Division 14 for Hydraulic Elevators.

3.16 SUBGRADE INSPECTION

A. Refer to Civil Drawings.

B. Refer to specific documents herein referenced, including but not limited to; Uniform Standard Specifications for Public Works Construction.

C. Notify Architect, Civil and Geotechnical engineer when excavations have reached required subgrade.

D. If Architect and/or engineers determine that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

3.17 UNAUTHORIZED EXCAVATION

A. Refer to Civil Drawings.

B. Refer to specific documents herein referenced, including but not limited to; Uniform Standard Specifications for Public Works Construction.

3.18 STORAGE OF SOIL MATERIALS

A. Refer to Civil Drawings.

B. Refer to specific documents herein referenced, including but not limited to; Uniform Standard Specifications for Public Works Construction.

C. Stockpile borrowed soil materials and excavated satisfactory soil materials without intermixing.
   1. Refer to Civil Drawings.
   2. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   3. Stockpile soil materials away from edge of excavations.
      a. Do not store within drip line of remaining trees.

3.19 BACKFILL

A. Place and compact backfill in excavations promptly in accordance with Civil Drawings and herein listed Reference documents for ‘Public Works Construction’ (MAG), including, but limited to the following:

1. Refer to Civil Drawings.

3.20 UTILITY TRENCH BACKFILL

A. Refer to Civil Drawings.

B. Refer to specific documents herein referenced, including but not limited to; Uniform Standard Specifications for Public Works Construction.

3.21 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
   1. Refer to Civil Drawings.
   2. Refer to specific documents herein referenced, including but not limited to; Uniform Standard Specifications for Public Works Construction.

B. Place and compact fill material in layers to required elevations as indicated in Drawings.

3.22 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within percentage of optimum moisture content in accordance with;
   1. Civil Drawings.
   2. Refer to specific documents herein referenced, including but not limited to; Uniform Standard Specifications for Public Works Construction.

3.23 GRADING

A. Refer to Civil Drawings.

B. Refer to specific documents herein referenced, including but not limited to; Uniform Standard Specifications for Public Works Construction.

3.24 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers in accordance with;
   1. Civil Drawings.
   2. Refer to specific documents herein referenced, including but not limited to; Uniform Standard Specifications for Public Works Construction.

3.25 SUBSURFACE DRAINAGE

A. Subdrainage Pipe.
   1. Refer to Civil Drawings.

2. Refer to specific documents herein referenced, including but not limited to; Uniform Standard Specifications for Public Works Construction.

3.26 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Refer to Civil Drawings.

B. Refer to specific documents herein referenced, including but not limited to; Uniform Standard Specifications for Public Works Construction.

3.27 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

A. Refer to Civil Drawings.

B. Refer to specific documents herein referenced, including but not limited to; Uniform Standard Specifications for Public Works Construction.

3.28 FIELD QUALITY CONTROL

A. Special Inspections: Coordinate with Special Inspector retained by Owner. .

B. Testing: Coordinate with qualified geotechnical engineering testing agency the Owner. will to perform test and inspections:

3.29 PROTECTION

A. Refer to Civil Drawings.

B. Refer to specific documents herein referenced, including but not limited to; Uniform Standard Specifications for Public Works Construction.

C. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion.
   1. Keep free of trash and debris.

3.30 CLEANUP

A. During Civil work, keep work area in an orderly condition. Haul away and remove all debris from areas.

- END OF SECTION -

- SECTION 31 3116 -

TERMITE CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Soil treatment with Termiticide.
   2. Wood framing & sheathing treatment with Termiticide.

1.3 RELATED SECTIONS

A. Pertinent Sections specifying Volatile Organic Compound (VOC) Content Restrictions.

B. Section 01 6116 “Volatile Organic Compound (VOC) Restriction”

C. Pertinent Sections specifying sealants or referencing this Section for sealant products and Execution Requirements.

D. Section 03 3000 “Cast-In-Place Concrete”

E. Civil Drawings.

F. Division 31 Earthwork sections.

1.4 REFERENCES

A. “Phoenix Building Construction Code”, International Building Code 2006, with City of Phoenix administrative provisions and amendments.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of termite control product.
   1. Include the EPA-Registered Label for Termiticide products.

B. VOC Submittals:

1. Product Data for VOC Compliance, Section 01 6116; Environmental Friendly, Nontoxic Pest Control product.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Product Certificates: For termite control products, from manufacturer.

C. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's records and include the following:
1. Date and time of application.
2. Moisture content of soil before application.
3. Termiticide brand name and manufacturer.
4. Quantity of undiluted termiticide used.
5. Dilutions, methods, volumes used, and rates of application.
6. Areas of application.
7. Water source for application.

1.7 CLOSEOUT SUBMITTALS:

A. Submit under provisions of Section 01 7700.

B. Warranty: Submit specified warranty.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located, and who employs workers trained and approved by manufacturer to install manufacturer's products, and who is accredited by manufacturer.

B. Regulatory Requirements: Formulate and apply Termiticides and Termiticide devices according to the EPA-Registered Label.

C. Source Limitations: Obtain termite control products from single source from single manufacturer.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.

B. Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.

1.10 WARRANTY

A. Soil Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work, consisting of applied soil Termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.

1. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Limits for adhesives sealants, fillers and primers. Comply with limits specified in Section 01 6116 “Volatile Organic Compound (VOC) Restrictions” for Environmental Friendly, Nontoxic Pest Control product.

2.2 SOIL TREATMENT

A. Termiticide: Provide an EPA-Registered Termiticide, complying with requirements of authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation. Provide quantity required for application at the label volume and rate for the maximum Termiticide concentration allowed for each specific use, according to product's EPA-Registered Label.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. BASF Corporation, TERMIDOR; **Termidor Dry** product, www.termidorhome.com
   b. Bayer Environmental Science, Backer by BAYER; **Premise 75 WP, http://www.backedbybayer.com/pest-management/termiticides/premise-75-wp**
   c. FMC Corporation, Agricultural Products Group; **Prevail FT Termiticide**, www.fmcapg.com
   d. Syngenta; **Demon Max Termiticide**, www.syngentapmp.com, www.impasse.com **(Active ingredianet; Cypermethrin – EPA Registration# 100-1218) Nick Grisafe, 909.353-5907)**
   f. Nisus Corporation, **BORA-CARE Commercial Termiticide**
2. Service Life of Treatment: Soil treatment Termiticide that is effective for not less than five years against infestation of subterranean termites.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per Termiticide label requirements, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.

B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's written instructions for preparation before beginning application of termite control treatment. Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.

B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by Termiticide manufacturer.

1. Fit filling hose connected to water source at the site with a backflow preventer, complying with requirements of authorities having jurisdiction.

3.3 APPLICATION, GENERAL

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EPA-Registered Label for products.

3.4 APPLYING SOIL TREATMENT

A. Application: Mix soil treatment Termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of Termiticide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute treatment evenly.

1. Slabs-on-Grade and Basement Slabs: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment.
   a. Treat soil materials before concrete footings and slabs are placed.
2. Foundations: Adjacent soil, including soil along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing.
   a. Avoid soil washout around footings.
3. Crawlspaces: Soil under and adjacent to foundations as previously indicated.
   a. Treat adjacent areas including around entrance platform, porches, and equipment bases.
   b. Apply overall treatment only where attached concrete platform and porches are on fill or ground.
4. Masonry: Treat voids.
5. Penetrations: At expansion joints, control joints, and areas where slabs will be penetrated.

B. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.

C. Protect Termiticide solution, dispersed in treated soils and fills, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.

D. Post warning signs in areas of application.

E. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

- END OF SECTION -

DIVISION 32 – EXTERIOR IMPROVEMENTS

TABLE OF CONTENTS

Pages

- SECTION 32 0200 -

GENERAL PROVISIONS FOR EXTERIOR IMPROVEMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Extent of exterior improvement work is shown on drawings and in schedules, typically.
   1. The work includes, but is not limited to:
      a. Asphalt paving.
      b. Aggregate base courses.
      c. Concrete paving
      d. Curbs, gutters, sidewalks and driveways.
      e. Landscape soil preparation.
      f. Landscape planting.
      g. Landscape irrigation.
      h. Landscape maintenance.
      i. Other work indicated.
      j. Precast concrete unit paving.

B. Specifications and/or information in Civil Drawings shall govern over these specifications.

1.3 RELATED REQUIREMENTS

A. Refer to Civil Drawings.

B. Refer to Landscape Drawings.

C. Division 01 Section pertaining to construction site cleaning.

D. Section 01 4000 “Quality Requirements”.

E. Section 01 5000 "Temporary Facilities and Controls" for temporary utility services, construction and support facilities, security and protection facilities, and temporary erosion- and sedimentation-control measures.

F. Section 01 7300 "Execution" for field engineering and surveying.

G. Section 02 3200 “Subsurface Investigation”.

H. Section 02 4116 “Structure Demolition”.

I. Section 03 3000 “Cast-In-Place Concrete”.

J. Section 31 0200 “General Provisions for Earthwork”.

K. Section 31 3116 “Termite Control”.

L. Section 32 1316 “Decorative Cement Concrete Paving” for integral colored site concrete including, but not limited to concrete bands between brick paving.

M. Section 32 1373 “Concrete Paving Joint Sealants”.

N. Section 33 0200 “General Provisions for Utilities”.

1.4 REFERENCES

A. “Phoenix Building Construction Code”, International Building Code 2006, with City of Phoenix administrative provisions and amendments.

B. American Society for Testing and Materials (ASTM).

C. American National Standards Institute (ANSI).

D. American Association of Nurserymen, Inc. (AAN).
   1. American Standard for Nursery Stock, latest edition (ANSI).

E. Standard Specifications for Public Works Construction, latest edition for applicable jurisdiction/agency.

F. Department of Transportation, latest publications for applicable jurisdiction/agency.

G. Geotechnical Report, refer to Section 02 3200 “Subsurface Investigation”.

H. Uniform Standard Specifications for Public Works Construction, Sponsored and Distributed by the Maricopa Association of Governments, 2013 Revision to the 2012 Edition, Arizona (MAG).

1.5 DEFINITIONS

A. Refer to Civil Drawings.

B. Refer to Landscape Drawings.

C. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.6 SUBMITTALS

A. General: Submit in accordance with Section 01 3300.

B. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

C. Product Data: For each type of the following manufactured products required:
1. Materials specific to scope of work.
2. Plants specific to scope of work.
3. Technical data and tested physical and performance properties.
4. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
5. Formwork
6. Steel reinforcing for concrete paving.
7. Concrete unit pavers.

D. Samples for Verification: For the following products, in sizes indicated below:
1. Materials specific to scope of work.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data:
1. For qualified testing agency.
2. For ready-mix concrete manufacturer.

B. Material Certificates: For each paving material.
1. Asphalt mix design(s).
2. Cementitious materials.
3. Steel reinforcement and reinforcement accessories.

C. Material Test Reports:
1. For each paving material, by a qualified testing agency.
2. Concrete paving aggregates.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications:
1. Asphalt paving-mix registered with and approved by authorities having jurisdiction or the DOT of state in which Project is located.
2. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

B. Testing Agency Qualifications:
   1. Asphalt work: Qualified according to ASTM D 3666 for testing indicated unless indicated otherwise in civil drawings.
   2. Concrete paving: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated unless indicated otherwise in Civil Drawings.

C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of applicable standards of local DOT and/or agency having jurisdiction for asphalt paving work.
   1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.
   2. Refer to Civil Drawings.
   3. Refer to referenced documents herein specified.

D. Concrete paving:
   1. ACI Publications: Comply with ACI 301 (ACI 301M) unless otherwise indicated.
   2. Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

E. Preinstallation Conference: Conduct conference at Project site.
   1. Asphalt Paving:
      a. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:
         1) Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
         2) Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
      b. Require representatives of each entity directly concerned with asphalt paving to attend, including the following:
         1) Contractor's superintendent.
         2) Asphalt paving subcontractor.
   2. Concrete paving:
      a. Review methods and procedures related to concrete paving, including but not limited to, the following:
         1) Concrete mixture design.
         2) Quality control of concrete materials and concrete paving construction practices.
   3. Concrete Unit Pavers:
      a. Review methods and procedures related to concrete paving, including but not limited to, the following:
         1) Sub base preparation.
         2) Transitions.
      b. Require representatives of each entity directly concerned with concrete paving to attend, including the following:
         1) Contractor's superintendent.
         2) Ready-mix concrete manufacturer.
         3) Concrete paving subcontractor.

1.9 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements of Section 01 6000.

B. Refer to Drawings

1.10 PROTECTION

A. Protection: After final rolling of asphalt, do not permit vehicular traffic on pavement until it has cooled and hardened.

1.11 PROJECT CONDITIONS

A. Asphalt:
   1. Refer to Civil Drawings.
   2. Refer to specific documents herein referenced, including but not limited to; Uniform Standard Specifications for Public Works Construction.
   3. Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

B. Concrete Paving:
   1. Refer to Civil Drawings.
   2. Refer to Landscape Drawings.
   3. Refer to specific documents herein referenced, including but not limited to; Uniform Standard Specifications for Public Works Construction.
   4. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
   5. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature in accordance with Pavement Marking specification.

C. Concrete Unit Pavers:
   1. Refer to Landscape Drawings.

D. Landscaping:
   1. Refer to Landscape Drawings.
   2. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed without having detrimental effects on the plant material, or finished product.
   3. When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify the Architect before planting. Remove all material deemed unsuitable for plant growth as directed by the Architect.
   4. No landscape materials may be planted before an irrigation operation and coverage test is completed and approved by the Architect.
   5. No landscape materials may be planted before finish grade is inspected and approved by the Architect.

1.12 SAFETY DURING CONSTRUCTION

A. The Contractor shall assume complete and sole responsibility for all job site conditions during the course of project construction, including but not limited to; safety of all persons and property.
   1. This requirement shall be established to apply continuously and not be limited to normal working hours.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Refer to Drawings.

2.2 MATERIALS

A. Refer to Drawings.

B. Refer to specific documents herein referenced, including but not limited to; Uniform Standard Specifications for Public Works Construction.

2.3 FORMS – CONCRETE PAVING

A. Refer to Drawings.

2.4 STEEL REINFORCEMENT – CONCRETE PAVING

A. Refer to Drawings.

2.5 AUXILIARY MATERIALS – ASPHALT PAVING

A. Herbicide: Commercial chemical for weed control, registered by the EPA, and not classified as "restricted use" for locations and conditions of application. Provide in granular, liquid, or wettable powder form.

B. Sand:
   1. Refer to Civil Drawings.
   2. Refer to specific documents herein referenced, including but not limited to; Uniform Standard Specifications for Public Works Construction.

2.6 SOIL

A. Refer to Landscape Drawings.

2.7 SOIL AMENDMENTS

A. Refer to Landscape Drawings

2.8 PLANT MATERIALS

A. Refer to Landscape Drawings.

2.9 MISCELLANEOUS LANDSCAPE MATERIALS

A. Refer to Landscape Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas within scope of work for compliance with requirements and conditions affecting installation and performance.

B. Verify that subgrade is dry and in suitable condition to begin paving.

C. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

D. Examine finish grades prior to proceeding with planting operation.

3.2 SUBGRADE INSPECTION

A. Refer to Civil Drawings.

B. Refer to specific documents herein referenced, including but not limited to; Uniform Standard Specifications for Public Works Construction.

C. Notify Architect, Civil and Geotechnical Engineer when excavations have reached required subgrade.

D. If Architect and/or engineers determine that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

3.3 PREPARATION

A. Refer to Civil Drawings.

B. Refer to Landscape Drawings.

C. Refer to specific documents herein referenced, including but not limited to; Uniform Standard Specifications for Public Works Construction.

D. Protect and maintain benchmarks and survey control points from disturbance during construction.

E. Remove loose material from compacted subbase surface immediately before placing asphalt or concrete.

F. Protect existing site improvements to remain from damage during construction.
   1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.4 PATCHING

A. Asphalt Pavement:
   1. Refer to Civil Drawings.
   2. Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 -inches (300 mm) into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Placing Patch Material: Fill excavated pavement areas with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

3.5 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
   1. Refer to Civil Drawings.
   2. Refer to specific documents herein referenced, including but not limited to; Uniform Standard Specifications for Public Works Construction.

B. Asphalt paving: Herbicide Treatment:
   1. Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.
   2. Mix herbicide with prime coat if formulated by manufacturer for that purpose.

3.6 INSTALLATION TOLERANCES – ASPHALT PAVING

A. Asphalt Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances unless indicated otherwise in Civil Drawings:
   1. Base Course: Plus or minus 1/2 -inch (13 mm).
   2. Surface Course: Plus 1/4 -inch (6 mm), no minus.

B. Asphalt Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances unless indicated otherwise in civil drawings as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:
   1. Base Course: 1/4 -inch (6 mm)

2. Surface Course: 1/8 -inch (3 mm)
3. Crowned Surfaces where indicated: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 -inch (6 mm).

3.7 SURFACE TREATMENTS

A. Asphalt Seal coats:
1. Refer to Civil Drawings.
2. Refer to specific documents herein referenced, including but not limited to; Uniform Standard Specifications for Public Works Construction.
3. Roll slurry seal to remove ridges and provide a uniform, smooth surface.

B. Concrete Paving:
1. Cure concrete in accordance with Civil Drawings in addition to;
   a. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
   b. Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations.
      1) Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

C. Concrete Unit Pavers:
   a. Prepare sub base in accordance with Landscape Drawings.

D. Landscape final grades:
1. Prepare landscape area’s prior to planting to required finish grades.
   a. Refer to Civil Drawings.
   b. Refer to Landscape Drawings.

3.8 SOIL TESTING

A. Test soil, analyze and provide results to Architect.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: A qualified testing agency to perform tests and inspections engaged and paid for in compliance with civil drawings, referenced documents and Division 1 requirements.

B. Thickness:
1. In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
   a. Refer also to Civil Drawings.
2. Test composite samples of fresh concrete obtained according to ASTM C 172.
   a. Refer also to Civil Drawings.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

3.10 PLANTING BED ESTABLISHMENT

A. Preparation of Planting Area:
   1. Refer to Landscape Drawings.

B. Weed Control: All planting areas, both turf and shrub/groundcover shall be weed free at the time of plant material installation.
   1. Refer to Landscape Drawings.
   2. Irrigate all areas to be planted for one week prior to spraying herbicide.

C. Excavation For Trees And Shrubs:
   1. Excavate pits, beds, and trenches as shown in details on the drawings.

3.11 PLANTING

A. Refer to Landscape Drawings.

3.12 PROTECTION

A. Refer to Civil Drawings.

B. Refer to Landscape Drawings.

C. Refer to specific documents herein referenced, including but not limited to; Uniform Standard Specifications for Public Works Construction.

D. Concrete paving:
   1. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
   2. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.
   3. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
   4. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

E. Concrete pavers:
   1. Remove and replace concrete pavers that are broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
   2. Protect concrete pavers from damage.

3. Maintain concrete pavers free of stains, discoloration, dirt, and other foreign material.
   a. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

F. Landscaping:
   1. During landscape work, keep pavements clean and work area in an orderly condition. Haul away and remove all debris from landscape areas, and do not leave any clippings or other material from landscape planting and/or maintenance period.
   2. Protect landscape work and materials from damage due to landscape operations, operations by other contractors and/or other trades. Maintain protection during installation and maintenance periods. Treat, repair or replace damaged landscape work as directed.

3.13 WASTE MATERIALS AND HANDLING

A. Remove surplus material and legally dispose of them off Owner's property.
   1. Handle waste material according to approved waste management plan.
   2. Refer to Section 01 7400 "Cleaning and Construction Waste Management".

3.14 CLEANUP

A. During civil work, keep work area in an orderly condition. Haul away and remove all debris from areas.

B. Landscaping:
   1. Powerwash all paving and flatwork as necessary to remove all staining and tire marks and provide a clean surface.

- END OF SECTION -

- SECTION 32 1316 -
DECORATIVE CEMENT CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Integrally colored concrete for:
      a. Site concrete
      b. Site paving bands.
      c. Where indicated in Drawings.

1.3 RELATED REQUIREMENTS

A. Pertinent Sections specifying Volatile Organic Compound (VOC) Content Restrictions.

B. Section 01 6116 “Volatile Organic Compound (VOC) Restrictions”

C. Civil and Landscape drawings for subgrade preparation, grading, and subbase course.

D. Civil and Landscape drawings for slab on grade concrete ramps and parking surfaces.

E. Section 03 3000 "Cast-in-Place Concrete" for general building applications of concrete.

F. Section 03 3500 " Concrete Finishing"

G. Section 32 1373 "Concrete Paving Joint Sealants" for joint sealants within decorative cement concrete pavement and at isolation joints of decorative cement concrete pavement with adjacent construction.

1.4 REFERENCES

A. “Phoenix Building Construction Code”, International Building Code 2006, with City of Phoenix administrative provisions and amendments.

B. 36 CFR 1191 - Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities; Final Rule; Federal Register, July 26, 1991; updated 2010.

C. American Society for Testing and Materials (ASTM):
1. ASTM C309 “Liquid Membrane-Forming Compounds for Curing Concrete.”
2. ASTM C494 “Standard Specification for Chemical Admixtures for Concrete.”
3. ASTM C494 . Standard specifications for chemical admixtures for concrete
4. ASTM C979 . Standard specifications for pigments for integrally colored concrete
5. ASTM C3 09 . Liquid membrane forming compounds for curing concrete
6. ACI 302 JR . Guide for concrete floor and slab construction
7. ACT *305* R . Hot weather concreting
8. ACT 306 R . Cold weather concreting
9. ACT 3 18 . Building code requirements for reinforced concrete
10. NRMCA . CJP5 . Plastic shrinkage cracking

1.5 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.6 SUBMITTALS

A. General: Submit in accordance with Section 01 3300.

B. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

C. Product Data: For each type of product indicated, demonstrate compliance with specified attributes.

D. VOC Submittals:
1. Product Data – VOC Limits: For adhesives sealants, fillers and primers, documentation including printed statement of VOC contents, comply with limits specified in Section 01 6116.

E. Design Mixtures:
1. For each integrally colored decorative cement concrete pavement mixture.
a. Include alternate mixture designs when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

F. Samples for Initial Selection: Manufacturer's color charts showing full range of colors available.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:
1. Aggregates.[Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.]

C. Material Certificates: For the following materials, signed by manufacturers:
   1. Cementitious materials.
   2. Steel reinforcement and reinforcement accessories.
   3. Fiber reinforcement.
   4. Admixtures.
   5. Curing compounds.
   6. Applied finish materials.
   7. Bonding agent or epoxy adhesive.
   8. Joint fillers.

D. Field quality-control test reports.

E. Minutes of preinstallation conference.

F. Closeout Submittals:
   1. Submit under provisions of Section 01 7700.
   2. Warranty: Submit specified warranty.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer of decorative cement concrete pavement systems.

B. Ready-Mix-Concrete Producer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
   1. Producer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
   1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.

D. Source Limitations: Obtain decorative cement concrete pavement products and each type or class of cementitious material of the same brand from the same manufacturer's plant and each aggregate through one source.

E. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.

F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

G. Integrally colored concrete Mockups: Cast mockups of sections approximately 48 –inches long of decorative cement concrete pavement to demonstrate typical pattern, texture, surface finish, color, joints, and standard of workmanship.
   1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.

2. In presence of Architect, damage part of the exposed surface of decorative cement concrete pavement for each finish, color, and texture required, and demonstrate materials and techniques proposed for repair to match adjacent undamaged surfaces.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."
1. Before submitting design mixtures, review decorative cement concrete pavement mixture design and examine procedures for ensuring quality of concrete materials and decorative cement concrete pavement construction practices. Require representatives of each entity directly concerned with decorative cement concrete pavement to attend, including the following:
a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixes.
c. Ready-mix concrete producer.
d. Decorative cement concrete pavement Installer.
e. Manufacturer's representative of decorative cement concrete pavement system.

I. Installer/Applicator shall provide adequate number of skilled workmen who are thoroughly trained and experienced in the necessary craft

J. Manufacturer’s Certification: Provide a letter of acknowledgement from the chemical manufacturer stating that the installer is a trained applicator and is familiar with proper procedures and installation requirements recommended by the manufacturer.

K. Environmental Limitations:
1. Comply with manufacturer’s written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation and other conditions affecting chemical performance.
2. Application of system shall take place a minimum of 21 days prior to fixture and trim installation and/or substantial completion.
3. Finish concrete area shall be closed to traffic during finish floor application and after application for the time as recommended by the manufacturer.
2. **PROJECT CONDITIONS**

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

1.10 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements of Section 01 6000.

B. All chemicals:
1. Comply with manufacturer's instructions.
2. Deliver in original, unopened packaging.
3. Store in dry conditions.

1.11 EXTRA MATERIAL

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Refer to Section 01 7843 “Spare Parts”

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Limits for adhesives sealants, fillers and primers. Comply with limits specified in Section 01 6116.

2.2 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.3 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
   1. Use flexible or curved forms for curves of a radius 100 feet (30.5 m) or less.

B. Forms for Textured Finish Concrete: Units of face design, size, arrangement, and configuration indicated. Provide solid backing and form supports to ensure stability of textured form liners.

C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.4 STEEL REINFORCEMENT, MATERIAL

A. Refer also to Section 03 3000 “Cast-In-Place Concrete”

B. Refer to Landscape drawings for site concrete.

2.5 CONCRETE MATERIALS

A. Refer also to Section 03 3000 “Cast-In-Place Concrete”

B. Refer to Landscape drawings for site concrete.

C. Cementitious Material: Use one of the following cementitious materials, of the same type, brand, and source, throughout Project:
   1. Gray Portland Cement: ASTM C 150, Type II, supplement with the following:

a. Fly Ash: ASTM C 618, Class F.

2. White Portland Cement: ASTM C 150, Type I.

D. Normal-Weight Aggregates: ASTM C 33, Class 4M, uniformly graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar pavement applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Aggregate Size: 3/4 inch (19 mm) nominal

2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

E. Water: Potable and complying with ASTM C 94/C 94M.

F. Air-Entraining Admixture: ASTM C 260.

G. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A., colored

2. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D, colored

3. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.

2.6 FIBER REINFORCEMENT, MATERIAL

A. Refer to Landscape drawings for site concrete.

B. Synthetic Fiber: Monofilament polypropylene fibers engineered and designed for use in decorative cement concrete pavement, complying with ASTM C 1116, Type III, 1/2 –inches to 1-1/2 -inches (13 to 38 mm) long.

1. Products: Subject to compliance with requirements, provide one of the following :

a. Axim Concrete Technologies; Fibrasol IIP.

b. Euclid Chemical Company (The); Fiberstrand 100.

c. FORTA Corporation; Forta Mono.

d. Grace Construction Products, W. R. Grace & Co.; Grace MicroFiber.

e. Metalcrete Industries; Polystrand 1000.

f. SI Concrete Systems; Fibermix Stealth.

2.7 COLOR MATERIALS – INTEGRAL MIX

A. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **CHROMIX P® and CHROMIX ML® Admixtures** by **SCOFIELD**, www.scofield.com Subject to compliance with requirements, provide the named product or a comparable product by one of the following manufactures:

a. ChemMasters.

b. Davis Colors.

c. Solomon Colors.

2. Substitutions: Equivalent products by alternate manufacturers will be considered subject to procedures specified in Section 01 2500 “Substitution Procedures”.
   a. Each such request shall include the name of the product and manufacturer and a complete description of the proposed substitute, including drawings, cuts, performance and test data, a list of projects of similar scope and photographs of existing installations, and any other information deemed necessary by the Architect for evaluation.

B. Integral Color admixture:
1. All concrete designated as integrally colored concrete in plans or specifications shall contain the proper proportion of admixture for color conditioned concrete as manufactured by the listed / indicated manufacturer.
   a. It shall be certified that the colored admixtures comply with the requirements of paragraph 407 of ACI 318-83 (Building code requirements for reinforced concrete) as water-reducing admixtures, and that their water-reducing components have tested for compliance with ASTM C494.
   b. The color-conditioned admixture shall be a single-component pigmented, water-reducing concrete admixture, factory formulated, and packaged in cubic yard increments, not multiple additives and pigments to dosed separately into the mix.
   c. The pigment portion of the colored admixture shall comply with ASTM C979. No Known Equal. Color as follows

2.8 CURING AND SEALING MATERIALS

A. Curing Paper: Nonstaining, waterproof paper, consisting of two layers of kraft paper cemented together and reinforced with fiber, complying with ASTM C 171.
1. Application: Stained concrete

B. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
1. Available Products:
   a. As approved by Integral color admixture manufacturer.

C. Integrally Colored Concrete - Curing Compound: Curing compound shall comply with ASTM C309 and be of same manufacturer as colored admixture, for use with integrally colored concrete.
1. Exterior Integrally Colored Concrete: **LITHOCHROME® COLORWAX**; **L. M. SCOFIELD COMPANY**. Use to cure exterior flatwork that will be allowed to cure naturally with only occasional maintenance or approved equivalent.

2.9 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber] or ASTM D 1752, cork or self-expanding cork.
1. Refer to Section 32 1373 “Concrete Paving Joint Sealants”
2. Refer to Drawings.

B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

2.10 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.
   1. Use a qualified independent testing agency for preparing and reporting proposed concrete mixture designs for the trial batch method.

B. Proportion mixtures to provide normal-weight concrete with the following properties:
   1. Compressive Strength (28 Days): 3500 psi (24.1 MPa) .
   2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45 .
   3. Slump Limit: 4 -inches (100 mm) , plus or minus 1 -inch (25 mm).

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
   1. Air Content: 4-1/2 percent plus or minus 1.5 percent for 1-1/2 -inch (38-mm) nominal maximum aggregate size.
   2. Air Content: 4-1/2 percent plus or minus 1.5 percent for 1 -inch (25-mm) nominal maximum aggregate size.
   3. Air Content: 5 percent plus or minus 1.5 percent for 3/4 -inch (19-mm) nominal maximum aggregate size.

D. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
   1. Use water reducing admixture and retarding admixture and accelerating admixture in concrete, as required, for placement and workability.
   2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

F. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
   1. Fly Ash or Pozzolan: 25 percent.
   2. Ground Granulated Blast-Furnace Slag: 50 percent.
   3. Combined Fly Ash or Pozzolan, and Ground Granulated Blast-Furnace Slag: 50 percent, with fly ash or pozzolan not exceeding 25 percent.

G. Synthetic Fiber: Uniformly disperse in concrete mix at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd. (0.60 kg/cu. m) <.

H. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.
   1. Mixing of integrally colored concrete:
      a. The concrete color admixture shall be added at the concrete batch plant.
      b. Minimum batch size shall be three (3) yards.
      c. The same brand of cement, source of sand, and water/cement ratio must be maintained for each load of the same color.

d. The batching procedures shall be as follows: Before adding color-conditioning admixture, the mixing drum must be thoroughly cleaned and wetted with approximately 40 gallons of the mix water and/or a portion of the aggregates.

e. One bag of the Chromix admixture correctly packaged for the mix design should be added per yard of concrete.

f. Proceed with normal batching of balance of ingredients

g. After loading is complete, mix at mixing speed for a minimum of 15 minutes.

h. No water should be added after a portion of the load has been discharged.

2.11 CONCRETE MIXING

A. Refer to Section 03 3300 “Cast-In-Place Concrete”

B. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 deg F (30 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

C. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For concrete mixes of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.

2. For concrete mixes larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).

3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

2.12 CONCRETE SURFACE PROTECTION , MATERIAL

A. Material:

1. Type: A multi-purpose floor covering.
2. Mfgr: L.M. SCOFIELD COMPANY
3. Product: Pro-Guard Dura Cover

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with tolerances for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction[. Limit vehicle speed to 3 mph (5 km/h).
2. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).
3. Subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 -inch (13 mm) require correction according to requirements in Division 2 Section "Earthwork."

C. Proceed with decorative cement concrete pavement operations only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

B. Protect adjacent construction from discoloration and spillage during application of color hardeners, release agents, stains, curing compounds, and sealers.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Refer also to Section 03 1000 “Concrete Forming and Accessaories”

B. Refer to Landscape drawings for site concrete.

C. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

D. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

A. Refer also to Section 03 2000 “Concrete Reinforcing”

B. Refer to Landscape drawings for site concrete.

C. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
1. Refer to landscape and civil drawings.
2. Refer to Section 03 1000 “Concrete Forming and Accessories”

D. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

E. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

F. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

G. Install fabricated bar mats in lengths as long as practicable.

1. Handle units to keep them flat and free of distortions.
2. Straighten bends, kinks, and other irregularities, or replace units as required before placement.
3. Set mats for a 2-inch (50-mm) overlap to adjacent mats.

3.5 JOINTS

A. Refer also to Section 03 3000 “Cast-In-Place Concrete”

B. Refer also to Section 03 3500 “Concrete Finishing”

C. Refer to Landscape drawings for site concrete.

D. General: Construct construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.

1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.

E. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour, unless pavement terminates at isolation joints.

1. Continue steel reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
2. Provide tie bars at sides of pavement strips where indicated.
3. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 -inches (38 mm) into concrete.
5. Dowelled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

F. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 50 feet (15.25 m) , unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler less than 1/2 -inch (13 mm) or more than 1 -inch (25 mm) below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
6. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

G. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch (6-mm) radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.

   a. Tolerance: Ensure that grooved joints are within 3 inches (75 mm) either way from centers of dowels.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

   a. Tolerance: Ensure that grooved joints are within 3 inches (75 mm) either way from centers of dowels.

3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

H. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 1/4-inch (6-mm) radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

A. Refer also to Section 03 3000 “Cast-In-Place Concrete”

B. Refer also to Section 03 3500 “Concrete Finishing”

C. Refer to Landscape drawings for site concrete.

D. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcement steel, and items to be embedded or cast in.
   1. Notify other trades to permit installation of their work.
   2. Coordinate with sub base concrete for brick paving.
   3. Coordinate with brick paving.

E. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.

F. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

G. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

H. Do not add water to concrete during delivery or at Project site.

I. Do not add water to fresh concrete after testing.

J. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

K. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.

L. Screed pavement surfaces with a straightedge and strike off.

M. Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

N. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.

O. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.

P. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg F (32 deg C).
   a. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water.
   b. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover reinforcement steel with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog spray forms, reinforcement steel, and subgrade just before placing concrete.
   a. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 FLOAT FINISHING

A. Refer to Section 03 3500 “Concrete Finishing”

B. General: Do not add water to concrete surfaces during finishing operations.

C. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations.

1. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units.
2. Finish surfaces to true planes.

3. Cut down high spots and fill low spots.
4. Refloat surface immediately to uniform granular texture.

3.8 INTEGRALLY COLORED CONCRETE FINISH

A. Integrally Colored Concrete Finish: After final floating, apply a hand-trowel finish followed by a broom finish to concrete.
   1. Coordinate with and confirm with Landscape drawings.

3.9 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder:
   1. Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations.
   2. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Compound: Apply curing compound immediately after final finishing. Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after application. Maintain continuity of coating and repair damage during curing period.
   1. Cure integrally colored concrete with a pigmented curing compound.

F. Curing and Sealing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions.
   1. Recoat areas subjected to heavy rainfall within three hours after initial application.
   2. Repeat process 24 hours later and apply a second coat.
      a. Maintain continuity of coating and repair damage during curing period.

G. Curing Paper: Cure with unwrinkled curing paper in pieces large enough to cover the entire width and edges of slab.
   1. Do not lap sheets.
   2. Fold curing paper down over pavement edges and secure with continuous banks of earth to prevent displacement or billowing due to wind.
      a. Immediately repair holes or tears in paper.

3.10 SEALER – INTEGRALLY COLORED CONCRETE

A. Clear Acrylic Sealer: Apply uniformly in two coats in continuous operations according to manufacturer's written instructions.
   1. Allow first coat to dry before applying second coat, at 90-degrees to the direction of the first coat using same application methods and rates.
   2. Begin sealing dry surface no sooner than 14 days after concrete placement.
   3. Allow stained concrete surfaces to dry before applying sealer.
   4. Mix slip-resistant additive thoroughly in sealer before application according to manufacturer's written instructions.
      a. Stir sealer occasionally during application to maintain even distribution of additive.

3.11 PAVEMENT TOLERANCES

A. Refer to Section 03 3500 “Concrete Finishing”

B. Comply with tolerances of ACI 117 and as follows:
   1. Elevation: 1/4 -inch (6 mm).
   2. Thickness: Plus 3/8 -inch (10 mm), minus 1/4 -inch (6 mm).
   3. Surface: Gap below 10-foot- (3-m-) long, unleveled straightedge not to exceed 1/4 inch (6 mm).
   4. Lateral Alignment and Spacing of Dowels: 1 -inch (25 mm).
   5. Vertical Alignment of Dowels: 1/4 -inch (6 mm).
   6. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge:
      a. Length of dowel 1/4 -inch per 12 -inches (6 mm per 300 mm).
   7. Joint Spacing: 3 -inches (75 mm).
   8. Contraction Joint Depth: Plus 1/4 -inch (6 mm), no minus.
   9. Joint Width: Plus 1/8 -inch (3 mm), no minus.

3.12 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
   1. Refer to Section 01 4523 Testing and Inspection Requirements”:

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
   1. Testing Frequency: Obtain at least 1 composite sample for each **100 cu. yd. (76 cu. m)** or fraction thereof of each concrete mix placed each day.
      a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
   2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix.
      a. Perform additional tests when concrete consistency appears to change.
   3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.

4. Concrete Temperature: ASTM C 1064/C 1064M; 1 test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and 1 test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test 1 specimen at 7 days for information and 2 specimens at 28 days.
    a. A compressive-strength test shall be the average compressive strength from 2 specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mix will be satisfactory if every average of any 3 consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).

D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing.
1. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

G. Remove and replace decorative cement concrete pavement where test results indicate that it does not comply with specified requirements.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.13 REPAIRS AND PROTECTION

A. Remove and replace decorative cement concrete pavement that is broken, damaged, or does not comply with requirements in this Section in complete sections from joint to joint, unless otherwise approved by Architect.

B. Protect concrete from damage.
1. Exclude traffic from pavement for at least 14 days after placement.
2. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

C. Maintain decorative cement concrete pavement free of stains, discoloration, dirt, and other foreign material.
1. Sweep decorative cement concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

3.14 CLEANING

A. The work area shall be kept clean and free of debris at all times.

B. Remove slurry and dust from adjoining surfaces as necessary.

C. Dispose of material containers in accordance with local regulations.

D. Protect finished work until fully cured per manufacturer's recommendations.

- END OF SECTION -

- SECTION 32 1373 -

CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Exterior joints in the following horizontal traffic surfaces:
   1. Isolation (Expansion) and contraction joints within cement concrete pavement.
   2. Isolation (Expansion) Joints between building and site concrete.
   3. Joints between different materials listed above.
   4. Other joints as indicated.

1.3 RELATED REQUIREMENTS

A. Pertinent Sections specifying Volatile Organic Compound (VOC) Content Restrictions.

B. Section 01 6116 “Volatile Organic Compound (VOC) Restrictions”

C. Pertinent Sections specifying sealants or referencing this Section for sealant products and Execution Requirements.

D. Section "07 9200 Joint Sealants" for sealing nontraffic and traffic joints in locations not specified in this Section.

E. Civil and Landscape Drawings for slab on grade concrete ramps and parking surfaces.

1.4 REFERENCES

A. “Phoenix Building Construction Code”, International Building Code 2006, with City of Phoenix administrative provisions and amendments.

B. Manufacturer's recommendations and specifications.

1.5 SUBMITTALS

A. General: Submit in accordance with Section 01 3300.

B. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

C. Product Data: For each type of product indicated, demonstrate compliance with specified attributes.

D. VOC Submittals:

1. Product Data – VOC Limits: For adhesives sealants, fillers and primers, documentation including printed statement of VOC contents, comply with limits specified in Section 01 6116.

E. Samples for initial selection purposes in form of manufacturer's standard bead samples, consisting of strips of actual products showing full range of colors available, for each product exposed to view.

F. Samples for Verification: For each type and color of joint sealant required. Install joint-sealant samples in 1/2-inch- (13-mm-), and 1/4-inch (6.4-mm) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

G. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.

H. Qualification Data: For Installer.

I. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:

J. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.

K. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

L. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for sealants.

M. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant colors (multiple colors will be required).

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

C. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

D. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

E. Submit not fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.

F. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.

G. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.

H. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

I. Product Testing: Obtain test results for "Product Test Reports" Paragraph in "Submittals" Article from a qualified testing agency based on testing of current sealant products within a 36-month period preceding the commencement of the Work.

J. Include sealants in mock-ups of site concrete.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of Section 01 6000.

B. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multi-component materials.

C. Store and handle materials to comply with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.8 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

B. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (4.4 deg C).

C. When joint substrates are wet or covered with frost.

D. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.

E. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Limits for adhesives sealants, fillers and primers. Comply with limits specified in Section 01 6116.

2.2 MANUFACTURERS

A. Available Products**:** Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

2.3 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: To match adjacent surfaces as approved by the Landscape Architect.

2.4 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

C. Multicomponent Pourable Urethane Sealant (Sealant #1):
   1. Available Products:
      a. Bostik Findley; Chem-Calk 550.
      b. Meadows, W. R., Inc.; Pourthane.
      c. Pacific Polymers, Inc.; Elasto-Thane 227 Type I (Self Leveling).
      d. Pecora Corporation; Urexpan NR-200.
      e. Polymeric Systems Inc.; PSI-270SL.
      f. Schnee-Morehead, Inc.; Permathane SM 7201.
      g. Sika Corporation, Inc.; Sikaflex - 2c SL.
      h. Sonneborn, Division of ChemRex Inc.; SL 2.
      i. Tremco; THC-900/901.
      j. Tremco; Vulkem 245.
   2. Type and Grade: M (multicomponent) and P (pourable).
   3. Class: 25.
   4. Use Related to Exposure: T (traffic).

5. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.

D. Multicomponent Nonsag Urethane (Sealant #2):
1. Available Products:
   a. Pacific Polymers, Inc.; Elasto-Thane 227 High Shore Type II (Gun Grade).
   b. Pecora Corporation; Dynatred.
   c. Polymeric Systems Inc.; PSI-270.
2. Type and Grade: M (multicomponent) and NS (nonsag).
3. Class: 25.
4. Use Related to Exposure: T (traffic).
5. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.
   a. Use O Joint Substrates: Galvanized steel, brick, granite, marble, and ceramic tile.

2.5 JOINT-SEALANT BACKER MATERIALS

A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.

B. Round Backer Rods for Cold- and Hot-Applied Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

C. Backer Strips for Cold- and Hot-Applied Sealants: ASTM D 5249; Type 2; of thickness and width required to control sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

D. Round Backer Rods for Cold-Applied Sealants: ASTM D 5249, Type 3, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

2.6 PRIMERS

A. Primers**:** Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install backer materials of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of backer materials.
2. Do not stretch, twist, puncture, or tear backer materials.
3. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses provided for each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Provide joint configuration to comply with joint-sealant manufacturer's written instructions, unless otherwise indicated.

F. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.

3.4 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without

deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations with repaired areas are indistinguishable from the original work.

3.6 SCHEDULE

A. Horizontal Joints, less than 5 percent slope; Sealant No. 1.

B. Horizontal Joints, grades steeper than 5 percent; Sealant No. 2.

C. Vertical Joints; Sealant No. 2.

- END OF SECTION -

- SECTION 32 1726 -

TACTILE (DETECTABLE) WARNING SURFACES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Surface applied advanced warning strip.
   2. Cast-in-place detectable/tactile warning surface tiles.

1.3 RELATED REQUIREMENTS

A. Pertinent Sections specifying Volatile Organic Compound (VOC) Content Restrictions.

B. Section 01 6116 “Volatile Organic Compound (VOC) Restrictions.

C. Civil and Landscape Drawings for asphalt pavement.

D. Civil and Landscape Drawings for concrete pavement.

E. Civil and Landscape Drawings for slab on grade concrete ramps and parking surfaces.

1.4 REFERENCES

A. “Phoenix Building Construction Code”, International Building Code 2006, with City of Phoenix administrative provisions and amendments.

B. 36 CFR 1191 - Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities; Final Rule; Federal Register, July 26, 1991; updated 2010.

C. Manufacturer's recommendations and specifications.

1.5 SUBMITTALS

A. General: Submit in accordance with Section 01 3300.

B. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

C. Product Data: For each type of product indicated, demonstrate compliance with specified attributes.
   1. Submit manufacturer's literature describing products, installation procedures and routine maintenance.

D. VOC Submittals:
   1. Product Data – VOC Limits: For adhesives sealants, fillers and primers, documentation including printed statement of VOC contents, comply with limits specified in Section 01 6116.

E. Samples for Verification Purposes: Submit two tile samples minimum 6 –inch by 6 -inch for each kind indicated.

F. Shop drawings are required for products specified showing fabrication details, composite structural system, tile surface profile, sound on cane contact amplification feature, plans of tile placement including joints, and material to be used as well as outlining installation materials and procedure.
   1. Indicate fastener locations for surface applied units.

G. Material Test Reports: Submit complete test reports from qualified accredited independent testing laboratory's to qualify that materials proposed for use are in compliance with requirements and meet or exceed the properties indicated on the specifications. All tests shall be conducted on a Cast In Place Detectable/Tactile Warning Surface Tile system as certified by a qualified independent testing laboratory and be current within a 24 month period.

H. Maintenance Instructions: Submit copies of manufacturer's specified installation and maintenance practices for each type of Detectable Warning Surface Tile and accessory as required.

1.6 QUALITY ASSURANCE

A. Provide Detectable/Tactile Warning Surface Tiles and accessories as produced, engineered and field tested products by a single manufacturer with a minimum of three (3) years experience in the manufacturing of Cast In Place and Surface Applied Detectable/Tactile Warning Surface Tiles.

B. Installer's Qualifications: Engage an experienced Installer certified in writing by Detectable/Tactile Warning Surface Tile manufacturer as qualified for installation, who has successfully completed installations similar in material, design, and extent to that indicated for Project.

C. Americans with Disabilities Act (ADA): Provide Surface Applied Detectable/Tactile Warning Surface Tiles which comply with the detectable warnings on walking surfaces section of the Americans with Disabilities Act (Title III Regulations, 28 CFR Part 36 ADA Standards For Accessible Design, Appendix A, Section 4.29.2 Detectable Warnings On Walking Surfaces).

1.7 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements of Section 01 6000.

B. Detectable/Tactile Warning Surface Tiles shall be suitably packaged or crated to prevent damage in shipment or handling. Finished surfaces shall be protected by sturdy plastic wrappings to protect tile from concrete residue during installation and tile type shall be identified by part number.

C. Detectable/Tactile Warning Surface Tiles shall be delivered to location at building site for storage prior to installation.

1.8 SITE CONDITIONS

A. Environmental Conditions and Protection: Maintain minimum temperature of 40°F in spaces to receive Detectable/Tactile Warning Surface Tiles for at least 24 hours prior to installation, during installation, and for not less than 24 hours after installation.

B. The use of water for work, cleaning or dust control, etc. shall be contained and controlled and shall not be allowed to come into contact with the general public. Provide barricades or screens to protect the general public.

1.9 WARRANTY

A. Cast-In-Place Detectable/Tactile Warning Surface Tiles shall be guaranteed in writing for a period of five (5) years from date of final completion. The guarantee includes defective work, breakage, deformation, fading and loosening of tiles.

B. Surface Applied Detectable/Tactile Warning Surface Tiles shall be guaranteed in writing for a period of five (5) years from date of final completion. The guarantee includes defective work, breakage, deformation, fading and loosening of tiles.

1.10 SEQUENCING

A. Coordinate with work as specified in Section 03300 “Cast-in-Place Concrete”.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Limits for adhesives sealants, fillers and primers. Comply with limits specified in Section 01 6116.

2.2 MANUFACTURERS

A. Basis-of-Design: The design based on VPC Cast-in-Place and VPC Surface Applied Detectable/Tactile Warning Surfaces manufactured by Engineered Plastics Inc. Williamsville, NY tel (800-682-2525), www.armor-tile.com.

1. Subject to compliance with requirements, provide the named product or a comparable product by one of the following manufactures:
2. Engineered Plastics Inc; Armor Tile.

2.3 CAST-IN-PLACE DETECTABLE WARNING TILES

A. Vitrified Polymer Composite (VPC) Cast-In-Place Detectable/Tactile Warning Surface Tiles shall be an epoxy polymer composition with an ultra violet stabilized coating employing aluminum oxide particles in the truncated domes. The tile shall incorporate an in-line pattern of truncated domes measuring nominal 0.2 -inch height, 0.9 -inch base diameter, and 0.45 -inch top diameter, spaced center-to-center 2.35 -inch as measured on a diagonal and 1.67 -inch as measured side by side. For wheelchair safety the field area shall consist of a non-slip surface with a minimum of 40 - 90° raised points 0.045 -inch high, per square inch.

1. Dimensions: Cast-In-Place Detectable/Tactile Warning Surface Tiles shall be held within the following dimensions and tolerances:
2. Length and Width: 24 –inches x 48 –inches nominal, unless otherwise indicated on drawings.
3. Depth: 1.375 (1-3/8 -inch) (+/-) 5 percent max.
4. Face Thickness: 0.1875 (1-3/8 -inch) (+/-) 5 percent max.
5. Warpage of Edge: 0.5 percent max.
6. Embedment Flange Spacing: shall be no greater than 3.1 -inch
7. Color: Yellow conforming to Federal Color No. 33538. Color shall be homogeneous throughout the tile.
8. Water Absorption of Tile when tested by ASTM D 570-98 not to exceed 0.05 percent.
9. Slip Resistance of Tile when tested by ASTM C 1028-96 the combined Wet and Dry Static Co-Efficients of Friction not to be less than 0.80 on top of domes and field area.
10. Compressive Strength of Tile when tested by ASTM D 695-02a not to be less than 28,000 psi.
11. Tensile Strength of Tile when tested by ASTM D 638-03 not to be less than 19,000 psi.
12. Flexural Strength of Tile when tested by ASTM D 790-03 not to be less than 25,000 psi.
13. Chemical Stain Resistance of Tile when tested by ASTM D 543-95 (re approved 2001) to withstand without discoloration or staining - 10 percent hydrochloric acid, urine, saturated calcium chloride, black stamp pad ink, chewing gum, red aerosol paint, 10 percent ammonium hydroxide, 1 percent soap solution, turpentine, Urea 5 percent, diesel fuel and motor oil.
14. Abrasive Wear of Tile when tested by BYK - Gardner Tester ASTM D 2486-00 with reciprocating linear motion of 37± cycles per minute over a 10 -inch travel. The abrasive medium, a 40 grit Norton Metallite sand paper, to be fixed and leveled to a holder. The combined mass of the sled, weight and wood block is to be 3.2 lb. Average wear depth shall not exceed 0.060 after 1000 abrasion cycles when measured on the top surface of the dome representing the average of three measurement locations per sample.
15. Resistance to Wear of Unglazed Ceramic Tile by Taber Abrasion per ASTM C501-84 (re approved 2002) shall not be less than 500.
16. Fire Resistance of Tile when tested to ASTM E 84-05 flame spread shall be less than 15.
17. Gardner Impact to Geometry ”GE” of the standard when tested by ASTM D 5420-04 to have a mean failure energy expressed as a function of specimen thickness of not less than 550 in. lbf/in. A failure is noted when a crack is visible on either surface or when any brittle splitting is observed on the bottom plaque in the specimen.
18. Accelerated Weathering of Tile when tested by ASTM G 155-05a for 3000 hours shall exhibit the following result – ΔE <4.5, as well as no deterioration, fading or chalking of surface of tile color No 33538

19. Accelerated Aging and Freeze Thaw Test of Tile and Adhesive System when tested to ASTM D 1037-99 shall show no evidence of cracking, delamination, warpage, checking, blistering, color change, loosening of tiles or other detrimental defects.
20. Salt and Spray Performance of Tile when tested to ASTM B 117-03 not to show any deterioration or other defects after 200 hours of exposure.
21. AASHTO HB-17 single wheel HS20-44 loading "Standard Specifications for Highways and Bridges". The Cast In Place Tile shall be mounted on a concrete platform with a ½ -inch airspace at the underside of the tile top plate then subjected to the specified maximum load of 10,400 lbs., corresponding to an 8000 lb individual wheel load and a 30 percent impact factor. The tile shall exhibit no visible damage at the maximum load of 10,400 lbs.
22. Embedment flange spacing shall be no greater than 3.1 -inch center to center spacing.

2.4 SURFACE APPLIED DETECTABLE WARNING SURFACES

A. Vitrified Polymer Composite (VPC) Surface Applied Detectable/Tactile Warning Surface Tiles shall be an epoxy polymer composition with an ultra violet stabilized coating employing aluminum oxide particles in the truncated domes. The tile shall incorporate an in-line pattern of truncated domes measuring nominal 0.2 -inch height, 0.9 -inch base diameter, and 0.45 -inch top diameter, spaced center-to-center 2.35 -inch as measured on a diagonal and 1.67 -inch as measured side by side. For wheelchair safety the field area shall consist of a non-slip surface with a minimum of 40 - 90° raised points 0.045 -inch high, per square inch.

1. Dimensions: Surface Applied Detectable/Tactile Warning Surface Tiles shall be held within the following dimensions and tolerances:
2. Length and Width: 24 –inches x 60 –inches nominal, unless otherwise indicated on the drawings.
3. Depth: 0.1875 (3/16 -inch), (+/-) 5 percent max.
4. Face Thickness: 0.1875 (3/16), (+/-) 5 percent max.
5. Warpage of Edge: 0.5 percent max.
6. Water Absorption of Tile when tested by ASTM D 570-98 not to exceed 0.05 percent.
7. Slip Resistance of Tile when tested by ASTM C 1028-96 the combined Wet and Dry Static Co-Efficients of Friction not to be less than 0.80 on top of domes and field area.
8. Compressive Strength of Tile when tested by ASTM D 695-02a not to be less than 28,000 psi.
9. Tensile Strength of Tile when tested by ASTM D 638-03 not to be less than 19,000 psi.
10. Flexural Strength of Tile when tested by ASTM D 790-03 not to be less than 25,000 psi.
11. Chemical Stain Resistance of Tile when tested by ASTM D 543-95 (re approved 2001) to withstand without discoloration or staining - 10 percent hydrochloric acid, urine, saturated calcium chloride, black stamp pad ink, chewing gum, red aerosol paint, 10 percent ammonium hydroxide, 1 percent soap solution, turpentine, Urea 5 percent, diesel fuel and motor oil.
12. Abrasive Wear of Tile when tested by BYK - Gardner Tester ASTM D 2486-00 with reciprocating linear motion of 37± cycles per minute over a 10 -inch travel. The abrasive medium, a 40 grit Norton Metallite sand paper, to be fixed and leveled to a holder. The combined mass of the sled, weight and wood block is to be 3.2 lb. Average wear depth shall not exceed 0.060 after 1000 abrasion cycles when measured on the top surface of the dome representing the average of three measurement locations per sample.
13. Resistance to Wear of Unglazed Ceramic Tile by Taber Abrasion per ASTM C501-84 (re approved 2002) shall not be less than 500.

14. Fire Resistance of Tile when tested to ASTM E 84-05 flame spread shall be less than 15.
15. Gardner Impact to Geometry "GE" of the standard when tested by ASTM D 5420-04 to have a mean failure energy expressed as a function of specimen thickness of not less than 550 in. lbf/in. A failure is noted when a crack is visible on either surface or when any brittle splitting is observed on the bottom plaque in the specimen.
16. Accelerated Weathering of Tile when tested by ASTM G 155-05a for 3000 hours shall exhibit the following result – ΔE <4.5, as well as no deterioration, fading or chalking of surface of tile color No 33538.
17. Accelerated Aging and Freeze Thaw Test of Tile and Adhesive System when tested to ASTM D 1037-99 shall show no evidence of cracking, delamination, warpage, checking, blistering, color change, loosening of tiles or other detrimental defects.
18. Salt and Spray Performance of Tile and Adhesive System when tested to ASTM B 117-03 not to show any deterioration or other defects after 200 hours of exposure.

2.5 ACCESSORIES

A. Fasteners: Color matched, corrosion resistant, flat head drive anchor: 1/4-inch diameter x 1 1/2-inch long as supplied by.

2.6 SEALANTS AND ADHESIVES

A. Listing of a product in these specifications shall not be construed as a solicitation or requirement to use any product or combination of products in violation of the requirements of South Coast Air Quality Management District Rule No.1168, as described in Rule 1168(g).
   1. If a listed product does not meet the requirements of this rule, request approval for use of an alternate product by the same or another manufacturer meeting the requirements of this rule.
   2. Do not use products which do not meet the requirements of this rule.

B. Subject to compliance with the specified standards, provide one of the following materials, to suit conditions indicated, and upon verifying compliance with volatile organic compound content requirements of the South Coast Air Quality Management District Rule No. 1168 for use on this project.

C. Adhesive: Surface adhesive as recommended by the manufacturer.

D. Sealant: Sealant as supplied by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION & PREPARATION

A. The surface to receive the Surface Applied Detectable/Tactile Warning Surface Tile is to be mechanically cleaned with a diamond cup grinder or shot blaster to remove any dirt or foreign material. This cleaning and roughening of the concrete surface should include at least 4 -inches around the perimeter of the area to receive the tile, and also along the cross pattern established by the corresponding areas on the backside of the tile. Those same areas should then be cleaned with a clean rag soaked in Acetone.

B. During Cast-In-Place Detectable/Tactile Warning Surface Tile installation procedures, ensure adequate safety guidelines are in place and that they are in accordance with the applicable industry and government standards.

C. Prior to placement of the Cast-In-Place Detectable/Tactile Warning Surface Tile system, review manufacturer and contract drawings with the Contractor prior to the construction and refer any and all discrepancies to the Engineer.

3.2 SURFACE APPLIED INSTALLATION

A. The application of all tiles, adhesives, mechanical fasteners, and caulking shall be in strict accordance with the guidelines set by their respective manufacturers. Not recommended for asphalt applications.

B. Set the tile true and square to the curb ramp area as detailed in the design drawings, so that its location can be marked on the concrete surface. A thin permanent marker works well. Remove tile when done marking its location.

C. Immediately prior to installing the Surface Applied Detectable/Tactile Warning Surface Tile, the concrete surfaces must be inspected to ensure that they are clean, dry, free of voids, curing compounds, projections, loose material, dust, oil, grease, sealers and determined to be structurally sound and cured for a minimum of 30 days.

D. Using Acetone, wipe the backside of the tile around the perimeter and along the internal cross pattern, to remove any dirt or dust particles from the area to receive the adhesive.

E. Apply adhesive to the backside of the tile, following the perimeter and internal cross pattern established by the tile manufacturer. Sufficient adhesive must be placed on the prescribed areas to have full coverage across the 2 -inch width of the adhesive locator and shall be applied to within 1/4-inch continuously around the perimeter edge of the tile. The entire tube of adhesive shall be applied to the back of each tile, sizes 24-inch x 36-inch and greater.

F. Set the tile true and square to the curb ramp area as detailed in the design drawings.

G. Working from the center of the tile outwards, proceed to drill and install all fasteners in the tile's molded recesses.

H. Standing with both feet applying pressure around the molded recess provided in the tile, drill a hole true and straight to a depth of 3-1/2 -inch using a 1/4-inch masonry drill bit. Drill through the tile without hammer option (on the drill) until the tile has been successfully penetrated, then with hammer option (on the drill) to drill into the concrete. Maintaining foot pressure on both sides of the hole while drilling prevents concrete dust from accumulating between the tile and concrete which can affect the tile being installed flush and may compromise installation integrity.

I. Immediately after drilling each hole, before moving on to the next, and while still applying foot pressure, mechanically fasten tiles to the concrete substrate using a leather bound or hard plastic mallet to set the fasteners. Ensure the fastener has been placed to full depth in the dome, straight, and flush to the top of dome. Drive the pin of the fastener with the mallet, taking care to avoid any inadvertent blows to the truncated dome or tile surface.

J. Following the installation of the fasteners, the concrete dust should be vacuumed, brushed or blown away from the tile's surface and adjacent concrete. Using Acetone on a rag, wipe the concrete around the tile's perimeter to ensure a clean, dry surface to receive perimeter sealant.

K. Perimeter caulking sealant should be applied following the sealant manufacturer's recommendations. Tape all perimeter edges of the tile back 1/16-inch from the tile's perimeter edge and tape the adjacent concrete back 1/2-inch from the tile's perimeter edge to maintain a straight and even caulking line. Apply sealant around tile perimeter using care to work sealant into any void between the tile and concrete interface. Tool the perimeter caulking with a rounded plastic applicator or spatula to create a cove profile between the tile and adjacent concrete. Remove tape immediately after tooling perimeter caulking sealant.

L. Do not allow foot traffic on installed tiles until the perimeter caulking sealant has cured sufficiently to avoid tracking. Curing time is weather dependant (average cure time at 75° F is 30 minutes). Adhesive or caulking on the surface of the tile can be removed with Acetone.

M. If installing adjacent tiles, note the orientation of each tile. Careful attention will reveal that one of the long edges of the tile is different than the other in regard to the tiny dotted texture. You may also note a larger perimeter margin before the tiny dotted texture pattern begins. Consistent orientation of each tile is required in order that the truncated domes on adjacent tiles line up with each other.

N. In order to maintain proper spacing between truncated domes on adjacent tiles, the tapered edge should be trimmed off using a continuous rim diamond blade in a circular saw or mini-grinder. The use of a straightedge to guide the cut is required. All cuts should be made prior to installation of the tiles. If installing adjacent tiles, care should be taken to leave a 1/8 -inch gap between each tile to allow for expansion and contraction.

O. If tiles are custom cut to size, if pre-molded recesses (to receive fasteners) are removed by the cut, or to maintain a tight installation to the substrate then any truncated dome can be center-drilled with a 1/4 -inch masonry drill bit to create a through hole, and the through hole must be countersunk with a suitable carbide countersink bit to receive mechanical fasteners. Care should be taken to not countersink too widely or deeply. Fasteners should be flush with the top of the truncated dome when countersunk properly.

3.3 CAST-IN-PLACE INSTALLATION

A. The installation of the structural embedment flange system and related materials shall be in strict accordance with the contract documents and the guidelines set by their respective manufacturers. Not recommended for asphalt applications.

B. The physical characteristics of the concrete shall be consistent with the contract specifications while maintaining a slump range of 4 to 7 permitting solid placement of the Cast In Place Detectable/Tactile Warning Surface Tile system. An overly wet mix will cause the tile to float. Under these conditions, suitable weights such as 2 concrete blocks or sandbags (25 lb) shall be placed on each tile.

C. The concrete pouring and finishing operations require typical mason's tools, however, a 4 –feet long level with electronic slope readout, 25 lb. weights, and a large non-marring rubber mallet are specific to the installation of the Cast-In-Place Detectable/Tactile Warning Surface Tile system. A vibrating mechanism such as that manufactured by Vibco can be employed, if desired. The vibrating unit should be fixed to a soft base such as wood, at least 1 -foot square.

D. The factory-installed plastic sheeting must remain in place during the entire installation process to prevent the splashing of concrete onto the finished surface of the tile.

E. When preparing to set the tile, it is important that no concrete be removed in the area to accept the tile. It is imperative that the installation technique eliminates any air voids under the tile. Holes in the tile perimeter allow air to escape during the installation process. Concrete will flow through the large holes in each embedment flange on the underside of the tile. This will lock the tile solidly into the cured concrete.

F. The concrete shall be poured and finished true and smooth to the required dimensions and slope prior to the tile placement. Immediately after finishing concrete, the electronic level should be used to check that the required slope is achieved. The tile shall be placed true and square to the curb edge in accordance with the contract drawings. The Cast-In-Place Detectable/Tactile Warning Surface Tiles shall be tamped (or vibrated) into the fresh concrete to ensure that the field level of the tile is flush to the adjacent concrete surface. The embedment process should not be accomplished by stepping on the tile as this may cause uneven setting which can result in air voids under the tile surface. The contract drawings indicate that the tile field level (base of truncated dome) is flush to adjacent surfaces to permit proper water drainage and eliminate tripping hazards between adjacent finishes.

G. In cold weather climates it is recommended that the Cast-In-Place Detectable/Tactile Warning Surface Tiles be set deeper such that the top of domes are level to the adjacent concrete on the top and sides of ramp and that the base of domes to allow water drainage. This installation will reduce the possibility of damage due to snow clearing operations.

H. Immediately after placement, the tile elevation is to be checked to adjacent concrete. The elevation and slope should be set consistent with contract drawings to permit water drainage to curb as the design dictates. Ensure that the field surface of the tile is flush with the surrounding concrete and back of curb so that no ponding is possible on the tile at the back side of curb.

I. While concrete is workable, a 3/8-inch radius edging tool shall be used to create a finished edge of concrete, then a steel trowel shall be used to finish the concrete around the tile's perimeter, flush to the field level of the tile.

J. During and after the tile installation and the concrete curing stage, it is imperative that there is no walking, leaning or external forces placed on the tile that may rock the tile causing a void between the underside of tile and concrete.

K. Following tile placement, review installation tolerances to contract drawings and adjust tile before the concrete sets. Two suitable weights of 25 lb each may be required to be placed on each tile as necessary to ensure solid contact of the underside of tile to concrete.

L. Following the concrete curing stage, protective plastic wrap is to be removed from the tile surface by cutting the plastic with a sharp knife, tight to the concrete/tile interface. If concrete bled under the plastic, a soft brass wire brush will clean the residue without damage to the tile surface.

M. If desired, individual tiles can be bolted together using 1/4-inch or equivalent hardware. This can help to ensure that adjacent tiles are flush to each other during the installation process. Tape or caulking can be placed on the underside of the bolted butt joint to ensure that concrete does not rise up between the tiles during installation. Any protective plastic wrap which was peeled back to facilitate bolting or cutting, should be replaced and taped to ensure that the tile surface remains free of concrete during the installation process.

N. Tiles can be cut to custom sizes, or to make a radius, using a continuous rim diamond blade in a circular saw or mini-grinder. Use of a straightedge to guide the cut is advisable where appropriate.

O. Any sound-amplifying plates on the underside of the tile, which are dislodged during handling or cutting, should be replaced and secured with construction adhesive. The air gap created between these plates and the bottom of the tile is important in preserving the sound on cane audible properties of the tile system as required.

3.4 CLEANING, PROTECTING AND MAINTENANCE

A. Protect tiles against damage during construction period to comply with Tactile Tile manufacturer's specification.

B. Protect tiles against damage from rolling loads following installation by covering with plywood or hardwood.

C. Clean Tactile Tiles not more than four days prior to date scheduled for inspection intended to establish date of substantial completion in each area of project. Clean Tactile Tile by method specified by Tactile Tile manufacturer.

D. Comply with manufacturers maintenance manual for cleaning and maintaining tile surface and it is recommended to perform annual inspections for safety and tile integrity.

- END OF SECTION -

DIVISION 33 – UTILITIES

TABLE OF CONTENTS

Pages

- SECTION 33 0200 -

GENERAL PROVISIONS FOR UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Extent of civil earthwork development work is shown on drawings and in schedules, typically.
   1. The work includes, but is not limited to:
      a. Water Utility Distribution Piping service facilities and appurtenances including the installation and testing.
      b. Sanitary Utility Sewerage Piping gravity system – sewer laterals, onsite sewer mains and appurtenances, manholes and structures, modification and removal of portions of existing on-site sewer mains, as indicated in Civil Drawings.
      c. Storm Utility Drainage Piping system – storm drain lines, trench drains and appurtenances and subdrain system, grease trap structure and other drainage improvements, manholes and structures as indicated in Civil Drawings.

B. Specifications and/or information in Civil Drawings shall govern over these specifications.

1.3 RELATED REQUIREMENTS

A. Refer to Civil Drawings.

B. Division 01 Section pertaining to construction site cleaning.

C. Section 01 5000 "Temporary Facilities and Controls" for temporary utility services, construction and support facilities, security and protection facilities, and temporary erosion- and sedimentation-control measures.

D. Section 01 7300 "Execution" for field engineering and surveying.

E. Section 02 3200 “Subsurface Investigation”.

G. Section 02 4116 “Structure Demolition”.

H. Section 03 3000 “Cast-In-Place Concrete”.

I. Section 21 1000 “Fire Suppression Systems”.

J. Section 31 0200 “General Provisions for Earthwork” for earth moving, trenching and backfilling.

K. Section 31 3116 “Termite Control”.

L. Section 32 0200 “General Provisions for Exterior Improvements”.

1.4 REFERENCES

A. “Phoenix Building Construction Code”, International Building Code 2006, with City of Phoenix administrative provisions and amendments.

B. American National Standards Institute (ANSI).
1. ANSI A10.6, Latest Demolition Operations-Safety Requirements.

C. American Society For Testing and Materials (ASTM).
1. ASTM D1785 PolyVinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80 and 120.
2. ASTM D2466 (Vinyl Chloride) (PVC) Plastic Pipe Fitting, Schedule 40.
3. ASTM D2564 Solvent Cements for PolyVinyl Chloride (PVC) Plastic Pipe and Fittings.
4. ASTM D2774 (R Latest) Underground Installation of Thermoplastic Pressure Piping.
5. ASTM D2855 Making Solvent-Cemented Joints with PolyVinyl Chloride (PVC) Pipe and Fittings.
6. ASTM F402 Safe Handling of Solvent Cements and Primers Used for Joining Thermoplastic Pipe and Fittings.

D. American Water Works Association (AWWA), www.awwa.org .
1. AWWA C-900 Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. Through 12 in., For Water.
2. AWWA C-509-80 Resilient-seated Gate Valve, 3 in. Through 12 in. NPS, For Water.
3. AWWA C-800 Underground Services Line Valves and Fittings.
4. AWWA M-23 PVC Pipe-Design and Installation.

E. Underwriters Laboratories, Inc. (UL), www.ul.com
1. UL 262 Gate Valves For Fire Protection Service, Sixth Edition.
2. UL 312 Check Valves For Fire Protection Service Seventh Edition.
3. UL 789 Indicator Posts For Fire-Protection Service, Eighth Edition.

F. Department of Transportation, latest publications for applicable jurisdiction/agency.

G. Geotechnical Report, refer to Section 02 3200 “Subsurface Investigation”.

H. National Fire Protection Association (NFPA): All fire service mains and pertinences shall comply with NFPA Latest Edition. In case on conflict between the drawings and NFPA 24, NFPA 24 requirements shall take precedence.

I. Uni-bell Plastic Pipe Association (UBPPA), www.uni-bell.org .
1. UBPPA UNI-B-8 Direct Tapping of Polyvinyl Chloride (PVC) Pressure Water Pipe
2. UNI B5 Installation of Polyvinyl Chloride (PVC) Sewer Pipe

3. UNI B6 Low-Pressure Air Testing of Installed Sewer Pipe

J. Uniform Standard Specifications for Public Works Construction, Sponsored and Distributed by the Maricopa Association of Governments, 2013 Revision to the 2012 Edition, Arizona (MAG).

K. Water district providing water to project.

1.5 DEFINITIONS

A. Refer to Civil Drawings.

B. FRP: Fiberglass-reinforced plastic.

1.6 SUBMITTALS

A. General: Submit in accordance with Section 01 3300.

B. Provide complete submittals at the same time as submittals for work in related sections to permit review of complete and integrated systems and assemblies.

C. Product Data: For each type of the following manufactured products required:
1. Materials specific to scope of work including, but not limited to:
   a. Water Utility:
      1) Pipe and Fittings.
      2) Joints and Couplings.
      3) Valves, including reduced pressure BFP.
      4) Valve and Meter Boxes.
      5) Fire Hydrants, Post Indicator Valves and Fire Department Connections.
      6) Technical data and tested physical and performance properties.
   b. Sanitary Utility:
      1) Pipe and Fittings.
      2) Pipe joint materials.
   c. Storm Utility:
      1) Pipe and Fittings.
      2) Pipe Joint Materials.
      3) Precast Concrete Catch Basins and Cleanouts.
      4) Plastic Area Drains (NDS, etc.).
      5) Specialty Metal Area Drains (Zurn, etc.).

D. Submit manufacturer's standard drawings or catalog cuts.

E. Certificates of Compliance:
1. General:
   a. Shall confirm and state that products meet the requirements specified, and that tests set forth in each applicable referenced publication have been performed, whether specified in that publication to be mandatory or otherwise and that

production control tests have been performed at the intervals or frequency specified in the publication.

1) Other tests shall have been performed within 3 years of the date of submittal of certificates on the same type, class, grade, and size of material as is being provided for the project.

2) Refer to Civil Drawings.

3) Refer to specific documents herein referenced, including but not limited to; Uniform Standard Specifications for Public Works Construction.

2. Water Utility:
   a. Pipe and Fittings.
   b. Pipe Joint Materials.
   c. Valves.
3. Sanitary:
   a. Pipe and Fittings.
   b. Pipe Joint Materials.
4. Storm Utility:
   a. Pipe and Fittings.
   b. Pipe Joint Materials.
   c. Precast Concrete Catch Basins and Cleanouts.
   d. Plastic Area Drains (NDS, etc.).
   e. Specialty Metal Area Drains (Zurn, etc.).

F. Shop Drawings:
1. Refer to Civil Drawings.
2. Storm Utility:
   a. Manholes: Include plans, elevations, sections, details, frames, and covers.
   b. The following when indicated in Civil Drawings: Catch basins, stormwater inlets and dry wells.
      1) Include plans, elevations, sections, details, frames, covers, and grates.
   c. Detention Structures: Include plans, elevations, sections, details, frames, covers, design calculations, and concrete design-mix reports.

1.7 INFORMATIONAL SUBMITTALS

A. Material Certificates:
1. Refer to Civil Drawings.
2. Piping and appurtenances.

B. Coordination Drawings:
1. Storm Utility:
   a. Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures
      1) Refer also to Civil Drawings.

C. Profile Drawings:

1. Storm Utility:
   a. Show storm drainage system piping in elevation. Draw profiles at horizontal scale of not less than 1 -inch equals 50 feet (1:500) and vertical scale of not less than 1 -inch equals 5 -feet (1:50). Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping if not indicated in Civil Drawings.

1.8 DELIVERY, STORAGE AND HANDLING

A. Refer to Civil Drawings.

B. Do not store plastic manholes, pipe, and fittings in direct sunlight.

C. Protect pipe, pipe fittings, and seals from dirt and damage.

D. Handle manholes according to manufacturer's written rigging instructions.

E. Handle catch basins and stormwater inlets according to manufacturer's written rigging instructions.

1.9 PROTECTION

A. The contractor shall notify UNDERGROUND SERVICE ALERT (USA) at 1-800-227-2600 at least two days prior to starting work and shall coordinate all work with utility company representatives.
   1. The existence and locations of existing underground facilities shown on the drawings were obtained from a search of available records. The contractor shall take precautionary measures to protect any existing facility shown on the drawings, and any other that is not of record or not shown on the drawings. The Contractor shall determine the exact location of all existing utilities before commencing the work, and shall be fully responsible for any and all damages that might be occasioned by the Contractor's failure to exactly locate and preserve any and all underground utilities.

B. Prior to commencing the work, the Contractor shall pothole all existing utilities at all crossing points and points of connection.

C. Shoring:
   1. Refer to Civil Drawings.
   2. Refer to specific documents herein referenced, including but not limited to; Uniform Standard Specifications for Public Works Construction.
   3. Refer to Section 31 0200 “General Provisions for Earthwork”.

1.10 PROJECT CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
   1. Notify Architect and Owner in agreed upon amount of time prior to proposed interruption of service.
   2. Do not proceed with interruption of service without written permission.

1.11 SITE INSPECTION AND LOCATION OF EXISTING ON-SITE UTILITIES

A. Prior to all work of this Section, carefully inspect the entire site and all existing items to be demolished and removed or to be left intact, and determine an orderly sequence for the performance of this work.

1.12 SAFETY DURING CONSTRUCTION

A. The Contractor shall assume complete and sole responsibility for all job site conditions during the course of project construction, including but not limited to; safety of all persons and property.

1. This requirement shall be established to apply continuously and not be limited to normal working hours.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Refer to Civil Drawings.

2.2 MATERIALS

A. Refer to Civil Drawings.

B. Refer to specific documents herein referenced, including but not limited to; standard specifications for ‘Public Works Projects’.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas within scope of work for compliance with requirements and conditions affecting installation and performance.

3.2 EARTHWORK

A. Refer to Civil Drawings.

B. Refer to specific documents herein referenced, including but not limited to; standard specifications for ‘Public Works Projects’.

C. Refer to Section 31 0200 “General Provisions for Earthwork”

3.3 PREPARATION

A. Refer to Civil Drawings.

B. Refer to specific documents herein referenced, including but not limited to; standard specifications for 'Public Works Projects'.

3.4 PIPING INSTALLATION

A. Water Utility:
1. Refer to Civil Drawings.
2. Refer to specific documents herein referenced, including but not limited to; standard specifications for 'Public Works Projects'.

B. Sanitary Utility:
1. Refer to Civil Drawings.
2. Refer to specific documents herein referenced, including but not limited to; standard specifications for 'Public Works Projects'.
3. Install sanitary pipelines and appurtenances in conformance with the provisions of applicable Standard Specifications, and the following requirements, unless required otherwise by Civil Drawings or Standard specifications for 'Public Works Projects':
   a. Location: The work covered by this section shall terminate at a point approximately 5 -feet from the building, or as indicated.
      1) When the location of the sewer piping is not clearly defined by dimensions on the drawings, do not lay sewer line closer horizontally than 10 -feet to a water main or service line.
      2) Where sanitary sewer lines pass below water lines, lay pipe so that no joint in the sewer line will be closer than 3 -feet, horizontal distance, to the water line.
   b. Earthwork and Buried Warning Tape: Perform earthwork operations including installation of buried warning tape in accordance with;
      1) Civil Drawings.
      2) Standard specifications for 'Public Works Projects'.
      3) Section 31 0200 "General Provisions for Earthwork"
   c. Pipe Laying and Jointing: Inspect each pipe and fitting before and after installation; replace those found defective and remove from site. Provide proper facilities for lowering sections of pipe into trenches. Lay non-pressure pipe with the bell or groove ends in the upgrade direction. Adjust spigots in bells and tongues in grooves to give a uniform space all around. Blocking or wedging between bells and spigots will not be permitted. Replace by one of the proper dimensions, pipe or fittings that do not allow sufficient space for installation of joint material. At the end of each workday, close open ends of pipe temporarily with wood blocks or bulkheads. Provide batterboards not more than 25 -feet apart in trenches for checking and ensuring that pipe invert elevations are as indicated. Laser beam method may be used in lieu of batterboards for the same purpose. Additionally comply with the following which will take precedence:
      1) Civil Drawings.
      2) Standard specifications for 'Public Works Projects'.
   d. Concrete encasement: Encase sewer lateral in locations indicated on the drawings, in accordance with Standard Drawing for 'Public Works Projects'.

C. Storm Utility:
1. Refer to Civil Drawings.
2. Refer to specific documents herein referenced, including but not limited to; standard specifications for 'Public Works Projects'.
3. Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

3.5 PROTECTION

A. Refer to Civil Drawings.

B. Refer to specific documents herein referenced, including but not limited to; standard specifications for 'Public Works Projects'.

3.6 FIELD QUALITY CONTROL

A. Water Utility:
1. Refer to Civil Drawings which would take precedence over these specifications.
2. Refer to specific documents herein referenced, including but not limited to; standard specifications for 'Public Works Projects' which would take precedence over these specifications.
3. Field Tests and Inspections: The Contractor shall perform pipeline testing in accordance with applicable Standard Specifications. The Contractor shall produce evidence, when required, that any item of work has been constructed in accordance with the drawings and specifications.
4. Testing Procedure: Test water mains and water service lines in accordance with the applicable specified standard.
   a. Test PVC plastic water service lines made with PVC plastic water main pipe in accordance with the requirements of applicable standard specifications and Civil Drawings.
   b. Test water service lines in accordance with applicable requirements of AWWA C600 for hydrostatic testing.
      1) No leakage will be allowed at plastic pipe joints.
5. Special Testing Requirements:
   a. Refer to Civil Drawings and standard specifications for 'Public Works Projects.
   b. If testing is not otherwise indicated, please conform to the following;
      1) Use a hydrostatic pressure 50 psi greater than the maximum working pressure of the system, except that for those portions of the system having pipe size larger than 2 -inches in diameter, hydrostatic test pressure shall be not less than 200 psi. Hold this pressure not less than 2 hours. Prior to the pressure test, fill that portion of the pipeline being tested with water for a soaking period of not less than 24 hours. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test.

B. Storm Utility:

1. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (610 mm) of backfill is in place, and again at completion of Project.
   a. Refer to Civil Drawings which would take precedence over these specifications.
   b. Refer to specific documents herein referenced, including but not limited to; standard specifications for 'Public Works Projects' which would take precedence over these specifications.
   c. Submit separate reports for each system inspection.
   d. Defects requiring correction include the following, but are not limited to:
      1) Alignment: Less than full diameter of inside of pipe is visible between structures.
      2) Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
      3) Damage: Crushed, broken, cracked, or otherwise damaged piping.
      4) Infiltration: Water leakage into piping.
      5) Exfiltration: Water leakage from or around piping.
   e. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
   f. Reinspect and repeat procedure until results are satisfactory.
2. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
   a. Refer to Civil Drawings which would take precedence over these specifications.
   b. Refer to specific documents herein referenced, including but not limited to; standard specifications for 'Public Works Projects' which would take precedence over these specifications.
   c. Do not enclose, cover, or put into service before inspection and approval.
   d. Test completed piping systems according to requirements of authorities having jurisdiction.
   e. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
   f. Submit separate report for each test.
   g. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction.
      1) Refer to Civil Drawings.
      2) Refer to specific documents herein referenced, including but not limited to; standard specifications for 'Public Works Projects'.
   h. Force-Main Storm Drainage Piping: Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressures in accordance with;
      1) Civil Drawings.
      2) AWWA Standards applicable to work and pipe type.
3. Leaks and loss in test pressure constitute defects that must be repaired.
4. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

C. Sanitary Utility:
   1. Tests for Nonpressure Sanitary Utility Drainage Lines:
      a. Refer to Civil Drawings.
      b. Refer to specific documents herein referenced, including but not limited to; standard specifications for 'Public Works Projects' including, but not limited to;
         1) Leakage Tests.
         2) Field inspection for plastic pipe fittings.
         3) Televising sewer manholes and storm drains.
         4) Balling of sewers.
   2. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
      a. Refer to Civil Drawings which would take precedence over these specifications.
      b. Refer to specific documents herein referenced, including but not limited to; standard specifications for 'Public Works Projects' which would take precedence over these specifications.
      c. Do not enclose, cover, or put into service before inspection and approval.
      d. Test completed piping systems according to requirements of authorities having jurisdiction.
      e. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
      f. Submit separate report for each test.
   3. Leaks and loss in test pressure constitute defects that must be repaired.
   4. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.7 WASTE MATERIALS AND HANDLING

A. Remove surplus material and legally dispose of them off Owner's property.
   1. Handle waste material according to approved waste management plan.
   2. Refer to Section 01 7400 "Cleaning And Construction Waste Management".

3.8 CLEANING AND CLEANUP

A. During civil work, keep work area in an orderly condition. Haul away and remove all debris from areas.

B. Clean interior of piping of dirt and superfluous materials.
   1. Flush with potable water.

- END OF SECTION -