DIVISION 21: FIRE SUPPRESSION

21 1000 WATER-BASED FIRE SUPPRESSION SYSTEMS

21 1313 WET-PIPE SPRINKLER SYSTEMS

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SECTION 21 1313

WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install complete wet-pipe fire sprinkler system as specified in Contract Documents.
   2. Furnish and install Firestop Penetration Systems for fire sprinkler system penetrations as described in Contract Documents.
   3. No glycol is to be used. Provide dry sidewall or pendant heads where protection extends beyond the thermal envelope of building – see Drawings.
   4. Coordinate hanger installation with spray foam schedule.

B. Related Requirements:
   1. Section 07 8400: 'Firestopping' for quality of Penetration Firestop Systems to be used on Project and submittal requirements.
   2. Section 28 3101: 'Fire Detection and Alarm System' for fire detection and alarm annunciation panels including connection of tamper switches and flow detectors to alarm system and furnishing and installing of low temperature switch.
   3. Section 33 1119: 'Fire Suppression Utility Water Distribution Piping'.

1.2 REFERENCES

1. Canadian Automatic Sprinkler Association:
   a. Applicable requirements as published by the Canadian Automatic Sprinkler Association (CASA).

1.3 SUBMITTALS

A. Action Submittals:
   1. Shop Drawings:
      a. Size sprinkler system using NFPA 13 hydraulic calculation design method based on water supply evaluation performed at building site:
         1) On submittals, refer to sprinkler heads by sprinkler identification or model number published in appropriate agency listing or approval. Trade names and other abbreviated designations are not acceptable.
      b. Submittal Procedure:
         1) After award of Contract and before purchase of equipment, submit seven sets of shop drawings with specifications and hydraulic calculations to Fire Sprinkler Consultant and two (2) sets to local jurisdiction having authority for fire prevention for review. If pipe schedule method is used, submit copies of schedules in NFPA 13 used in sizing pipe.
         2) After integrating Fire Sprinkler Consultant's and AHJ's comments into drawings, licensed certified fire protection engineer of record who designed fire protection system shall stamp, sign, and date each sheet of shop drawings and first page of specifications and calculations.
         3) Submit stamped documents to Owner and to AHJ for fire prevention for final approval.
         4) After final approval, submit four copies of approved stamped documents to Fire Sprinkler Consultant.
         5) Failure of system to meet requirements of authority having jurisdiction and/or approved stamped construction documents shall be corrected at no additional cost to Owner.

B. Informational Submittals:
   1. Certificates:

a. Provide one (1) copy of completed NFPA 13 'Contractor's Material and Test Certification for Aboveground Piping' as specified in 'Field Quality Control' in Part 3 of this specification:

2. Qualification Statement:
   a. Licensed fire protection engineer or fire protection system designer:
      1) Licensed for area of Project.
      2) Provide Qualification documentation if requested by Fire Sprinkler Consultant or Owner’s Representative.
   b. Installer:
      1) Provide Qualification documentation if requested by Fire Sprinkler Consultant or Owner’s Representative.

C. Closeout Submittals:
1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
   a. Operations and Maintenance Data:
      1) Maintenance and instructions.
         a) List of system components used indicating name and model of each item.
         b) Manufacturer's maintenance instructions for each component installed in Project.
         c) Instructions shall include installation instructions, parts numbers and lists, operation instructions of equipment, and maintenance and lubrication instructions.
   b. Warranty Documentation:
      1) Include copies of required warranties.
   c. Record Documentation:
      1) Include copies of approved shop drawings.
      2) Provide master index showing items included.
      3) Provide name, address, and phone number of Architect, Fire Sprinkler Consultant, General Contractor, and Fire Protection subcontractor.
      4) Provide operating instructions to include:
         a) General description of fire protection system.
         b) Step by step procedure to follow for shutting down system or putting system into operation.
      5) Provide signed copy of NFPA 13 'Contractor's Material and Test Certification for Aboveground Piping'.
2. Instruction of Owner (as specified in Part 3 of this specification):
   a. Provide Owner with copy of latest version of NFPA 25.

D. Maintenance Material Submittals:
1. Extra Stock Materials:
   a. Spare sprinkler heads in the quantity recommended by NFPA 13 selected in representative proportion to quantity used in Project and in accordance with NFPA 13 (Six (6) spare sprinkler heads minimum). Do not include dry barrel Pendent and dry barrel Sidewall sprinkler heads.
   b. Provide spare heads in cabinet with sprinkler head wrench for each type of head used. After approval of cabinet and contents, mount cabinet in convenient location in Riser Room.

1.4 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:
1. Unless noted otherwise, system shall conform to:
   a. NFPA 13, 'Light & Ordinary Hazard Occupancies’.
   b. NFPA 24, 'Service Mains and Their Appurtenances, Private’.
   c. NFPA 25, ‘Inspection, Testing, and Maintenance.
   d. NFPA 101, 'Life Safety Code’.
   e. Requirements of local water department and local authority having jurisdiction for fire protection.
   f. Applicable requirements as published by the Canadian Automatic Sprinkler Association (CASA).
   g. Comply with backflow prevention requirements and, if required, include device in hydraulic calculations.
   h. Applicable rules, regulations, laws, and ordinances.

B. Qualifications:
   1. Licensed fire protection engineer or fire protection system designer engaged in design of fire protection systems. Engineer / designer shall:
      a. Licensed for area of Project.
      b. Minimum five (5) years experience in fire protection system installations.
      c. Minimum five (5) satisfactorily completed installations in past three (3) years of projects similar in size, scope, and complexity required for this project before bidding.
      d. Be responsible for overseeing preparation of shop drawings, hydraulic calculations where applicable, and system installation.
      e. Make complete inspection of installation.
      f. Provide corrected record drawings to Owner with letter of acceptance.
      g. Certify that installation is in accordance with Contract Documents.
      h. Upon request, submit documentation.
   2. Installer:
      a. Licensed for area of Project.
      b. Minimum five (5) years experience in fire protection system installations.
      c. Minimum five (5) satisfactorily completed installations in past three (3) years of projects similar in size, scope, and complexity required for this project before bidding.
      d. Upon request, submit documentation.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Manufacturers:
   1. Manufacturer Contact List:
      a. Croker Corp, Elmsford, NY www.croker.com.
      b. Gruvlock by Anvil International, Portsmouth, NH www.anvilintl.com.
      c. HO Trerice Company, Oak Park, MI www.hotco.com.
      d. Kennedy Valve, Elmira, NY www.kennedyvalve.com.
      e. Milwaukee Valve Co, New Berlin, WI www.milwaukeevalve.com.
      f. Mueller Company, Decatur, IL www.muellerflo.com.
      g. Nibco Inc, Elkhart, IN www.nibco.com.
      h. Notifier by Honeywell, Northford, CT www.notifier.com.
      i. Potter Electric Signal Company, St. Louis, MO www.pottersignal.com.
      j. Potter-Roemer, Cerritos, CA www.potterroemer.com.
      k. Reliable Automatic Sprinkler Co, Mount Vernon, NY www.reliablesprinkler.com.
      l. System Sensor, St Charles, IL www.systemsensor.com.
      m. TYCO Fire & Building Products, Lansdale, PA www.tyco-fire.com.
      n. Victualic Company of America, Easton, PA or Victualic Company of Canada, Rexdale, ON www.victaulic.com.
      o. Viking Corp, Hastings, MI www.vikingcorp.com.

B. Description:
   1. Automatic wet-pipe fire sprinkler system starting at flange in Fire Riser Room 124 and extending throughout heated portions of building.
   2. Building is constructed with a warm attic and overbuild areas – see Drawings.
   3. Cold areas (exterior penetrations at canopies) to be protected with dry sprinkler heads.
   4. Dry sprinkler heads preferred over and into Vestibules.

C. Performance:
   1. Design Criteria:
      a. Area of Application and Corresponding Design Density:
         1) Serving Area and Mechanical, Electrical, and Janitorial Areas:
            a) Ordinary Hazard Group 1.
            b) Design density = 0.15 gpm per sq ft over 1,500 sq ft.
         2) Storage Areas:

a) Ordinary Hazard Group 2.
b) Design density = 0.20 gpm per sq ft over 1,500 sq ft.

3) All Other Areas:
a) Light Hazard.
b) Design density = 0.10 gpm per sq ft over 1,500 sq ft.

4) Increase remote areas by 30 percent where ceiling / roof is sloped more than 2 inches per ft.

5) Remote areas may be reduced within parameters indicated in NFPA 13 for use of quick response sprinklers throughout.

b. Maximum Coverage per Sprinkler Head:
1) Ordinary Hazard Areas: 130 sq ft.
2) Attic Areas: 120 sq ft.
3) Light Hazard Areas: 225 sq ft.

c. Design Area shall be hydraulically most remote area in accordance with NFPA 13.
1) Provide a 10% safety allowance under adjusted water flow supply curve.

d. Maximum velocity of water flow within piping: 20 feet per sec.

D. Components:
1. General: Use only domestically manufactured cast iron pipe fittings, valves, sprinkler heads, and other components.
a. Pipe of foreign manufacture that meets ASTM Standards is acceptable.
b. Ductile iron fittings of foreign manufacture are acceptable.
2. Pipe:
a. Schedule 40 Welded Steel:
1) Exterior, Above Ground: Schedule 40 hot-dip galvanized welded steel meeting requirements of ASTM A53/A53M, ASTM A135/A135M or ASTM A795/A795M.
2) Interior, Above Ground: Schedule 40 black welded steel meeting requirements of ASTM A53/A53M, ASTM A135/A135M or ASTM A795/A795M.
3) Connections:
a) 2 inches And Smaller: Screwed, flanged, or roll grooved coupling system.
b) 2-1/2 inches And Larger: Flanged or roll grooved coupling system.
3. Fittings:
a. Usage:
1) 2 inches And Smaller: Welded, screwed, flanged, or roll grooved coupling system. For use with schedule 40 carbon steel pipe.
2) 2-1/2 inches And Larger: Welded, flanged, or roll grooved coupling system.
b. Types And Quality:
1) Screwed:
a) Cast iron meeting requirements of ANSI B16.4 or ductile iron meeting requirements of ANSI B16.3 and ASTM A536, Grade 65-45-12.
b) Threaded fittings and pipe shall have threads cut to ANSI B1.20.1.
c) Do not extend pipe into fittings to reduce waterway.
d) Ream pipe after cutting to remove burrs and fins.
2) Flanged: Steel meeting requirements of ANSI B16.5.
3) Welded:
a) Carbon steel meeting requirements of ASTM A234/A234M.
b) Weld pipe using methods complying with AWS B2.1, level AR-3. Welding procedures and performance of welders shall comply with AWS B2.1, level AR3.
4) Roll Grooved Pipe Coupling System:
a) Ductile iron meeting requirements of ASTM A395/A395M and ASTM A536, and ULC listed.
b) Grooved products used on Project shall be from same manufacturer. Grooving tools shall be as recommended by manufacturer of grooved products.
c) Category Four Approved Products: See Section 01 6200 for definition of Categories:

	Gruvlok	Tyco (Grinnell)	Victaulic
Rigid Couplings	7401	772	Style 005
Flexible Couplings [1]	7000	705	Style 75

Flange Adaptors [2]	7012	71	Style 744
Grooved Coupling Gaskets [3]	'E' EPDM	Grade 'E' EPDM	'E' EPDM [4]

[1] Use in locations where vibration attenuation, stress relief, thermal expansion, or seismic design is required / needed.
[2] Class 125 or 150.
[3] Temperature rated 30 to 150 deg F. NSF-61 certified.
[4] Grade 'A'.

c. Use of saddle or hole cut type mechanical tees is **NOT APPROVED**.

4. Valves:
   a. Butterfly Valves:
      1) Design Criteria:
         a) UL / ULC / CASA approved.
         b) Indicating type.
      2) Category Four Approved Products: See Section 01 6200 for definitions of Categories:
         a) Milwaukee:
            (1) Model BB-SCS02 threaded ends with tamper switch one inch to 2 inches.
            (2) Model BBVSCS02 Grooved ends with tamper switch 2 inches to 2-1/2 inch.
         b) Nibco:
            (1) Model WD3510-8 Wafer type with valve tamper switch.
            (2) Model GD4765-8N Grooved type with valve tamper switch, 2-1/2 inches to 8 inches.
         c) Tyco (Grinnell):
            (1) Model BFV-N wafer.
            (2) Model BFV-N grooved.
         d) Victaulic: Series 705W Grooved end type with internal supv. switches.
         e) Kennedy:
            (1) Model 01W wafer.
            (2) Model G300 grooved.
   b. Gate Valves:
      1) Design Criteria:
         a) UL / ULC / CASA approved.
         b) Outside Screw and Yoke Type (O.S.&Y).
         c) Class 150 psi.
      2) Category Four Approved Products: See Section 01 6200 for definitions of Categories:
         a) Nibco:
            (1) T-104-0 with Threaded Ends 1/2 inchto 2 inches.
            (2) F-637-31 Flanged Ends.
         b) Mueller: R-2360-6 Flanged Ends.
         c) Victaulic: Series 771 Grooved Ends
   c. Ball Valves:
      1) Design Criteria:
         a) UL / ULC / CASA approved.
         b) Valve tamper switch.
      2) Category Four Approved Products: See Section 01 6200 for definitions of Categories:
         a) Milwaukee: BB-SCS02 with threaded ends.
         b) Nibco: KT-505 with threaded ends.
         c) Nibco: KG-505 with grooved ends.
         d) Victaulic: Series 728 with grooved or threaded ends.
   d. Swing Check Valves:
      1) 1/2 to 3 inch horizontal check.
         a) Design Criteria:
            (1) Regrinding type.
            (2) Renewable disk.
            (3) Bronze Class 125 with threaded ends.
         b) Category Four Approved Products: See Section 01 6200 for definitions of Categories:
            (1) Nibco: KT-403-W.
            (2) Victaulic: Series 712.
            (3) Viking: G-1 Grooved ends.

2) 2 to 4 inch Horizontal check:
   a) Design Criteria:
      (1) Grooved ends.
      (2) Ductile iron body.
      (3) Rated 300 psi.
   b) Category Four Approved Products: See Section 01 6200 for definitions of Categories:
      (1) Tyco (Grinnell): CV-1F Grooved ends.
      (2) Victaulic: Series 712.
      (3) Viking: G-1 Grooved ends.
3) 3 to 12 inch Horizontal check:
   a) Design Criteria:
      (1) Bolted bonnet.
      (2) Raised face flanges.
      (3) Bronze mounted with ductile iron body.
      (4) 125 lb Class A.
   b) Category Four Approved Products: See Section 01 6200 for definitions of Categories:
      (1) Nibco: F-938-31.
      (2) Mueller: A-2120-6.
      (3) Viking: F-1 grooved and flanged.

e. Wafer Type Check Valves:
   1) Design Criteria:
      a) 4 to 8 inch cast iron body.
      b) 175 psi minimum working pressure.
      c) Rubber Seat.
   2) Category Four Approved Products: See Section 01 6200 for definitions of Categories:
      a) Nibco: KW-900-W.
      b) Mueller: A-2102.
      c) Kennedy: Fig.706.

f. Grooved-End Check Valves:
   1) Design Criteria:
      a) UL / ULC / CASA listed and approved to 250 psi maximum operating pressure.
      b) 2-1/2 to 12 inch ductile iron body.
      c) Disc And Seat:
         (1) 2-1/2 And 3 Inch: Aluminum bronze disc with mounted elastomer seal and PPS (polyphenylene sulfide) coated seat.
         (2) 4 Inch And Larger: Elastomer encapsulated ductile iron disc with welded in nickel seat.
         (3) Viking: Model VK462.
   2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      a) Nibco: KG-900-W grooved ends.
      b) Victaulic: Series 717.
      c) Kennedy: Fig.426.

g. Alarm Check Valves:
   1) Category Four Approved Products: See Section 01 6200 for definitions of Categories:
      a) Reliable: E with gauges and drain.
      b) Tyco (Grinnell): Model AV-1-300.
      c) Victaulic: Series 751 with gauges and drain.
      d) Viking: J-1 with gauges and drain.

h. Backflow Preventer: Make and model shown on Drawings or as required by local codes.

i. Retard Chamber:
   1) Design Criteria:
      a) Self-draining.
   2) Category Four Approved Products: See Section 01 6200 for definitions of Categories:
      a) Reliable: E-1.
      b) Victaulic: Series 752.
      c) Viking: C-1.

j. Inspector's Test Valve:
   1) Design Criteria:

a) Bronze body with threaded or grooved ends.
b) Combination sight glass / orifice.

2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
a) Tyco (Grinnell): Model F350.
b) Victaulic: Testmaster Alarm Test Module Style 720.

5. Sprinkler Heads:
a. Concealed Pendant:
1) Design Criteria:
a) Adjustable cover.
b) UL / ULC / CASA listed and approved.
c) Coordinate concealed cover finish with Fire Sprinkler Consultant.
2) Type One Acceptable Products:
a) Wet Pendant, Flat Profile:
(1) Reliable: F4FR.
(2) Victaulic: Model 3802.
(3) Viking: Model VK462.
(4) Tyco (Grinnell): Model RF11.
(5) Equal as approved by Fire Sprinkler Consultant before bidding. See Section 01 6200.
b) Dry Pendant:
(1) Flat Profile:
(a) Tyco (Grinnell): DS-C.
(b) Victaulic: V3618.
(2) Equal as approved by Fire Sprinkler Consultant before bidding. See Section 01 6200.
b. Horizontal Sidewall Sprinkler:
1) Design Criteria:
a) UL / ULC / CASA listed and approved.
b) Recess adjustable.
c) Where guards are required, use chrome plated sprinkler guards that are listed, that are approved by Sprinkler Manufacturer for use with head, and that are supplied by Sprinkler Manufacturer.
2) Type One Acceptable Products:
a) Wet System:
(1) Reliable: F1FR.
(2) Tyco (Grinnell): Model TY-FRB.
(3) Victualic: Model V2710.
(4) Viking: VK305.
(5) Equal as approved by Fire Sprinkler Consultant before bidding. See Section 01 6200.
b) Dry System:
(1) Reliable: F3QR.
(2) Tyco (Grinnell): DS-1.
(3) Victualic: Model V3610.
(4) Viking: VK162.
(5) Equal as approved by Fire Sprinkler Consultant before bidding. See Section 01 6200.
c. Attic Sprinklers, Upright:
1) Design Criteria:
a) UL / ULC / CASA listed and approved.
b) Approved for use in roof structures, combustible and non-combustible, with ceiling below.
2) Category Four Approved Products: See Section 01 6200 for definitions of Categories:
a) Tyco: BB, SD, or HIP.
d. Pendant Sprinklers:
1) Design Criteria:
a) UL / ULC / CASA listed and approved.
b) Where guards or escutcheons are required, use chrome plated sprinkler guards and escutcheons that are listed, that are approved by Sprinkler Manufacturer for use with head, and that are supplied by Sprinkler Manufacturer.

2) Type One Acceptable Products:
   a) Reliable: F1FR.
   b) Tyco: TY-FRB.
   c) Victaulic: Model V2704.
   d) Viking: VK302.
   e) Equal as approved by Fire Sprinkler Consultant before bidding. See Section 01 6200.

e. Upright Sprinklers:
   1) Design Criteria:
      a) UL / ULC / CASA listed and approved.
   2) Type One Acceptable Products:
      a) Reliable: F1FR.
      b) Tyco: TY-FRB.
      c) Victaulic: Models V2704.
      d) Viking: VK300.
      e) Equal as approved by Fire Sprinkler Consultant before bidding. See Section 01 6200.

6. Water Flow Alarm:
   a. Electric Flow Alarm:
      1) Design Criteria:
         a) UL / ULC / CASA listed and approved.
      2) Category Four Approved Products: See Section 01 6200 for definitions of Categories:
         a) Potter Electric: Horn Strobe, SASH-120, 120VAC.
         b) System Sensor: Horn Strobe, P2RHK-120, 120 VAC.
7. Pressure Gauges:
   a. Mechanical Water Pressure Gauges:
      1) Design Criteria:
         a) UL / ULC / CASA listed and approved.
         b) 3-1/2 inch diameter dial.
         c) 0 to 300 psi in 5 psi increments.
      2) Category Four Approved Products: See Section 01 6200 for definitions of Categories:
         a) Reliable: UA.
         b) HO Trerice: 500.
         c) Viking: 01124A.
8. Waterflow Detectors:
   a. Electrical Water Flow Switch:
      1) Design Criteria:
         a) UL / ULC / CASA listed.
         b) Switch activates with flow of 10 gpm or more.
         c) Two single pole double throw switches.
         d) Automatic reset.
      2) Category Four Approved Products: See Section 01 6200 for definitions of Categories:
         a) Potter-Roemer: Model 6201 thru 6208.
         b) System Sensor: WFD20 thru WFD80.
         c) Viking: VSR-F.
9. Tamper Switch
   a. Weather and Tamper Resistant Switch.
      1) Design Criteria:
         a) UL / ULC / CASA listed.
         b) Mount to monitor valve and not interfere with operation.
         c) Shall operate in horizontal and vertical position.
      2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
         a) Control Valves and Butterfly Valves:
            (1) Potter Electric: Model PCVS.
            (2) Notifier: Model PIBV2.
            (3) System Sensor: Model PIBV2.
         b) O.S. & Y Valves:
            (1) Potter Electric: Model OSYSU.
            (2) System sensor: Model OSY2.
10. Automatic Drain Device:

a. Design Criteria:
1) Straight Design, 3/4 inch.
b. Category Four Approved Products: See Section 01 6200 for definitions of Categories:
1) Nibco: Ball-Drip.
2) Potter-Roemer: Figure 5982.
3) Viking: B-1.

11. Fire Department Connection (confirm acceptance with local Fire Prevention Bureau AHJ):
a. Two-way Inlet with single clapper:
1) Class One Quality Standards: See Section 01 6200:
a) Round 'AUTO SPKR' identification plate, red enamel finish aluminum plate:
(1) Croker: Fig 6766.
(2) Potter-Roemer Fig. 5966.
2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
a) Rough chrome plated:
(1) Croker: 6405-RC.
(2) Potter-Roemer: Fig. 5710-C.
b) Caps and Chains:
(1) Croker: 6747 RC.
(2) Potter-Roemer: 4625.

12. Riser Manifold Assembly:
a. Design Criteria:
1) Groove x Groove Manifold Body.
2) Water Flow Alarm Switch, VSC with Vane, UL / ULC / CASA listed and approved.
3) 300 psi Water Pressure Gauge.
4) Test and Drain Valve with Manifold Drain Trim and 1/2 inch diameter test Orifice.
5) Pressure Relief Valve, 175 psi, non-adjustable, pipe discharge to test Drain Valve.
b. Category Four Approved Products: See Section 01 6200 for definitions of Categories:
1) Tyco: Model 513.
2) Victaulic: Style 747P.

2.2 ACCESSORIES

A. Manufacturers:
1. Manufacturer Contact List:
a. Anvil International, Portsmouth, NH www.anvilintl.com.
b. Eaton, Highland, IL www.cooperbline.com.

B. Hangers, Rods, And Clamps:
1. Design Criteria:
a. Galvanized, unless specified otherwise, and UL/CASA listed and labeled for service intended.
b. Hanger supports for sprinkler piping to conformance with NFPA 13.
2. Class One Quality Standard:
a. Hangers and accessories shall be Anvil numbers specified or equals by B-Line by Eaton.
b. Pipe Ring Hangers: Equal to Anvil Fig 69.
c. Riser Clamps: Equal to Anvil Fig. 261.

C. Posted System Diagram:
1. Provide single floor plan diagram showing wet pipe system elements.
2. Include following information on diagram sheet:
a. Step by step shut down procedure.
b. Step by step system drainage procedure.
c. Step by step start-up procedure.
d. Step by step procedure for protection of system from freezing.
e. Step by step procedure to follow in deactivating system for maintenance.
3. Laminate diagram with plastic and mat or frame suitable for hanging near riser.

PART 3 - EXECUTION

3.1 INSTALLERS

A. Acceptable Installers. See Section 01 4301:
   1. Meet Quality Assurance Installer Qualifications as specified in Part 1 of this specification.

3.2 EXAMINATION

A. Drawings:
   1. Fire Protection Drawings show general arrangement of piping. Follow as closely as actual building construction and work of other trades will permit. Install system so it drains.
   2. Consider Architectural and Structural Drawings part of this work insofar as these drawings furnish information relating to design and construction of building. These Drawings take precedence over Fire Protection Drawings.
   3. Because of small scale of Drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions and to enable system to drain.

3.3 INSTALLATION

A. Connect system to flange provided under Section 33 1119: 'Fire Suppression Utility Water Distribution Piping'. After installation of riser, fill annular space between pipe, sleeve, and slab as detailed on Drawings.

B. Install sprinkler systems in accordance with requirements of latest edition of NFPA 13 and as specified below:
   1. Provide maintenance access to equipment.
   2. Conceal sprinkler lines installed in occupied areas.
   3. Along Equipment Platform areas, route pipe to side or underneath framed walkway. Do not impede egress.
   4. Along Attic catwalk, route pipe and offset drops to sprinkler heads to side of plywood access as not to impede egress.
   5. Install to enable drainage of system.
      a. Install main drain from riser according to NFPA 13.
   6. Install piping system, except for dry heads, so it will not be exposed to freezing temperatures.
   7. Do not use dropped, damaged, or used sprinkler heads.
   8. Install tamper switches and flow detectors where located by Fire Sprinkler Consultant.
   9. Except for Siamese connection, install automatic ball drip device in lowest point of piping to fire department connection and drain to floor drain or to exterior of building.
   10. Brace and support system.

C. Flush system at full design flow rate for minimum five minutes. Route water to outside of building. Protect landscaping and other exterior elements from damage during flow tests.

3.4 FIELD QUALITY CONTROL

A. Field Tests:
   1. Pressure Test:
      a. Hydrostatically test system to 200 psi minimum for two (2) hours as required by 'Contractor's Material And Testing certificate for Aboveground Piping':
         1) NFPA 13 (2010), Figure 24.1.
         2) NFPA 13 (2013), Figure 25.1.
         3) NFPA 13 (2016), Figure 25.1.

2. Water Flow Test:
   a. Test to determine static and residual pressures and corresponding flow rate at point of connection to utility water main.
   b. Adjust water flow test data for seasonal fluctuations and future growth as recommended by Water Utility and AHJ.
   c. At point of connection to utility water main, combine inside and outside hose stream allowances.
3. Check piping in relation to insulation envelope to be certain piping and auxiliary drains are properly enclosed inside building insulation envelope. Report unsatisfactory conditions to Fire Sprinkler Consultant.
4. Tests shall be witnessed by Fire Sprinkler Consultant and representative of local jurisdiction over fire prevention.

3.5 CLOSE-OUT ACTIVITIES

A. Instruction of Owner:
   1. Instruction Sessions:
      a. Instruct Owner's personnel in operation and maintenance of system utilizing ‘Operation And Maintenance Manual’ when so doing. Minimum instruction period shall be four (4) hours.
      b. Instruction sessions shall occur after Substantial Completion inspection when system is properly working and before final payment is made.
      c. Provide Owner with copy of latest version of NFPA 25.

B. Training:
   1. Installer required to provide FM Training from latest version of NFPA 25 with checklist and brief explanation of following inspections:
      a. Weekly Inspection.
      b. Monthly Inspection.
      c. Quarterly Inspection.
      d. Semi-Annual Inspection.
      e. Annual Inspection.

3.6 VERIFICATION

A. At completion of installation, ensure Fire Sprinkler System is operational:
   1. Arrange to have and pay for components and system operation verification by Professional Engineer registered in the Province of Alberta.
   2. Submit verification certificate signed and sealed by the Professional Engineer registered in the Province of Alberta for submission to the AHJ.
      a. Provide completed C-2 schedule.

END OF SECTION

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DIVISION 22: PLUMBING

22 0500 COMMON WORK RESULTS FOR PLUMBING

22 0501 COMMON PLUMBING REQUIREMENTS
22 0529 HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT
22 0553 IDENTIFICATION FOR PLUMBING PIPES AND EQUIPMENT
22 0719 PLUMBING PIPING INSULATION

22 1000 PLUMBING PIPES AND PUMPS

22 1116 DOMESTIC WATER PIPING
22 1119 DOMESTIC WATER PIPING SPECIALTIES
22 1313 FACILITY SANITARY SEWERS
22 1319 FACILITY SANITARY SEWER SPECIALTIES

22 3000 PLUMBING EQUIPMENT

22 3423 GAS DOMESTIC WATER HEATERS

22 4000 PLUMBING FIXTURES

22 4213 COMMERCIAL WATER CLOSETS AND URINALS
22 4216 COMMERCIAL LAVATORIES AND SINKS
22 4700 DRINKING FOUNTAINS AND WATER COOLERS

END OF TABLE OF CONTENTS

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SECTION 22 0501

COMMON PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Common requirements and procedures for plumbing systems.
   2. Responsibility for proper operation of electrically powered equipment furnished under this Division.
   3. Furnish and install sealants relating to installation of systems installed under this Division.
   4. Furnish and install Firestop Penetration Systems for plumbing systems penetrations as described in Contract Documents.

B. Products Furnished But Not Installed Under This Section:
   1. Sleeves, inserts, supports, and equipment for plumbing systems installed under other Sections.

C. Related Requirements:
   1. Section 03 3111: 'Cast-In-Place Structural Concrete' for exterior concrete pads and bases for mechanical equipment.
   2. Section 05 0523: 'Metal Fastening' for quality and requirements for welding.
   3. Section 07 8400: 'Firestopping' for quality of penetration firestop systems to be used on Project and submittal requirements.
   4. Section 07 9213: 'Elastomeric Joint Sealant' for quality at building exterior.
   5. Sections Under 09 9000 Heading: 'Paints And Coatings' for painting of plumbing items requiring field painting.
   6. Division 26: 'Electrical' for raceway and conduit, unless specified otherwise, and line voltage wiring.
   7. Division 33: 'Utilities' for piped utilities.
   8. Slots and openings through floors, walls, ceilings, and roofs provided under other Divisions in their respective materials.

1.2 SUBMITTALS

A. Action Submittals:
   1. Product Data:
      a. Manufacturer's catalog data for each manufactured item.
         1) Provide section in submittal for each type of item of equipment. Include Manufacturer's catalog data of each manufactured item and enough information to show compliance with Contract Document requirements. Literature shall show capacities and size of equipment used and be marked indicating each specific item with applicable data underlined.
         2) Include name, address, and phone number of each supplier.

B. Informational Submittals:
   1. Qualification Statement:
      a. Plumbing Subcontractor:
         1) Provide Qualification documentation if requested by Architect or Owner.
      b. Installer:
         1) Provide Qualification documentation if requested by Architect or Owner.

C. Closeout Submittals:
   1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
      a. Operations and Maintenance Data:

1) At beginning of PLUMBING section of Operations And Maintenance Manual, provide master index showing items included:
   a) Provide name, address, and phone number of Architect, Architect's Mechanical Engineer, General Contractor, and Plumbing subcontractor.
   b) Identify maintenance instructions by using same equipment identification used in Contract Drawings. Maintenance instructions shall include:
      (1) List of plumbing equipment used indicating name, model, serial number, and nameplate data of each item together with number and name associated with each system item.
      (2) Manufacturer's maintenance instructions for each piece of plumbing equipment installed in Project. Instructions shall include name of vendor, installation instructions, parts numbers and lists, operation instructions of equipment, and maintenance instructions.
   c) Provide operating instructions to include:
      (1) General description of fire protection system.
      (2) Step by step procedure to follow for shutting down system or putting system into operation.

b. Warranty Documentation:
   1) Include copies of warranties required in individual Sections of Division 22.

c. Turn over installation tools and spare parts supplied with plumbing equipment to FM Group for maintenance stock.

1.3 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Perform work in accordance with applicable provisions of Plumbing Codes applicable to Project. Provide materials and labor necessary to comply with rules, regulations, and ordinances.
   2. In case of differences between building codes, laws, local ordinances, utility company regulations, and Contract Documents, the most stringent shall govern. Notify Architect in writing of such differences before performing work affected by such differences.
   3. Identification:
      a. Motor and equipment name plates as well as applicable UL / ULC and AGA / CGA labels shall be in place when Project is turned over to Owner.

B. Qualifications. Requirements of Section 01 4301 applies, but not limited to following:
   1. Plumbing Subcontractor:
      a. Company specializing in performing work of this section.
         1) Minimum five (5) years experience in plumbing installations.
         2) Minimum five (5) satisfactorily completed installations in past three (3) years of projects similar in size, scope, and complexity required for this project before bidding.
      b. Upon request, submit documentation.
   2. Installer:
      a. Licensed for area of Project.
      b. Designate one (1) individual as project foremen who shall be on site at all times during installation and experienced with installation procedures required for this project.
      c. Upon request, submit documentation.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Delivery And Acceptance Requirements:
   1. Accept valves on site in shipping containers with labeling in place.
   2. Provide temporary protective coating on cast iron and steel valves.
   3. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

B. Storage And Handling Requirements:

1. In addition to requirements specified in Division 01, stored material shall be readily accessible for inspection by Architect until installed.
2. Store items subject to moisture damage in dry, heated spaces.

1.5 WARRANTY

A. Manufacturer Warranty:
   1. Provide certificates of warranty for each piece of equipment made out in favor of Owner.

B. Special Warranty:
   1. Guarantee plumbing systems to be free from noise in operation that may develop from failure to construct system in accordance with Contract Documents.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Components shall bear Manufacturer's name and trade name. Equipment and materials of same general type shall be of same make throughout work to provide uniform appearance, operation, and maintenance.

B. Pipe And Pipe Fittings:
   1. Weld-O-Let and Screw-O-Let fittings are acceptable.

C. Sleeves:
   1. General:
      a. Two sizes larger than bare pipe or insulation on insulated pipe.
   2. In Concrete And Masonry:
      a. Sleeves through outside walls, interior shear walls, and footings shall be schedule 40 PVC.
   3. In Framing And Suspended Floor Slabs:
      a. Schedule 40 PVC.

D. Valves:
   1. Valves of same type shall be of same manufacturer.

PART 3 - EXECUTION

3.1 INSTALLERS

A. Acceptable Installers:
   1. Meet Quality Assurance Installer Qualifications as specified in Part 1 of this specification.

3.2 EXAMINATION

A. Drawings:
   1. Plumbing Drawings show general arrangement of piping, equipment, etc. Follow as closely as actual building construction and work of other trades will permit.
   2. Consider Architectural and Structural Drawings part of this work insofar as these drawings furnish information relating to design and construction of building. These drawings take precedence over Plumbing Drawings.
   3. Because of small scale of Drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. Investigate structural and finish conditions affecting this work

and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions.

B. Verification Of Conditions:
   1. Examine premises to understand conditions that may affect performance of work of this Division before submitting proposals for this work. Examine adjoining work on which plumbing work is dependent for efficiency and report work that requires correction.
   2. Ensure that items to be furnished fit space available. Make necessary field measurements to ascertain space requirements including those for connections and furnish and install equipment of size and shape so final installation shall suit true intent and meaning of Contract Documents. If approval is received by Addendum or Change Order to use other than originally specified items, be responsible for specified capacities and for ensuring that items to be furnished will fit space available.
   3. Check that slots and openings provided under other Divisions through floors, walls, ceilings, and roofs are properly located. Perform cutting and patching caused by neglecting to coordinate with Divisions providing slots and openings at no additional cost to Owner.
   4. No subsequent allowance for time or money will be considered for any consequence related to failure to examine site conditions.

3.3 PREPARATION

A. Changes Due To Equipment Selection:
   1. Where equipment specified or otherwise approved requires different arrangement or connections from that shown in Contract Documents, submit drawings showing proposed installations.
   2. If proposed changes are approved, install equipment to operate properly and in harmony with intent of Contract Documents. Make incidental changes in piping, ductwork, supports, installation, wiring, heaters, panelboards, and as otherwise necessary.
   3. Provide additional motors, valves, controllers, fittings, and other equipment required for proper operation of systems resulting from selection of equipment.
   4. Be responsible for proper location of rough-in and connections provided under other Divisions.

3.4 INSTALLATION

A. Interface With Other Work:
   1. Furnish exact location of electrical connections and complete information on motor controls to installer of electrical system.
   2. Furnish sleeves, inserts, supports, and equipment that are to be installed by others in sufficient time to be incorporated into construction as work proceeds. Locate these items and confirm that they are properly installed.

B. Cut carefully to minimize necessity for repairs to previously installed or existing work. Do not cut beams, columns, or trusses.

C. Locating Equipment:
   1. Arrange pipes and equipment to permit ready access to valves, cocks, unions, traps, and to clear openings of doors and access panels.
   2. Adjust locations of pipes, equipment, and fixtures to accommodate work to interferences anticipated and encountered.
   3. Install plumbing work to permit removal of equipment and parts of equipment requiring periodic replacement or maintenance without damage to or interference with other parts of equipment or structure.
   4. Determine exact route and location of each pipe before fabrication.
      a. Right-Of-Way:
         1) Lines that pitch shall have right-of-way over those that do not pitch. For example, plumbing drains shall normally have right-of-way.
         2) Lines whose elevations cannot be changed shall have right-of-way over lines whose elevations can be changed.

b. Offsets, Transitions, and Changes in Direction:
   1) Make offsets, transitions, and changes in direction in pipes as required to maintain proper head room and pitch of sloping lines whether or not indicated on Drawings.
   2) Furnish and install all traps, air vents, sanitary vents, and devices as required to effect these offsets, transitions, and changes in direction.

D. Penetration Firestops:
   1. Install Penetration Firestop System appropriate for penetration at plumbing systems penetrations through walls, ceilings, roofs, and top plates of walls.

E. Sealants:
   1. Seal openings through building exterior caused by penetrations of elements of plumbing systems.
   2. Furnish and install acoustical sealant to seal penetrations through acoustically insulated walls and ceilings.

F. Furnish and install complete system of piping, valved as indicated or as necessary to completely control entire apparatus:
   1. Pipe drawings are diagrammatic and indicate general location and connections. Piping may have to be offset, lowered, or raised as required or directed at site. This does not relieve this Division from responsibility for proper installation of plumbing systems.
   2. Arrange piping to not interfere with removal of other equipment, ducts, or devices, or block access to doors, windows, or access openings:
      a. Arrange so as to facilitate removal of tube bundles.
      b. Provide accessible flanges or ground joint unions, as applicable for type of piping specified, at connections to equipment and on bypasses.
         1) Make connections of dissimilar metals with di-electric unions.
         2) Install valves and unions ahead of traps and strainers. Provide unions on both sides of traps.
      c. Do not use reducing bushings, bull head tees, close nipples, or running couplings. Street elbows are allowed only on potable water pipe 3/4 inch in diameter and smaller.
      d. Install piping systems so they may be easily drained
      e. Install piping to insure noiseless circulation.
      f. Place valves and specialties to permit easy operation and access. Valves shall be regulated, packed, and glands adjusted at completion of work before final acceptance.
   3. Do not install piping in shear walls.
   4. Cut piping accurately to measurements established at site. Remove burr and cutting slag from pipes.
   5. Work piping into place without springing or forcing. Make piping connections to pumps and other equipment without strain at piping connection. Remove bolts in flanged connections or disconnect piping to demonstrate that piping has been so connected, if requested.
   6. Make changes in direction with proper fittings.
   7. Expansion of Thermoplastic Pipe:
      a. Provide for expansion in every 30 feet of straight run.
      b. Provide 12 inch offset below roof line in each vent line penetrating roof.
   8. Expansion of PEX Pipe: Allow for expansion and contraction of PEX pipe as recommended by Pipe Manufacturer.

G. Sleeves:
   1. Do not place sleeves around soil, waste, or vent lines passing through concrete slabs on grade.
   2. Provide sleeves around pipes passing through concrete or masonry floors, walls, partitions, or structural members. Seal sleeves with specified sealants. Follow Pipe Manufacturer's recommendations for PEX pipe penetrations through studs and floor slabs.
   3. Sleeves through floors shall extend 1/4 inch above floor finish in mechanical equipment rooms. In other rooms, sleeves shall be flush with floor.
   4. Sleeves through floors and foundation walls shall be watertight.

H. Escutcheons:
   1. Provide spring clamp plates where pipes run through walls, floors, or ceilings and are exposed in finished locations of building. Plates shall be chrome plated heavy brass of plain pattern and shall be set tight on pipe and to building surface.

3.5 REPAIR / RESTORATION

A. Each Section of this Division shall bear expense of cutting, patching, repairing, and replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it:
   1. Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown.
   2. Surface finishes shall exactly match existing finishes of same materials.

3.6 FIELD QUALITY CONTROL

A. Field Tests:
   1. Perform tests on plumbing piping systems. Furnish devices required for testing purposes.

B. Non-Conforming Work:
   1. Replace material or workmanship proven defective with sound material at no additional cost to Owner.
   2. Repeat tests on new material, if requested.

3.7 CLEANING

A. Remove dirt, grease, and other foreign matter from each length of piping before installation:
   1. After each section of piping used for movement of water is installed, flush with clean water, except where specified otherwise.
   2. Arrange temporary flushing connections for each section of piping and arrange for flushing total piping system.
   3. Provide temporary cross connections and water supply for flushing and drainage and remove after completion of work.

B. Clean exposed piping, equipment, and fixtures. Remove stickers from fixtures and adjust flush valves.

3.8 CLOSEOUT ACTIVITIES

A. Instruction of Owner:
   1. Instruct building maintenance personnel and Stake Physical Facilities Representative in operation and maintenance of plumbing systems utilizing Operation And Maintenance Manual when so doing.
   2. Conduct instruction period after Substantial Completion inspection when systems are properly working and before final payment is made.

3.9 PROTECTION

A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system. Cap or plug open ends of pipes and equipment to keep dirt and other foreign materials out of system. Do not use plugs of rags, wool, cotton waste, or similar materials.

END OF SECTION

SECTION 22 0529

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Common hanger and support requirements and procedures for plumbing systems.
   2. Coordinate installation with spray foam schedule.

B. Products Installed But Not Furnished Under This Section:
   1. Paint identification for gas piping used in HVAC equipment.

C. Related Requirements:
   1. Section 05 0523: ‘Metal Fastening’ for quality and requirements for welding.
   2. Section 07 8400: ‘Firestopping’ for quality of Penetration Firestop Systems to be used on Project and submittal requirements.
   3. Sections Under 09 9000 Heading: Painting of mechanical items requiring field painting.
   4. Slots and openings through floors, walls, ceilings, and roofs provided under other Divisions in their respective materials.
   5. Section 23 0529: 'Hangers And Supports For HVAC Piping And Equipment’ for gas piping used with HVAC equipment.
   6. Section 23 0553: 'Identification For HVAC Piping And Equipment’ for paint identification of gas piping used with HVAC equipment.

1.2 SUBMITTALS

A. Action Submittals:
   1. Product Data:
      a. Manufacturer's catalog data for each manufactured item.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Manufacturers:
   1. Manufacturer Contact List:
      a. Anvil International, Portsmouth, NH www.anvilintl.com.
      b. Cooper B-Line, Highland, IL www.b-line.com.
      c. Unistrut, Wayne, MI www.tyco-unistrut.com.

B. Materials:
   1. Hangers, Rods, And Inserts
      a. Galvanized and ULC approved for service intended.
      b. Support horizontal piping from hangers or on roller assemblies with channel supports, except where trapeze type hangers are explicitly shown on Drawings. Hangers shall have double nuts.
         1) Support insulated pipes 2 inches in diameter and smaller with adjustable swivel ring hanger with insulation protection shield. Gauge and length of shield shall be in accordance with Anvil design data.
            a) Type Two Acceptable Products:
               (1) Swivel Ring Hanger: Anvil Fig. 69.

(2) Insulation Protection Shield: Anvil Fig. 167.
(3) Equals by Cooper B-Line.

2) Support insulated pipes 2-1/2 inches in diameter and larger with clevis hanger or roller assembly with an insulation protection shield. Gauge and length of shield shall be according to Anvil design data.
a) Type Two Acceptable Products:
(1) Clevis Hanger: Anvil Fig. 260.
(2) Roller Assembly: Anvil Fig. 171.
(3) Insulation Protection Shield: Anvil Fig. 167.
(4) Equals by Cooper B-Line.

3) Support uninsulated copper pipe 2 inches in diameter and smaller from swivel ring hanger, copper plated and otherwise fully suitable for use with copper tubing. Support non-copper uninsulated pipes from swivel ring hanger.
a) Type Two Acceptable Products:
(1) Swivel Ring Hanger For Copper Pipe: Anvil Fig. CT-69.
(2) Swivel Ring Hanger For Other Pipe: Anvil Fig. 69.
(3) Equals by Cooper B-Line.

4) Support uninsulated copper pipe 2-1/2 inches in diameter and larger from clevis hanger, copper plated hangers and otherwise fully suitable for use with copper tubing. Support non-copper uninsulated pipes from clevis hanger.
a) Type Two Acceptable Products:
(1) Clevis Hanger For Copper Pipe: Anvil Fig. CT-65.
(2) Clevis Hanger For Other Pipe: Anvil Fig. 260.
(3) Equals by Cooper B-Line.

c. Support rods for single pipe shall be in accordance with following table:

Rod Diameter	Pipe Size
3/8 inch	2 inches and smaller
1/2 inch	2-1/2 to 3-1/2 inches
5/8 inch	4 to 5 inches
3/4 inch	6 inches
7/8 inch	8 to 12 inches

d. Support rods for multiple pipe supported on steel angle trapeze hangers shall be in accordance with following table:

Rods		Number of Pipes per Hanger for Each Pipe Size						
Number	Diameter	2 Inch	2.5 Inch	3 Inch	4 Inch	5 Inch	6 Inch	8 Inch
2	3/8 Inch	Two	0	0	0	0	0	0
2	1/2 Inch	Three	Three	Two	0	0	0	0
2	5/8 Inch	Six	Four	Three	Two	0	0	0
2	5/8 Inch	Nine	Seven	Five	Three	Two	Two	0
2	5/8 Inch	Twelve	Nine	Seven	Five	Three	Two	Two

1) Size trapeze angles so bending stress is less than 10,000 psi.

e. Riser Clamps For Vertical Piping:
1) Type Two Acceptable Products:
a) Anvil Fig. 261.
b) Equals by Cooper B-Line.

f. Concrete Inserts:
1) Individual Inserts:
a) Suitable for special nuts size 3/8 inch through 7/8 inch with yoke to receive concrete reinforcing rods, and with malleable iron lugs for attaching to forms.
b) Type Two Acceptable Products:
(1) Anvil Fig. 282.
(2) Equals by Cooper B-Line.

2) Continuous Inserts:

a) Class Two Quality Standard: Equal to Unistrut P-3200 series.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Piping:
1. Properly support piping and make adequate provisions for expansion, contraction, slope, and anchorage.
   a. Except for underground pipe, suspend piping from roof trusses or clamp to vertical walls using Unistrut and clamps. Do not hang pipe from other pipe, equipment, or ductwork. Laying of piping on any building element is not allowed.
   b. Supports For Horizontal Piping:
      1) Support metal piping at 96 inches on center maximum for pipe 1-1/4 inches or larger and 72 inches on center maximum for pipe 1-1/8 inch or less.
      2) Support thermoplastic pipe at 48 inches on center maximum.
      3) Support PEX pipe at 32 inches minimum on center.
      4) Provide support at each elbow. Install additional support as required.
   c. Supports for Vertical Piping:
      1) Place riser clamps at each floor or ceiling level.
      2) Securely support clamps by structural members, which in turn are supported directly from building structure.
      3) Provide clamps as necessary to brace pipe to wall.
   d. Insulate hangers for copper pipe from piping by means of at least two layers of Scotch 33 plastic tape.
2. Gas piping Identification:
   a. Apply paint identification for gas piping used with HVAC equipment as specified in Section 23 0553.

END OF SECTION

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SECTION 22 0553

IDENTIFICATION FOR PLUMBING PIPES AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install identification of plumbing piping and equipment as described in Contract Documents.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Materials:
   1. Labels:
      a. Equipment Identification:
         1) Black formica, with white reveal when engraved.
         2) Lettering to be 3/16 inch high minimum.
   2. Paint:
      a. One Coat Primer:
         1) 6-2 Quick Drying Latex Primer Sealer over fabric covers.
         2) 6-205 Metal Primer under dark color paint.
         3) 6-6 Metal Primer under light color paint.
      b. Finish Coats: Two coats 53 Line Acrylic Enamel.
      c. Performance Standard: Paints specified are from Pittsburgh Paint & Glass (PPG), Pittsburgh, PA www.pittsburghpaints.com or PPG Canada Inc, Mississauga, ON (800) 263-4350 or (905) 238-6441.
      d. Type Two Acceptable Products. See Section 01 6200.
         1) Paint of equal quality from following Manufacturers may be submitted for Architect's approval before use. Maintain specified colors, shades, and contrasts.
            a) Benjamin Moore, Montvale, NJ www.benjaminmoore.com or Toronto, ON (800) 304-0304 or (416) 766-1176.
            b) ICI Dulux, Cleveland, OH or ICI Paints Canada Inc, Concord, ON www.dulux.com.
            c) Sherwin Williams, Cleveland, OH www.sherwin-williams.com.

PART 3 - EXECUTION

3.1 APPLICATION

A. Labels:
   1. Identify following items with specified labels fastened to equipment with screws (unless noted otherwise):
      a. Water Heater.
      b. Domestic Hot Water Recirculation Pump.
   2. Engrave following data from Equipment Schedules on Drawings onto labels:
      a. Equipment mark.
      b. Room(s) served.
      c. Panel and breaker from which unit is powered.

B. Painting:

1. Only painted legends, directional arrows, and color bands are acceptable.
2. Locate identifying legends, directional arrows, and color bands at following points on exposed piping of each piping system:
   a. Adjacent to each item of equipment.
   b. At point of entry and exit where piping goes through wall.
   c. On each riser and junction.
   d. Every 25 feet on long continuous lines.
   e. Stenciled symbols shall be one inch high and black.

3.2 ATTACHMENTS

A. Schedules:
   1. Pipe Identification Schedule:
      a. Apply stenciled symbols as follows:

Pipe Use	Abbreviation	Direction of Flow
Domestic Cold Water	CW	➡
Domestic Hot Water	HW	➡
Domestic Tempered Water	TW	➡
Domestic Recirc Water	HW Recirc	➡
Hydronic Glycol	Glycol	➡
Natural Gas	Nat Gas	---

END OF SECTION

SECTION 22 0719

PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install insulation on hot (and recirculation) and cold water lines, fittings, valves, and accessories as described in Contract Documents.

B. Related Requirements:
   1. Section 22 1116: 'Domestic Water Piping'.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Manufacturers:
   1. Manufacturer Contact List:
      a. Armacell, Mebane, NC www.armaflex.com.
      b. Childers Products Co, Eastlake, OH www.fosterproducts.com.
      c. IMCOA, Youngsville, NC www.nomacokflex.com.
      d. Johns-Manville, Denver, CO www.jm.com.
      e. Knauf, Shelbyville, IN www.knauffiberglass.com.
      f. Manson, Brossard, PQ, Canada www.isolationmanson.com.
      g. Nomaco Inc, Yopungsville, NC www.nomacokflex.com.
      h. Owens-Corning, Toledo, OH www.owenscorning.com.
      i. Speedline Corp, Solon, OH www.speedlinepvc.com.

B. Materials:
   1. Above Grade Metal Piping:
      a. Insulation For Piping:
         1) Snap-on glass fiber or melamine foam pipe insulation, or heavy density pipe insulation with factory vapor jacket.
         2) Insulation Thickness:

Service Water Temperature	Pipe Sizes Up to 1-1/4 In	1-1/2 to 2 In	Over 2 In
170 - 180 Deg F	One In	1-1/2 In	2 In
140 - 160 Deg F	1/2 In	One In	1-1/2 In
45 - 130 Deg F	1/2 In	1/2 In	One In

         3) Performance Standards: Fiberglas ASJ by Owens-Corning.
         4) Type One Acceptable Manufacturers:
            a) Childers Products.
            b) Knauf.
            c) Manson.
            d) Owens-Corning.
            e) Johns-Manville.
            f) Equal as approved by Architect before bidding. See Section 01 6200.
      b. Fitting, Valve, And Accessory Covers:
         1) PVC.
         2) Performance Standard: Zeston by Johns-Manville.

3) Type One Acceptable Manufacturers:
   a) Knauf.
   b) Speedline.
   c) Johns-Manville.
   d) Equal as approved by Architect before bidding. See Section 01 6200.

2. Pex Piping:
   a. Insulation:
      1) 1/2 inch thick.
      2) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
         a) SS Tubolit by Armacell.
         b) ImcoLock by Imcoa.
         c) Nomalock or Therma-Cel by Nomaco.
   b. Joint Sealant:
      1) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
         a) Armacell 520.
         b) Nomaco K-Flex R-373.
         c)
3. PP-R Piping:
   a. Insulation:
      1) 1/2 inch thick.
      2) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
         a) SS Tubolit by Armacell.
         b) ImcoLock by Imcoa.
         c) Nomalock or Therma-Cel by Nomaco.
   b. Joint Sealant:
      1) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
         a) Armacell 520.
         b) Nomaco K-Flex R-373.

PART 3 - EXECUTION

3.1 APPLICATION

A. Above Grade Piping:
   1. Apply insulation to clean, dry piping with joints tightly butted.
   2. Install insulation in manner to facilitate removal for repairs. Place sections or blocks so least possible damage to insulation will result from inspection or repairs of piping or equipment.
   3. Piping up to 1-1/4 inch Diameter:
      a. Adhere 'factory applied vapor barrier jacket lap' smoothly and securely at longitudinal laps with white vapor barrier adhesive.
      b. Adhere 3 inch wide self-sealing butt joint strips over end joints.
   4. Piping 1-1/2 inches Diameter And Larger:
      a. Use broken-joint construction in application of two-layer covering.
      b. Fill cracks and depressions with insulating cement mixed to thick plastic paste.
         1) Apply by hand in several layers to make up total specified thickness.
         2) Final layer shall have smooth uniform finish before application of covering.
   5. Fittings, Valves, And Accessories:
      a. Do not apply insulation over flanged joints or victaulic couplings until piping has been brought up to operating temperature and flange bolts have been fully tightened. Insulate valves so wheel, stem, and packing nut are exposed.
      b. Insulate with same type and thickness of insulation as pipe, with ends of insulation tucked snugly into throat of fitting and edges adjacent to pipe insulation tufted and tucked in.
      c. Piping Up To 1-1/4 Inch Diameter:
         1) Cover insulation with one piece fitting cover secured by stapling or taping ends to adjacent pipe covering.
         2) Alternate Method:

a) Insulate fittings, valves, and accessories with one inch of insulating cement and vapor seal with two 1/8 inch wet coats of vapor barrier mastic reinforced with glass fabric extending 2 inches onto adjacent insulation.

d. Piping 1-1/2 inches To 2 Inches:
   1) Insulate with hydraulic setting insulating cement or equal, to thickness equal to adjoining pipe insulation.
   2) Apply final coat of fitting mastic over insulating cement.
e. Piping 2-1/2 inch And Larger:
   1) Insulate with segments of molded insulation securely wired in place and coated with skim coat of insulating cement.
   2) Apply fitting mastic, fitting tape and finish with final coat of fitting mastic.

6. Pipe Hangers:
   a. Do not allow pipes to come in contact with hangers.
   b. Pipe Shield:
      1) Provide schedule 40 PVC by 6 inch long at each clevis and/or unistrut type hanger.
      2) Provide 16 ga by 6 inch long galvanized shields at each pipe hanger to protect pipe insulation from crushing by clevis hanger.
      3) Provide 22 ga by 6 inch long galvanized shield at each pipe hanger to protect insulation from crushing by Unistrut type hanger.
   c. At Pipe Hangers:
      1) Provide rigid calcium silicate insulation (100 psi compressive strength) at least 2 inches beyond shield.
7. Protect insulation wherever leak from valve stem or other source might drip on insulated surface, with aluminum cover or shield rolled up at edges and sufficiently large in area and of shape that dripping will not splash on surrounding insulation.

B. Below Grade Piping:
   1. Not allowed under building beyond the main water service riser.

END OF SECTION

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SECTION 22 1116

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Perform excavating and backfilling required by work of this Section.
   2. Furnish and install potable water piping complete with necessary valves, connections, and accessories inside building and connect with outside utility lines 5 feet from building perimeter as described in Contract Documents.

B. Related Requirements:
   1. Section 03 3111: ‘Cast-In-Place Structural Concrete’.
      a. Pre-installation conference held jointly with other concrete related sections.
   2. Section 22 0501: 'Common Piping Requirements'.
   3. Section 22 0719: 'Plumbing Piping Insulation'.
   4. Section 31 2316: 'Excavation' for criteria for performance of excavation.
   5. Section 31 2323: 'Fill' for criteria for performance of backfill.
   6. Section 33 1116: 'Site Water Utility Distribution Piping' for domestic water piping from 5 feet from building perimeter to main.

1.2 REFERENCES

A. Reference Standards:
   1. American National Standards Institute / American Society of Sanitary Engineers:
      a. ANSI/ASSE 1003-2009, 'Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems'.
      b. ANSI/ASSE 1017-2009, ‘Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems'.
      c. ANSI/ASSE 1070-2015, ‘Performance Requirements for Water Temperature Limiting Devices'.
   2. ASTM International:
      a. ASTM B88-16, 'Standard Specification for Seamless Copper Water Tube'.
      b. ASTM E84-18b, ‘Standard Test Method for Surface Burning Characteristics of Building Materials’.
      c. ASTM F876-17, ‘Standard Specification for Crosslinked Polyethylene (PEX) Tubing’.
      d. ASTM F877-18a, ‘Standard Specification for Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems’.
      e. ASTM F1807-18a, ‘Standard Specification for Metal Insert Fittings Utilizing a Copper Crimp Ring for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing’.
      f. ASTM F2023-15, ‘’Standard Test Method for Evaluating the Oxidative Resistance of Crosslinked Polyethylene (PEX) Tubing and Systems to Hot Chlorinated Water’.
      g. ASTM F2389-17a, ‘Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems'.
   3. CSA Group (Canadian Standards Association):
      a. CSA B137 Series-17, ‘Thermoplastic Pressure Piping Compendium’:
         1) B137.5, ‘Crosslinked Polyethylene (PEX) tubing Systems for Pressure Applications’.
      b. CSA B356-10 (R2015), ' Water pressure reducing valves for domestic water supply systems'.
   4. NSF International Standard:
      a. NSF P171, 'Protocol for Chlorine Resistance of Plastic Piping Materials' (1999).
   5. NSF International Standard / American National Standards Institute:

a. NSF/ANSI 14-2018, 'Plastic Piping System Components and Related Materials'.
b. NSF/ANSI 61-2017, 'Drinking Water System Components - Health Effects'.
c. NSF/ANSI 372-2016, 'Drinking Water System Components - Lead Content'.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Qualifications:
1. Manufacturer Qualifications:
a. PP-R pipe and PP-RCT pipe:
1) Certified by NSF International.
2. Installers Qualifications:
a. PP-R pipe and PP-RCT pipe:
1) Certified by Manufacturer.

B. Pre-Installation Conference:
1. Participate in pre-installation conference as specified in Section 03 3111.

1.4 SUBMITTALS

A. Action Submittals:
1. Product Data:
a. Manufacturer's Literature:
1) PEX pipe and PEX pipe fittings.
2) PP-R pipe and PP-R pipe fittings.
2. Samples:
a. PEX pipe fitting.

B. Informational Submittals:
1. Test And Evaluation Reports:
a. Written report of sterilization test.

1.5 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
1. Meet NSF International Standards for materials or products that come into contact with drinking water, drinking water treatment chemicals, or both for chemical contaminants and impurities that are indirectly imparted to drinking water from products, components, and materials used in drinking water systems.

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Manufacturers:
1. Manufacturer Contact List:
a. Aquatherm, Inc., Lindon, UT www.aquathermpipe.com.
b. Acorn Controls, City of Industry, CA www.acorneng.com
c. Cash Acme, Cullman, AL www.cashacme.com
d. Chicago Faucets, Des Plaines, IL, www.chicagofaucets.com.
e. Cla-Val Company, Costa Mesa, CA or Cla-Val Canada Ltd, Beamsville, ON www.cla-val.com.
f. Conbraco Industries Inc, Matthews, NC www.conbraco.com or Conbraco (Honeywell Ltd), Scarborough, ON (416) 293-8111.
g. Hammond Valve, New Berlin, WI www.hammondvalve.com.

h. Handy & Harmon Products Div, Fairfield, CT www.handyharmon.com or Handy and Harmon of Canada Ltd, Rexdale, ON (800) 463-1465 or (416) 675-1860.
i. Harris Products Group, Cincinnati, OH www.harrisproductsgroup.com.
j. Honeywell Inc, Minneapolis, MN www.honeywell.com.
k. Leonard Valve Co, Cranston, RI www.leonardvalve.com.
l. Milwaukee Valve Co, New Berlin, WI www.milwaukeevalve.com.
m. Nibco Inc, Elkhart, IN www.nibco.com.
n. Nupi Americas, Early Branch, SC www.nupiamericas.com.
o. Rehau, Leesburg, VA www.rehau-na.com.
p. Sloan Valve Co, Franklin Park, IL www.sloanvalve.com.
q. Spence Engineering Co, Walden, NY www.spenceengineering.com.
r. Symmons Industries, Braintree, MA www.symmons.com.
s. Uponor Inc, Apple Valley, MN www.uponor-usa.com.
t. Viega ProPress, Wichita, KS www.viega-na.com.
u. Watts Regulator Co, Andover, MA www.wattsreg.com.
v. Wilkins (Zurn Wilkins), Paso Robles, CA www.zurn.com.
w. Zurn PEX, Inc., Commerce, TX www.zurnpex.com.

B. Materials:
1. Design Criteria:
a. All drinking water products, components, and materials above and below grade used in drinking water systems must meet NSF International Standards for Lead Free.
b. No CPVC allowed.
2. Pipe:
a. Copper:
1) Above-Grade:
a) Meet requirements of ASTM B88, Type L.
2) Below-Grade:
a) Not allowed.
b. Cross-Linked Polyethylene (PEX):
1) Certified with NSF International against NSF Standards NSF/ANSI 14, NSF/ANSI 61, NSF/ANSI 372, and NSF P171 Protocol.
2) Copper tube size (CTS) outside dimensions and Standard Dimension Ratio (SDR) of 9.
3) Pressure rated for 160 psi at 73 deg F, 100 psi at 180 deg F, and 80 psi at 200 deg F.
4) Marked with Manufacturer's name, design pressure and temperature ratings, and third-party certification stamp for NSF-PW.
5) Manufactured by Engel or peroxide method (PEX-A) or by silane method (PEX-B).
6) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
a) `Raupex by Rehau.
b) Wirsbo Aquapex by Uponor.
c) ViegaPEX by Viega.
d) Zurn PEX by Zurn PEX.
c. Polypropylene-Random (PP-R):
1) Above-Grade:
a) Meet requirements of ASTM F2389 and be certified by NSF International per ASTM F2389, NSF/ANSI 14, and NSF/ANSI 61.
b) Aquatherm: SDR 7.4 Greenpipe faser for domestic hot water and SDR 7.4 or SDR 11 greenpipe for domestic cold water. Aquatherm Lilac SDR 11 purple piping for recycled/reclaimed water systems.
c) Nupi Americas: Clima pipe for domestic Hot water SDR-7.3 or cold water SDR 11 Nupi Niron Monolayer purple pipe for recycled/ reclaimed water Systems.
2) Below-Grade:
a) Not allowed.
3) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
a) Aquatherm Greenpipe, Greenpipe faser, and Lilac by Aquatherm.
b) Nupi Americas Clima pipe, and Nupi Niron.
3. Fittings:
a. For Copper Pipe: Wrought copper.
b. For PEX Pipe:
1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:

a) Everloc by Rehau.
b) Viega PEX Press Zero Lead Fittings with attached stainless steel sleeves or Viega PEX Press Radel-R Polymer with attached stainless steel sleeves by Viega.
c) ProPEX fittings by Uponor including EP flow-through multiport tees.
d) Zurn PEX XL, DZR and CR fittings.

c. For PP-R Pipe:
1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
a) Greenpipe by Aquatherm.
b) Niron Clima by Nupi Americas.

4. Connections For Copper Pipe:
a. Above-Grade:
1) Sweat copper type with 95/5 or 96/4 Tin-Antimony solder, Bridgit solder, or Silvabrite 100 solder. Use only lead-free solder.
2) Viega ProPress System
b. Below Grade:
1) Not allowed.

5. Connections For PP-R Pipe:
a. Above-Grade:
1) Socket-fusion, fusion-outlet, electrofusion, buttwelding, and mechanical transition fittings including threaded adapters, groove adapters, and flanges.
b. Below-Grade:
1) Not allowed.

6. Ball Valves:
a. Use ball valves exclusively unless otherwise specified. Ball valves shall be by single manufacturer from approved list below.
b. Valves shall be two-piece, full port for 150 psi SWP.
1) Operate with flow in either direction, suitable for throttling and tight shut-off.
2) Body: Bronze, 150 psig wsp at 350 deg F and 400 psig wog.
3) Seat: Bubble tight at 100 psig under water.
c. Class One Quality Standard: Nibco T585 or S585.
1) Equal by Conbraco 'Apollo,' Hammond, Milwaukee, or Watts.
d. PP-R piping if used:
1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
a) PP-R fusion-weld ball valves by Aquatherm.
b) PP-RCT Fusion by Nupi Americas.

7. Combination Pressure Reducing Valve / Strainer:
a. Integral stainless steel strainer, or separate 'Y' strainer installed upstream of pressure reducing valve.
b. Meet ANSI/ASSE 1003 or CSA B356 requirements.
c. Built-in thermal expansion bypass check valve.
d. Class One Quality Standard: Watts LFU5B:
1) Equal by Cash Acme, Cla-Val Hi Capacity, Conbraco 36C, Honeywell-Braukmann, Spence Hi Capacity, Watts, or Wilkins. See Section 01 6200.

8. Mixing Valve For Lavatories:
a. Solid brass construction and CSA B125 certified.
b. Includes integral check valves and inlet screen. Features advanced paraffin-based actuation technology.
c. Flow of 5.7 GPM with maximum 10 psi pressure drop. Perform to minimum flow of 0.5 GPM in accordance with ASSE 1070.
d. Set for 110 deg F Service.
e. Match Construction Drawings for connection sizes.
f. Class One Quality Standard: Powers LFLM495. See Section 01 6200.
g. Acceptable Manufacturers: Acorn, Chicago Faucets, Leonard, Powers, Sloan, Symmons and Watts.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locate cold water lines a minimum of 6 inches from hot water line.

3.2 FIELD QUALITY CONTROL

A. Field Tests:
   1. Before pipes are covered, test systems in presence of Architect/Engineer at 125 psig hydrostatic pressure for four (4) hours and show no leaks.
   2. Disconnect equipment not suitable for 125 psig pressure from piping system during test period.
   3. PP-R Piping:
      a. Test in accordance with Manufacturer's instructions prior to covering.
         1) Provide documentation.

3.3 CLEANING

A. Sterilize potable water system with solution containing 200 parts per million minimum of available chlorine and maintaining pH of 7.5 minimum. Introduce chlorinating materials into system in manner approved by Architect/Engineer. Allow sterilization solution to remain for twenty-four (24) hours and open and close valves and faucets several times during that time.

B. After sterilization, flush solution from system with clean water until residual chlorine content is less than 0.2 parts per million.

C. Water system will not be accepted until negative bacteriological test is made on water taken from system. Repeat dosing as necessary until such negative test is accomplished.

END OF SECTION

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SECTION 22 1119

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install miscellaneous potable water piping specialties as described in Contract Documents.

B. Related Requirements:
   1. Section 22 0501: 'Common Plumbing Requirements'.

1.2 REFERENCES

A. Reference Standards:
   1. NSF International Standard / American National Standards Institute:
      a. NSF/ANSI 61-2014a, 'Drinking Water System Components - Health Effects'.
      b. NSF/ANSI 372-2011, 'Drinking Water System Components - Lead Content'.

1.3 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Meet NSF International Standards for materials or products that come into contact with drinking water, drinking water treatment chemicals, or both for chemical contaminants and impurities that are indirectly imparted to drinking water from products, components, and materials used in drinking water systems.

PART 2 - PRODUCTS

2.1 ACCESSORIES

A. Manufacturers:
   1. Manufacturer Contact List:
      a. Ashcroft, Stratford, CT www.ashcroftinc.com.
      b. H O Trerice, Oak Park, MI www.hotco.com.
      c. Josam Co, Michigan City, IN www.josam.com.
      d. Jay R. Smith Maufacturing Co, Montgomery, AL www.jrsmith.com.
      e. Prier Products, Inc., Grandview, MD www.prier.com.
      f. Sioux Chief Manufacturing Co, Peculiar, MO www.siouxchief.com.
      g. Wade (Division of Tyler Pipe), Tyler, TX www.wadedrains.com.
      h. Watts Industries, Burlington, ON, Canada www.wattscda.com.
      i. Weiss Instruments, Inc., Holtsville, NY www.weissinstruments.com.
      j. Woodford Manufacturing, Colorado Springs, CO www.woodfordmfg.com.
      k. Zurn Cast Metals, Erie, PA or Zurn Industries Limited, Mississauga, ON www.zurn.com.

B. Materials:
   1. Trap Seal:
      a. Design Criteria:
         1) See Drawing detail.
      b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:

1) Mifab – MiGard – see Drawing detail:
   a) Install per Manufacturer's recommendations to suit floor drain sizes.

2. Pressure Reducing Station:
   a. Design Criteria:
      1) Meet NSF International Standards for Lead Free.
   b. Pressure Gauges:
      1) Gauges shall have following features:
         a) Cast aluminum case.
         b) Chrome plated ring.
         c) Impact resistant window.
         d) Phosphor bronze alloy steel bourdon tube.
         e) 1/2 percent scale range accuracy.
         f) 4-1/2 inch diameter dial face.
         g) Range 0 to 100 psig.
      2) Class One Quality Standard: 500X by H O Trerice.
         a) Equal by Ashcroft or Weiss. See Section 01 6200.
   c. Brass Gauge Cocks:
      1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
         a) 1092 by Ashcroft.
         b) 865 by H O Trerice.
3. Exterior Hydrants:
   a. Design Criteria:
      1) Provide with integral anti-siphon device. Key-operated.
      2) Non-freeze.
      3) Meet NSF International Standards for Lead Free.
   b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      1) Josam: 71050.
      2) Jay R. Smith: 5609-QT.
      3) Prier: C-634.
      4) Wade: W-8600.
      5) Watts: HY-725.
      6) Woodford: 67.
      7) Zurn: Z-1310.
4. Water Hammer Arrestors:
   a. Design Criteria:
      1) Meet NSF International Standards for Lead Free.
      2) Nesting type, air pre-charged bellows with casing.
      3) Bellows constructed of stabilized 18-8 stainless steel.
   b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      1) Josam: 75003.
      2) Jay R. Smith: 5020.
      3) Sioux Chief: 650 Series.
      4) Wade: 20.
5. Double Check Valve Backflow Preventer (meet AHJ standard details – see Drawings):
   a. Design Criteria:
      1) Meet NSF International Standards for Lead Free.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Gauges: Connect to pipe with 1/4 inch connections utilizing gauge cocks.

B. Water Hammer Arrestors: Locate to meet current Plumbing Code.

END OF SECTION

SECTION 22 1313

FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install soil, waste, and vent piping systems within building and connect with outside utility lines 5 feet out from building where applicable.
   2. Perform excavation and backfill required by work of this Section.

B. Related Requirements:
   1. Sections Under 07 3000 Heading: Furnishing and installing of roof jacks and pipe flashing at roof.
   2. Section 07 8400: ‘Firestopping’ for quality of firestopping material.
   3. Section 22 0501: ‘Common Plumbing Requirements’.
   4. Section 22 1319: 'Facility Sanitary Sewer Specialties' for furnishing of sewer specialties.
   5. Section 31 2316: 'Excavation' for criteria for performance of excavation.
   6. Section 31 2323: 'Fill' for criteria for performance of backfill and compaction.
   7. Section 33 3313: 'Sanitary Utility Sewerage' for sewage piping from 5 feet out from building to main.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference: Participate in pre-installation conference specified in Section 03 3111.

1.3 REFERENCES

A. Reference Standards:
   1. ASTM International:
      a. ASTM D2235-04(2016), ‘Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings'.
      b. ASTM D2321-18, ‘Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications'.
      c. ASTM D2564-12(2018), ‘Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems'.
      d. ASTM D3034–16, ‘Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings'.
      e. ASTM F628–12, ‘Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe With a Cellular Core'.
      f. ASTM F656–15, ‘Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings'.
      g. ASTM F891–16, ‘Standard Specification for Coextruded Poly(Vinyl Chloride) (PVC) Plastic Pipe With a Cellular Core'.
   2. CSA Group (Canadian Standards Association):
      a. CSA B1800-18, 'Thermoplastic Nonpressure Pipe Compendium':
         1) CSA-B182.1, ‘Plastic Drain and Sewer Pipe and Pipe Fittings'.
         2) CSA B182.2, ‘PSM Type Polyvinylchloride (PVC) Sewer Pipe Fittings'.
   3. International Code Council:
      a. ICC IPC-2018, 'International Plumbing Code'.

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Performance:
   1. Design Criteria:
      a. Minimum size of waste piping installed under floor slab on grade shall be 2 inches.
      b. Meet requirements of CAN/CSA-B182.1 for plastic piping systems.

B. Materials:
   1. Piping And Fittings: PVC Schedule 40 cellular core plastic pipe and pipe fittings meeting requirements of ASTM F891, joined using cement primer meeting requirements of ASTM F656 and pipe cement meeting requirements of ASTM D2564.
      a. Furnish wall cleanouts with chrome wall cover and screw.
   2. Piping And Fittings: ABS Schedule 40 cellular core plastic pipe and pipe fittings meeting requirements of ASTM F628, joined with pipe cement meeting requirements of ASTM D2235.
      a. Furnish wall cleanouts with chrome wall cover and screw.
   3. Cleanouts:
      a. Furnish wall cleanouts with chrome wall cover and screw.
      b. Type Two Acceptable Products:
         1) Finish Floors:
            a) Josam: 56010.
            b) J. R. Smith: 4023.
            c) Mifab: C1100C-R-1.
            d) Wade: W-6000.
            e) Watts: CO-200-R.
            f) Zurn: Z-1402.
         2) Resilient Flooring:
            a) Josam: 56010-12.
            b) J. R. Smith: 4140.
            c) Mifab: C1100C-T-1.
            d) Wade: W-6000-T.
            e) Watts: CO-200-T.
            f) Zurn: Z-1400.
         3) Finished Wall:
            a) Josam: 58790.
            b) J. R. Smith: 4530.
            c) Mifab: C1460RD.
            d) Wade: W8560E.
            e) Watts: CO-460-RD.
            f) Zurn: Z-1446.
         4) Exposed Drain Lines:
            a) Josam: 58910.
            b) J. R. Smith: 4510.
            c) Mifab: C1460.
            d) Wade: W8560B.
            e) Watts: CO-460.
            f) Zurn: Z-1440.
         5) General Purpose:
            a) Josam: 58900.
            b) J. R. Smith: 4400.
            c) Mifab: C1300-MF
            d) Wade: W8550E.
            e) Watts: CO-380.
            f) Zurn: Z-1440.
         6) Equal as approved by Architect before installation. See Section 01 6200.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Excavate and backfill as specified in Sections 31 2316 and 31 2323 with following additional requirements:
   1. Runs shall be as close as possible to those shown on Drawings.
   2. Excavate to required depth and grade to obtain fall required. Grade soil and waste lines within building perimeter 1/4 inch fall in one foot in direction of flow.
   3. Bottom of trenches shall be hard. Tamp as required.
   4. Remove debris from trench before laying of pipe.
   5. Do not cut trenches near footings without consulting Architect.

B. Thermoplastic Pipe And Fittings:
   1. General: Piping and joints shall be clean and installed according to Manufacturer's recommendations. Break down contaminated joints, clean seats and gaskets and reinstall.
   2. Above Grade: Locate pipe hangers every 4 feet on center maximum and at elbows.
   3. Below Grade:
      a. Install in accordance with Manufacturer's recommendations and ASTM D2321.
      b. Stabilize unstable trench bottoms.
      c. Bed pipe true to line and grade with continuous support from firm base.
         1) Bedding depth: 4 to 6 inches.
         2) Material and compaction to meet ASTM standard noted above.
      d. Excavate bell holes into bedding material so pipe is uniformly supported along its entire length. Blocking to grade pipe is forbidden.
      e. Trench width at top of pipe:
         1) Minimum: 18 inches or diameter of pipe plus 12 inches, whichever is greater.
         2) Maximum: Outside diameter of pipe plus 24 inches.
      f. Do not use backhoe or power equipment to assemble pipe.
      g. Initial backfill shall be 12 inches above top of pipe with material specified in referenced ASTM standard.
      h. Minimum cover over top of pipe not under building slab:
         1) 36 inches before wheel loading.
         2) 48 inches before compaction.

C. Install piping so cleanouts may be installed as follows:
   1. At every 135 degrees of accumulative change in direction for horizontal lines.
   2. Every 25 feet of horizontal run (pipe sizes less than 3”); every 50 feet of horizontal run (pipe sizes between 3” and 4”); every 85 feet of horizontal run (pipe sizes greater than 4”);.
   3. Extend piping to accessible surface. Do not install piping so cleanouts must be installed in carpeted floors. In such locations, configure piping so wall type cleanouts may be used.

D. Each fixture and appliance discharging water into sanitary sewer or building sewer lines shall have seal trap in connection with complete venting system so gasses pass freely to atmosphere with no pressure or siphon condition on water seal.

E. Vent entire waste system to atmosphere. Join lines together in fewest practicable numbers before projecting above roof. Set back vent lines so they will not pierce roof near edge or valley. Vent line terminations shall be:
   1. 6 inches minimum above roof and 12 inches minimum from any vertical surface.
   2. Same size as vent pipe.
   3. In areas where minimum design temperature is below 0 deg F or where frost or snow closure may be possible:
      a. Vent line terminations shall be same size as vent pipe, except no smaller than 2 inches in diameter.
      b. Vents shall terminate 10 inches minimum above roof or higher if required by local codes.

F. Furnish and install firestopping at penetrations of fire-rated structures as required under Sections 07 8400 and 22 0501.

G. If test Tees are used for testing, plug Tees so wall finish can be installed. Do not leave as exposed cleanouts.

3.2 FIELD QUALITY CONTROL

A. Field Tests:
   1. Conduct tests for leaks and defective work. Notify Architect before testing.
   2. Thermoplastic Pipe System:
      a. Before backfilling and compacting of trenches, Fill waste and vent system with water to roof level or 10 feet minimum, and show no leaks for two hours. Correct leaks and defective work.
      b. After backfilling and compacting of trenches is complete but before placing floor slab, re-test as specified above. Uncover pipe and correct leaks and defective work. Re-backfill and compact and re-test.

END OF SECTION

SECTION 22 1319

FACILITY SANITARY SEWER SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Products Furnished But Not Installed Under this Section as described in Contract Documents.

B. Related Requirements:
1. Section 09 3013: 'Ceramic Tile' for floor drains in ceramic tile floors.
2. Section 22 0501: 'Common Plumbing Requirements'.
3. Section 22 1119: 'Domestic Water Piping Specialties'.
4. Section 22 1313: ‘Facility Sanitary Sewers’ for installation of miscellaneous sanitary sewer specialties.

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Manufacturers:
1. Manufacturer Contact List:
a. Josam Co, Michigan City, IN www.josam.com.
b. Jay R. Smith Manufacturing Co, Montgomery, AL www.jrsmith.com.
c. Mifab Manufacturing Inc, Chicago, IL www.mifab.com.
d. Proset Systems, Lawrenceville, GA www.prosetsystems.com.
e. Sioux Chief Manufacturing Co, Peculiar, MO www.siouxchief.com.
f. Sureseal Manufacturing, Tacoma WA www.thesureseal.com.
1) Contact Information:
a) All Areas except Idaho and Utah: Rick Ensley (253) 564-0624, rick@thesureseal.com.
b) Idaho and Utah Areas: Mark Evans, phone (801) 748-1222, mark@franklinjames.com.
g. Wade Div Tyler Pipe, Tyler, TX www.wadedrains.com.
h. Watts Drainage, Spindale, NC www.watts.com or Watts Industries, Burlington, ON, Canada www.wattscda.com.
i. Zurn Industries, LLC, Erie PA www.zurn.com. or Zurn Industries Ltd, Mississuaga, ON (905) 795-8844.

B. Performance:
1. Design Criteria:
a. All materials NOT required to be low lead compliant.

C. Components:
1. Drains And Drain Accessories:
a. Floor Drain FD-1 – see schedule on Drawings:
1) Approved types with deep seal trap and chrome plated strainer.
2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
a) Josam: 30000-50-Z-5A.
b) J. R. Smith: 2010-A.
c) Mifab: F-1100-C.
d) Sioux Chief: 832.
e) Wade: 1100.
f) Watts: FD-200-A.

g) Zurn: Z-415.

D. Accessories:
1. Drain Accessories:
a. Floor Drains:
1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
a) Mifab – MiGard – see details on Drawings and match to size of floor drain.

PART 3 - EXECUTION: Not Used

END OF SECTION

SECTION 22 3423

GAS DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install gas-fired storage type water heater as described in Contract Documents.

B. Related Requirements:
   1. Section 22 0501: 'Common Plumbing Requirements'.
   2. Section 22 1116: 'Domestic Water Piping'.
   3. Section 23 5135: ‘Air Piping’.

1.2 REFERENCES

A. Reference Standards:
   1. CSA Group / American National Standards Institute:
      a. CSA ANSI Z21.22-2015/CSA 4.4-2015, ‘Relief Valves for Hot Water Supply Systems'.
   2. NSF International Standard / American National Standards Institute:
      a. NSF/ANSI 61-2017, 'Drinking Water System Components - Health Effects'.
      b. NSF/ANSI 372-2016, 'Drinking Water System Components - Lead Content'.

1.3 SUBMITTALS

A. Closeout Submittals:
   1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
      a. Operations and Maintenance Data:
         1) Maintenance and operational instructions.
      b. Warranty Documentation:
         1) Final, executed copy of Warranty.
      c. Record Documentation:
         1) Manufacturers documentation:
            a) Manufacturer's literature or cut sheet.

1.4 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Meet NSF International Standards for materials or products that come into contact with drinking water, drinking water treatment chemicals, or both for chemical contaminants and impurities that are indirectly imparted to drinking water from products, components, and materials used in drinking water systems.
   2. Anchoring Components:
      a. See details in Drawings:
         1) Straps/anchoring systems.
         2) Fasteners.

1.5 WARRANTY

A. Manufacturer Warranty:

1. Provide Manufacture standard warranty from date of Substantial Completion covering both tank and component parts for leakage or other malfunction caused by defects in materials and/or workmanship.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Manufacturers:
   1. Manufacturer Contact List:
      a. American Water Heater Co, Johnson City, TN www.americanwaterheater.com.
      b. A O Smith Water Products Co, Ashland City, TN www.hotwater.com or A O Smith Enterprise Ltd, Stratford, ON (800) 265-8520 or (519) 271-5800.
      c. Enovative Group, Venice, CA www.enovativegroup.com.
      d. Bradford White Corp, Ambler, PA www.bradfordwhite.com.
      e. Heat Transfer Products, East Freetown, MA www.htproducts.com.
      f. Lochinvar, Lebanon, TN www.lochinvar.com.
      g. Rheem Water Heating, Montomery, AL www.rheem.com.
      h. State Industries Inc, Ashland City, TN www.stateind.com.

B. Materials:
   1. Design Criteria:
      a. All (wetted) drinking water products, components, and materials used in drinking water systems must meet NSF International Standards for Lead Free.
   2. Condensing Type Water Heaters:
      a. Stainless steel or 90/10 cupronickel heat exchanger, pressure tested and rated for 150 psi w.p. complete with thermostat, high limit control, gas pressure regulator, 100 percent safety shutoff and powered combustion air blower. AGA and CGA approved.
      b. 94 percent thermal efficiency.
      c. Temperature and pressure relief valve sized to match heat input and set to relieve at 120 psi.
      d. Vacuum relief valve meeting requirements of CSA ANSI Z21.22.
      e. 30 - 65 Gallon:
         1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
            a) Polaris Model PGC3 34-130-2NV by American (34 gallons).
            b) Polaris PGC3 50-130-3NV by American (50 gallons).
            c) Cyclone BTX-100 by A. O. Smith (50 gallon).
            d) EF-60T-125E-3N by Bradford White (60 gallon).
            e) Phoenix PH100-55 by Heat Transfer Products (55 gallons).
            f) RGH-100 by Heat Transfer Products (30 gallon).
            g) SNR126-065 by Lochinvan (65 Gallon).
            h) HE45-100 by Rheem (45 gallons).
            i) Force 90+ SHE50 100NE by State Industries (50 gallons).

2.2 ACCESSORIES

A. Anchoring Components:
   1. See details in Drawings:
      a. One inch by 18 ga galvanized steel straps.
      b. No. 10 by 2-1/2 inch screws.

B. Recirculation Pump and Circulation Pump Control:
   1. Hot water demand control type.
   2. WR-16A Wireless Receiver.
   3. WM-S-16A Wireless Motion Sensors.
   4. Type One Acceptable Products:

a. AutoHot 150 Series with wireless receiver and sensors by Enovative Group.
b. Equal as approved by Architect before bidding. See Section 01 6200.

C. Thermal Expansion Absorbers:
1. Bladder type for use with potable water systems.
2. Type One Acceptable Products:
a. Therm-X-Trol ST-12 by Amtrol Inc, West Warwick, RI www.amtrol.com.
b. Equal as approved by Architect before bidding. See Section 01 6200.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install temperature-pressure relief valve on hot water heater and pipe discharge into drain pan prior to entering floor drain – see details.

B. Anchor water heater to wall using one anchoring strap and specified screws.
1. Anchors shall be installed to suit readability of nomenclature on tank.

C. Install hot water circulation pump and pump controls per manufacturer's instructions:
1. Coordinate with Contract Drawings and Reflected Ceiling Plan for location of wireless receiver(s) and motion sensors.
2. Connect wireless receiver(s) to pump control box.
3. Install wireless motion sensors.

3.2 ADJUSTING

A. Set discharge water temperature at 140 deg F or as indicated on Contract Drawings.

END OF SECTION

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SECTION 22 4213

COMMERCIAL WATER CLOSETS AND URINALS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install plumbing fixtures as described in Contract Documents.

B. Related Requirements:
   1. Section 07 9213: 'Elastomeric Joint Sealants' for sealants used between fixtures and other substrates.
   2. Section 22 0501: 'Common Plumbing Requirements'.
   3. Section 22 1116: 'Domestic Water Piping'.

1.2 REFERENCES

A. Definitions:
   1. High-Efficiency Toilet (HET): Toilets with effective flush volume of 1.28 gallons or less.
   2. Maximum Performance (MaP): Toilet testing that rates toilet efficiency and flush performance by measuring number of grams of solid waste (soybean paste and toilet paper) that a toilet can flush and remove completely from fixture in single flush represented as a scale or score. 1000 grams is highest score possible (www.map-testing.com).

B. Reference Standards:
   1. American Society of Mechanical Engineers / CSA Group (Canadian Standards Association):
      a. ASME A112.19.2-2018/CSA B45.1-18, 'Ceramic Plumbing Fixtures'.

1.3 SUBMITTALS

A. Closeout Submittals:
   1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
      a. Operation and Maintenance Data:
         1) Sensor Operated operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Manufacturers:
   1. Manufacturer Contact List:
      a. American Standard Brands, Piscataway, NJ www.americanstandard-us.com or American Standard Canada, Mississauga, ON www.americanstandard.ca.
      b. AMTC - Advanced Modern Technologies Corp, Woodland Hills, CA www.amtcorporation.com.
      c. Bemis Manufacturing Co, Sheboygan Falls, WI www.bemismfg.com.
      d. Beneke by Sanderson Plumbing Products, Columbus, MS www.sppi.com.
      e. Church Seat Co, Sheboygan Falls WI www.churchseats.com.

f. Delany Flush Valves, Charlottesville, VA www.delanyproduct.com.
g. Delta Faucet Co, Indianapolis, IN www.deltafaucet.com or Delta Faucet Canada, London, ON (519) 659-3626.
h. Dearborn Brass, Cleveland, OH www.dearbornbrass.com.
i. Josam Co, Michigan City, IN www.josam.com.
j. Jay R. Smith Mfg. Co, Montgomery, AL www.jrsmith.com.
k. Kohler Co Plumbing Div, Kohler, WI www.us.kohler.com.
l. McGuire Manufacturing Co, Cheshire, CT www.mcguiremfg.com.
m. Mifab Manufacturing Inc, Amherst, NY www.mifab.com.
n. Moen Incorporated, North Olmsted, OH, or Moen Canada, Oakville, ON www.moen.com.
o. Olsonite Corp, Newnan, GA www.olsonite.net or Olsonite Co Ltd, Tilbury, ON (519) 682-1240.
p. Sloan Valve Co, Franklin Park, IL www.sloanvalve.com.
q. South Fork Manufacturing, Coalville, UT (801) 953-3001 www.dirt-grabber.com.
r. Toto U.S.A., Inc., Morrow, GA www.totousa.com
s. Wade Div Tyler Pipe, Tyler, TX www.wadedrains.com.
t. Watts Drainage, Spindale, NC www.wattsdrainage.com or Watts Industries, Burlington, ON, Canada www.wattscda.com.
u. Zurn Industries, LLC, Erie PA www.zurn.com. or Zurn Industries Ltd, Mississuaga, ON (905) 795-8844.

B. Performance:
1. Design Criteria:
a. Meet or exceed ASME A112.19.2/CSA B45.1 for Vitreous China Plumbing Fixtures.
b. Interior exposed pipe, valves, and fixture trim, including trim behind custom casework doors, shall be chrome plated.
c. All materials NOT required to be low lead compliant.
d. Do not use toilets with effective flush volume of less than 1.28 gallons.

C. Materials:
1. Water Closets:
a. Floor Mounted With Tank:
1) HET (High-Efficiency Toilet) - Standard Fixture WC-1:
a) Water usage of 1.28 gallons per flush.
b) MaP Score of 1000 grams.
c) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
(1) American Standard: Cadet 3 Elongated 215CA.004.
(2) Kohler: Wellworth K-3948.
(3) Toto: 'ECO Drake' CST744E.or CST744EG.
2) Handicap Accessible Fixture WC-3:
a) Water usage of 1.6 gallons per flush.
b) 18 inch maximum rim height.
c) MaP Score of 1000 grams.
d) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
(1) American Standard: Cadet 3 Right Height Elongated 215AA.004.
(2) Kohler: Highline K-3979.
(3) Toto: 'ADA Drake' CST744SL.
3) HET (High-Efficiency Toilet) - Handicap Accessible Fixture WC-2:
a) Water usage of 1.28 gallons per flush.
b) 18 inch maximum rim height.
c) MaP Score of 1000 grams.
d) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
(1) American Standard: Cadet Pro Right Height Elongated 215AA.104.
(2) Kohler: Highline K-3949.
(3) Toto: 'ADA Drake' CST744EL.
2. Water Closet Accessories:
a. Seats:

1) Provide split front type with check hinge. Provide lid at barrier free locations.
2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
   a) Standard And Handicap Accessible Fixtures:
      (1) American Standard: 5905.100SS.
      (2) Bemis: 1655SSC.
      (3) Beneke: 527 SS.
      (4) Church: 9500SSC.
      (5) Kohler: K-4731-C.
      (6) Olsonite: 95SSC.
      (7) Toto SC534.

b. Supply Pipe And Stop:
   1) Provide chrome plated quarter-turn brass ball valve, 12 inch braided stainless steel riser, and chrome-plated steel flange.
   2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      a) McGuire: BV2166CC.
      b) Zurn: Z8804.

3. Urinals:
   a. HEU (High-Efficiency Urinal) - Standard Fixture UR-1:
      1) Water usage of 0.5 gallons per flush.
      2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
         a) American Standard: Washbrook FloWise 6590.001.
         b) Kohler: Bardon K-4904-ET.
         c) Sloan SU-1009.
         d) Toto: UT447E.
4. Urinal Accessories:
   a. Carrier / Support:
      1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
         a) Josam.
         b) Jay R. Smith.
         c) Mifab.
         d) Wade.
         e) Zurn.
   b. Flush Valve:
      1) HEU (High-Efficiency Urinal) - Standard:
         a) Proximity sensor type with battery.
         b) Low flow, 0.5 gallon per flush maximum.
         c) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
            (1) American Standard 6063.051.
            (2) Delany: PL 1451-0.5.
            (3) Delta: 81T231BTA factory set to 0.5 gallons per flush.
            (4) Moen: 8315.
            (5) Sloan: 8186-0.5.
            (6) Zurn: ZER6003AV-EWS with maintenance override button.
   c. Flush Valve Filter:
      1) Required in following flush valves:
         a) Sloan.
         b) Zurn.
      2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
         a) SFDG1 'Dirt Grabber' by South Fork Manufacturing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install each fixture with separate vent line. Do not circuit vent.

B. Ensure provisions are made for proper support of fixtures and that rough-in piping is accurately set and protected from movement and damage.
   1. Seal wall-mounted fixtures around edges to wall with sealant specified in Section 07 9213 'Elastomeric Joint Sealants'.
   2. Attach wall-hung fixtures to carriers.
   3. Support fixture hanger or arm free of finished wall.

C. Adjust flush valves for proper flow.

D. Provide each individual fixture supply with accessible chrome-plated stop valve with hand wheel.

E. Urinals: Install with accessible stop or control valve in each branch supply line.

F. Mounting – see A401:
   1. Urinals:
      a. Standard: 24 inches from floor to bottom lip.
      b. Handicap Accessible: 17 inches maximum from floor to bottom lip.

G. Water Closets:
   1. Floor or Wall Fixtures:
      a. Make fixture connections with approved brand of flange, secured, and caulked securely to waste pipe. Make joints between fixtures and flanges tight with approved fixture setting compound or gaskets. Caulk between fixtures with sealant specified in Section 07 9213. Point edges.

H. Flush Valve Filters:
   1. Install in Sloan and Zurn only flush valves.
   2. Install after water lines have been flushed out, but before turning water into flush valve.

3.2 CLEANING

A. Polish chrome finish at completion of Project.

END OF SECTION

SECTION 22 4216

COMMERCIAL LAVATORIES AND SINKS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install plumbing fixtures as described in Contract Documents.

B. Related Requirements:
   1. Section 07 9213: 'Elastomeric Joint Sealants' for sealants used between fixtures and other substrates.
   2. Section 22 0501: 'Common Plumbing Requirements'.
   3. Section 22 1116: 'Domestic Water Piping'.

1.2 REFERENCES

A. Reference Standard:
   1. American National Standards Institute / International Code Council:
      a. ANSI/ICC A117.1-2017, 'Standard for Accessible and Usable Buildings and Facilities'.
   2. American Society of Mechanical Engineers / Canadian Standards Association (CSA Group):
      a. ASME A112.18.1-2018/CSA B125.1-18, ‘Plumbing Supply Fittings’.
      b. ASME A112.19.1-2018/CSA B45.2-18, 'Enamelled Cast Iron and Enamelled Steel Plumbing Fixtures’.
      c. ASME A112.19.3-2017/CSA B45.4-17, ‘Stainless steel plumbing fixtures’.
   3. CSA Group (Canadian Standards Association):
      a. CSA B125.1-18/ASME A112.18.1-2018, ‘Plumbing Supply Fittings’.
      b. CSA B45.2-18/ASME A112.19.1-2018, ‘Enamelled Cast Iron and Enamelled Steel Plumbing Fixtures’.
      c. CSA B45.4-17/ASME A112.19.3-2017, ‘Stainless Steel Plumbing Fixtures’.
   4. NSF International Standard / American National Standards Institute:
      a. NSF/ANSI 61-2017, 'Drinking Water System Components - Health Effects'.
      b. NSF/ANSI 372-2016, 'Drinking Water System Components - Lead Content'.

1.3 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Meet NSF International Standards for materials or products that come into contact with drinking water, drinking water treatment chemicals, or both for chemical contaminants and impurities that are indirectly imparted to drinking water from products, components, and materials used in drinking water systems.

1.4 SUBMITTALS

A. Closeout Submittals:
   1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
      a. Warranty Documentation:
         1) Final, executed copy of Warranty.

1.5 WARRANTY

A. Manufacturer Warranty:
   1. Manufacturer's standard Warranty against material or Manufacturing defects.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Manufacturers:
   1. Manufacturer Contact List:
      a. American Standard Brands, Piscataway, NJ www.americanstandard-us.com or American Standard Canada, Mississauga, ON www.americanstandard.ca.
      b. Brocar Products Inc, Cincinnati, OH www.brocar.com.
      c. CECO, Huntington Park, CA www.cecosinks.com.
      d. Chicago Faucet Co, Des Plaines, IL www.chicagofaucets.com.
      e. Dearborn Brass, Tyler, TX www.dearbornbrass.com.
      f. Delta Faucet Co, Indianapolis, IN www.deltafaucet.com or Delta Faucet Canada, London, ON (519) 659-3626.
      g. Engineered Brass Co. (EBC) (Just Manufacturing Co.), Franklin Park, IL www.justmfg.com.
      h. Elkay Manufacturing Co, Oak Brook, IL www.elkay.com.
      i. Josam Co, Michigan City, IN www.josam.com.
      j. Jay R. Smith Maufacturing Co, Montgomery, AL www.jrsmith.com.
      k. Just Manufacturing Co, Franklin Park, IL www.justsinks.com.
      l. Keeney Manufacturing Co, Newington, CT www.keeneymfg.com.
      m. Kindred USA, Midland, ON www.kindred-sinkware.com.
      n. Kohler Co Plumbing Div, Kohler, WI www.us.kohler.com.
      o. McGuire Manufacturing Co, Cheshire, CT www.mcguiremfg.com.
      p. Mifab Manufacturing Inc, Amherst, NY www.mifab.com.
      q. Moen Incorporated, North Olmsted, OH, or Moen Canada, Oakville, ON www.moen.com.
      r. Omni Flow Controls, Harbor City, CA www.chronomite.com or www.omniflowcontrols.com.
      s. Plumberex Specialty Products, Palm Springs, CA www.plumberex.com.
      t. Sloan Valve Co, Franklin Park, IL www.sloanvalve.com.
      u. Speakman Company, New Castle, DE www.speakmancompany.com.
      v. Symmons, Braintree, MA www.symmons.com.
      w. T & S Brass & Bronze Works Inc, Travelers Rest, SC www.tsbrass.com.
      x. TrueBro Inc, Collierville, TN www.truebro.com.
      y. Wade Div Tyler Pipe, Tyler, TX www.wadedrains.com.
      z. Watts Drainage, Spindale, NC www.wattsdrainage.com or Watts Industries, Burlington, ON, Canada www.wattscda.com.
      aa. Zurn Commercial Brass, Sanford, NC www.zurn.com or Zurn Industries Ltd, Mississuaga, ON (905) 795-8844.
      bb. Zurn Cast Metal, Erie, PA www.zurn.com.

B. Performance:
   1. Design Criteria:
      a. Interior exposed pipe, valves, and fixture trim, including trim behind custom casework doors, shall be chrome plated.
      b. Faucets and other fixture fittings shall conform to requirements of ASME A112.18.1/CSA B125.1.
      c. Lavatories shall conform to requirements of:
         1) Enamelled cast iron and enamelled steel fixtures.
            a) ASME A112.19.1/CSA B45.2.
            b) CSA B45.2/ASME A112.19.1.
         2) Stainless steel plumbing fixtures:
            a) ASME A112.19.3/CSA B45.4.
            b) CSA B45.4/ASME A112.19.3.

C. Components:
1. Lavatories And Fittings:
a. Standard and Handicap Accessible Self Supporting Lavatories LAV-1:
1) Size: 20 by 18 inches nominal.
2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
a) American Standard: Lucern 0355.012.
b) Kohler: Greenwich K-2032.
3) Carrier / Support:
a) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
(1) Josam: 17100.
(2) Jay R. Smith: 0700.
(3) Mifab: MC-41.
(4) Wade: 520-M36.
b. Lavatory Fittings:
1) Automatic Faucet and Grid Strainer For Handicap Accessible Sinks all LAV-1:
a) Design Criteria:
(1) Meet NSF International Standards for Lead Free.
(2) CSA certified.
(3) Complies to ASME A112.18.1/CSA B125.1
(4) Electronic battery operated 4” one-piece body with integral waterproof sensor and connector.
(5) Surface mount control box.
b) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
(1) American Standard: equal.
(2) Chicago: equal.
(3) Delta: 591T1250 w/ control box.
(4) Kohler: equal.
(5) Moen: equal.
(6) Speakman: equal.
(7) T & S: equal.
(8) Zurn: equal.
2) Flow Control Fitting:
a) Design Criteria:
(1) Meet NSF International Standards for Lead Free.
b) Accessories:
(1) Provide vandal-proof type in place of aerator. Flow shall be 0.5 gpm.
c) Category Four Approved Product. See Section 01 6200 for definitions of Categories:
(1) Omni L-200 Series by Chronomite Laboratories.
3) Supply pipes with stops:
a) Design Criteria:
(1) Meet NSF International Standards for Lead Free.
b) Accessories:
(1) Provide chrome plated quarter-turn brass ball valve, 12 inches long braided stainless steel riser, and chrome-plated steel flange.
c) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
(1) McGuire: BV2165CC.
(2) Zurn: Z8804 LRQ-PC.
4) Trap:
a) Description:
(1) standard accessible ‘P’ trap covered with insulated jacket.
5) Safety Covers for Handicap Accessible Lavatories all LAV-1:
a) Description:
(1) Provide protection on water supply pipes and on trap.
b) Design Criteria:
(1) Not required to meet NSF International Standards for Lead Free.

c) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
(1) Trapwrap by Brocar Products Inc.
(2) Pro Wrap by McGuire Products.
(3) Lav Guard 2 by TrueBro.
(4) Pro Extreme by Plumberex.

2. Stainless Steel Sinks And Fittings:
a. Design Criteria:
1) Not required to meet NSF International Standards for Lead Free.
2) Self-rimming, 18 gauge stainless steel, satin finish.
b. Double Compartment Sinks S-1:
1) Design Criteria:
a) Not required to meet NSF International Standards for Lead Free.
2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
a) Elkay: LR 3319.
b) Just: DL-1933-A-GR.
c) Kindred: LBT 4408P-1.
c. Single Compartment Sink SS-1:
1) Description:
a) Size: 22 by 19.5 inches nominal.
2) Design Criteria:
a) Not required to meet NSF International Standards for Lead Free.
3) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
a) Elkay: LR-2219.
b) Just: SL-1921-AG-R.
c) Kindred: LBS 4008P-1.
d. Stainless Steel Sink Fittings:
1) Faucets for Sacrament Preparation Room Sink SS-1:
a) Design Criteria:
(1) Meet NSF International Standards for Lead Free.
b) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
(1) American Standard: Gooseneck Swivel Spout 7100.241H.
(2) Chicago: 350-ABCP.
(3) Delta: 27C643-R4.
(4) Kohler: K-7895-C.
(5) Moen: 8103.
(6) Speakman: SC-7112.
(7) T & S: 0305-01.
(8) Zurn: Z-825B1FC.
2) Faucets for Serving Area Sinks S-1:
a) Design Criteria:
(1) Meet NSF International Standards for Lead Free.
b) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
(1) Moen: 8227. (swivel).
(2) Speakman: SC-5724. (swivel).
3) Supply pipes with stops:
a) Design Criteria:
(1) Meet NSF International Standards for Lead Free.
b) Accessories:
(1) Provide chrome plated quarter-turn brass ball valve, 12 inches long braided stainless steel riser, and chrome-plated steel flange.
c) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
(1) McGuire: BV2165CC.
(2) Zurn: Z8804 LRQ-PC.
4) Flow Control Fitting:
a) Design Criteria:
(1) Meet NSF International Standards for Lead Free.

b) Accessories:
(1) Provide vandal-proof type in place of aerator. Flow shall be 1.5 gpm.
c) Category Four Approved Product. See Section 01 6200 for definitions of Categories:
(1) Omni A-200 Series by Chronomite Laboratories.
5) Waste For Standard Stainless Steel Sinks:
a) Design Criteria:
(1) Not required to meet NSF International Standards for Lead Free.
b) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
(1) Elkay: LK-99.
(2) Kindred: 1130.
(3) Kohler: K8801.
(4) McGuire: 151.
(5) Zurn Z-8740-PC.
6) Waste For Sacrament Preparation Room Sink:
a) Design Criteria:
(1) Not required to meet NSF International Standards for Lead Free.
b) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
(1) Elkay: LK18.
(2) Just: J-35FS.
(3) Kohler: K8807G.
(4) McGuire: 152.
(5) Zurn Z-8739-PC.
7) Trap:
a) Description:
(1) standard accessible 'P' trap covered with insulated jacket at Serving Area.

3. Miscellaneous Sinks And Fittings:
a. Service Sink JS-1:
1) Description:
a) Floor Type, enameled cast iron, 28 inches square with vinyl coated rim guard or 24 inches square with Stainless Steel rim guard.
2) Design Criteria:
a) Not required to meet NSF International Standards for Lead Free.
3) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
a) American Standard: Florwell Enameled Cast Iron 7741.000 with vinyl rim guard 7745.811.
b) CECO: 871.
c) Kohler: Whitby K-6710.
d) Zurn: 5850.
4) Service Sink Fittings:
a) Design Criteria:
(1) Not required to meet NSF International Standards for Lead Free.
b) Supply:
(1) Mounting height of 42 inches.
(2) Provide 48 inch hose and clamp.
(3) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
(a) American Standard: Exposed Yoke Wall-Mount Utility Faucet with top brace 8344.112 with threaded spout.
(b) Chicago: 897 CP.
(c) Delta: 28T9 with 28T911 hose and bracket.
(d) Kohler: K-8928.
(e) Moen: 8124.
(f) Speakman: SC-5812.
(g) T&S: B-0665-BSTP.
(h) Zurn: Z-843M1.
c) Drain and Strainer:

(1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
(a) American Standard: Grid strainer 7721.038.
(b) Kohler: K-9146, 3 inch IPS.

d) Trap: PVC, or ABS to match piping.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install each fixture with separate vent line. Do not circuit vent.

B. Ensure provisions are made for proper support of fixtures and that rough-in piping is accurately set and protected from movement and damage.

C. Seal wall-mounted fixtures around edges to wall and counter top fixtures to countertop with sealant specified in Section 07 9213.

D. Unless otherwise noted, provide each individual fixture supply with chrome-plated stop valve with hand wheel.

E. Install fixtures with accessible stop or control valve in each hot and cold water branch supply line.

F. Self-Supporting Lavatories: Install using carriers. Support carrier free of finished wall.

G. Install Safety Covers on all under sink / lavatories with exposed water supply pipes and traps.

H. Install Handicap Accessible Fixtures as per 2019 National Building Code – Alberta Edition height mounting requirements - see A401.

3.2 CLEANING

A. Polish chrome finish at completion of Project.

END OF SECTION

SECTION 22 4700

DRINKING FOUNTAINS AND WATER COOLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install drinking water cooling system units as described in Contract Documents.

B. Related Requirements:
   1. Section 22 0501: 'Common Plumbing Requirements'.
   2. Section 22 1116: 'Domestic Water Piping'.

1.2 REFERENCES

A. Reference Standard:
   1. American National Standards Institute / International Code Council:
      a. ANSI/ICC A117.1-2017, 'Standard for Accessible and Usable Buildings and Facilities'.
   2. Canadian Standards Association (CA):
      a. CSA C22.2 No. 120-13 (R2018), ‘Refrigeration Equipment’.
   3. NSF International Standard / American National Standards Institute:
      a. Water Cooler:
         1) NSF/ANSI 61-2017, 'Drinking Water System Components - Health Effects'.
         2) NSF/ANSI 372-2016, 'Drinking Water System Components - Lead Content'.

1.3 SUBMITTALS

A. Closeout Submittals:
   1. Warranty Documentation:
      a. Provide Manufacturer Warranty.

1.4 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Handicap Accessible Products to meet ANSI/ICC A117 Accessible requirements.
   2. Meet NSF International Standards for materials or products that come into contact with drinking water, drinking water treatment chemicals, or both for chemical contaminants and impurities that are indirectly imparted to drinking water from products, components, and materials used in drinking water systems.

1.5 WARRANTY

A. Manufacturer standard warranty on unit.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Manufacturers:

1. Manufacturer Contact List:
   a. Elkay Manufacturing Co, Oak Brook, IL www.elkay.com.
   b. Halsey Taylor, Oak Brook, IL www.halseytaylor.com.
   c. Murdock Manufacturing (Acorn), City of Industry, CA www.murdockmfg.com.
   d. Oasis, Tri Palm International, Columbus OH www.oasiswatercoolers.com.

B. Design Criteria:
1. All drinking water products, components, and materials above and below grade used in drinking water systems must meet NSF International Standards for Lead Free.
2. Interior exposed pipe, valves, and fixture trim shall be chrome plated.

C. Materials:
1. Handicap Accessible Bi-Level Cooler:
   a. Design Criteria:
      1) Vandal proof operating bar on front and both sides.
      2) 8 GPH water at 50 deg F water cooled from 80°F inlet water and 90°F ambient per ASHRAE testing.
      3) 115-120 V, 60 Hz, single phase.
      4) Flexible bubbler.
      5) Build-In strainer.
      6) Meets state and federal requirements for both children or adults as defined by the Americans with Disabilities Act.
   b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      1) Elkay: Model EZSTL8LC.
      2) Halsey Taylor: Model HAC8FSBL-Q-ADA.
      3) Murdock Manufacturing: Model A172408B-UBL.
      4) Oasis: Model PG8ACSL.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fixtures with accessible stop or control valve.

B. Mounting:
1. General:
   a. Coordinate location of fountain with location and height of electrical outlet to ensure concealment of outlet by fountain.
   b. Anchor bottom of fountain to wall.
   c. Install 3/8 inch IPS union connection and Chicago No. 441 stop to building supply line.
   d. Install 1-1/4 inch IPS slip cast brass 'P' trap. Install trap so it is concealed.
2. Accessible Drinking Fountains:
   a. Spout outlets of wheelchair accessible drinking fountains shall be 36 inches maximum above floor.
   b. Spout outlets of drinking fountains for standing persons shall be 42 inches above floor.

3.2 CLEANING

A. Polish chrome finish at completion of Project.

END OF SECTION

DIVISION 23: HEATING, VENTILATING, AND AIR-CONDITIONING

23 0500 COMMON WORK RESULTS FOR HVAC

23 0501 COMMON HVAC REQUIREMENTS
23 0529 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
23 0553 IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
23 0713 DUCT INSULATION
23 0719 HVAC PIPING INSULATION
23 0933 ELECTRIC AND ELECTRONIC CONTROL SYSTEM FOR HVAC

23 1000 FACILITY FUEL SYSTEMS

23 1123 FACILITY NATURAL GAS PIPING

23 2000 HVAC PIPING AND PUMPS

23 2113 HYDRONIC PIPING: ABOVE GRADE
23 2114 HYDRONIC PIPING SYSTEM SPECIALTIES
23 2300 REFRIGERANT PIPING
23 2600 CONDENSATE DRAIN PIPING

23 3000 HVAC AIR DISTRIBUTION

23 3001 COMMON DUCT REQUIREMENTS
23 3114 LOW-PRESSURE METAL DUCTS
23 3300 AIR DUCT ACCESSORIES
23 3316 FIRE AND SMOKE DAMPERS
23 3346 FLEXIBLE DUCTS
23 3401 EXHAUST FANS
23 3713 DIFFUSERS, REGISTERS, AND GRILLES
23 3714 LOUVERS AND VENTS

23 4000 HVAC AIR CLEANING DEVICES

23 4100 AIR FILTERS

23 5000 CENTRAL HEATING EQUIPMENT

23 5135 AIR PIPING
23 5224 NATURAL GAS CONDENSING BOILERS
23 5417 GAS-FIRED FURNACES

23 6000 CENTRAL COOLING EQUIPMENT

23 6214 COMPRESSOR UNITS: AIR CONDITIONING (5 TON OR LESS)

23 7000 CENTRAL HVAC EQUIPMENT

23 7223 PACKAGED AIR-TO-AIR ENERGY RECOVERY UNITS

23 8000 DECENTRALIZED HVAC EQUIPMENT

23 8333 ELECTRIC RADIANT HEATERS

END OF TABLE OF CONTENTS

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SECTION 23 0501

COMMON HVAC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Common requirements and procedures for HVAC systems.
   2. Responsibility for proper operation of electrically powered equipment furnished under this Division.
   3. Interface with Testing And Balancing Agency.
   4. Furnish and install sealants relating to installation of systems installed under this Division.
   5. Furnish and install Firestop Penetration Systems for HVAC system penetrations as described in Contract Documents.
   6. Furnish and install sound and vibration control elements.

B. Products Furnished But Not Installed Under This Section:
   1. Sleeves, inserts, and equipment for mechanical systems installed under other Sections.

C. Related Requirements:
   1. Section 03 3111: 'Cast-In-Place Structural Concrete' for exterior concrete pads and bases for mechanical equipment.
   2. Section 05 0523: 'Metal Fastening' for quality and requirements for welding.
   3. Section 07 8400: 'Firestopping' for quality of Penetration Firestop Systems to be used on Project and submittal requirements.
   4. Section 07 9213: 'Elastometric Joint Sealant' for quality of sealants used at building exterior.
   5. Section 07 9219: 'Acoustical Joint Sealants' for quality of acoustical sealants.
   6. Sections Under 09 9000 Heading: Painting of mechanical items requiring field painting.
   7. Division 26: Raceway and conduit, unless specified otherwise, line voltage wiring, outlets, and disconnect switches.
   8. Slots and openings through floors, walls, ceilings, and roofs provided under other Divisions in their respective materials.
   9. Sections Under 33 5000 Heading: Fuel Distribution Utilities.

1.2 SUBMITTALS

A. Action Submittals:
   1. Product Data:
      a. Manufacturer's catalog data for each manufactured item.
         1) Provide section in submittal for each type of item of equipment. Include Manufacturer's catalog data of each manufactured item and enough information to show compliance with Contract Document requirements. Literature shall show capacities and size of equipment used and be marked indicating each specific item with applicable data underlined.
         2) Include name, address, and phone number of each supplier.
   2. Shop Drawings:
      a. Schematic control diagrams for each separate fan system, heating system, control panel, etc. Each diagram shall show locations of all control and operational components and devices. Mark correct operating settings for each control device on these diagrams.
      b. Diagram for electrical control system showing wiring of related electrical control items such as firestats, fuses, interlocks, electrical switches, and relays. Include drawings showing electrical power requirements and connection locations.
      c. Drawing of each temperature control panel identifying components in panels and their function.

d. Other shop drawings required by Division 23 trade Sections.

B. Closeout Submittals:
1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
a. Operations and Maintenance Data (Modify and add to requirements of Section 01 7800):
1) At beginning of HVAC section of Operations And Maintenance Manual, provide master index showing items included.
a) Provide name, address, and phone number of Architect, Architect's Mechanical Engineer, General Contractor, and HVAC, Sheet Metal, Refrigeration, and Temperature Control subcontractors.
b) Identify maintenance instructions by using same equipment identification used in Contract Drawings. Maintenance instructions shall include:
(1) List of HVAC equipment used indicating name, model, serial number, and nameplate data of each item together with number and name associated with each system item.
(2) Manufacturer's maintenance instructions for each piece of HVAC equipment installed in Project. Instructions shall include name of vendor, installation instructions, parts numbers and lists, operation instructions of equipment, and maintenance and lubrication instructions.
(3) Summary list of mechanical equipment requiring lubrication showing name of equipment, location, and type and frequency of lubrication.
(4) Manual for Honeywell thermostat published by Honeywell – see ME sheets.
c) Provide operating instructions to include:
(1) General description of each HVAC system.
(2) Step by step procedure to follow in putting each piece of HVAC equipment into operation.
(3) Provide diagrams for electrical control system showing wiring of items such as smoke detectors, fuses, interlocks, electrical switches, and relays.
b. Warranty Documentation:
1) Include copies of warranties required in individual Sections of Division 23.
c. Record Documentation:
1) Manufacturers documentation:
a) Copies of approved shop drawings.

1.3 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
1. Perform work in accordance with applicable provisions of Gas Ordinances applicable to Project. Provide materials and labor necessary to comply with rules, regulations, and ordinances.
2. In case of differences between building codes, laws, local ordinances, utility company regulations, and Contract Documents, the most stringent shall govern. Notify Architect in writing of such differences before performing work affected by such differences.
3. Identification:
a. Motor and equipment name plates as well as applicable UL / ULC and AGA / CGA labels shall be in place when Project is turned over to Owner.

B. Qualifications: Requirements of Section 01 4301 applies, but not limited to following:
1. Company:
a. Company specializing in performing work of this section.
1) Minimum five (5) years experience in HVAC installations.
2) Minimum five (5) satisfactorily completed installations in past three (3) years of projects similar in size, scope, and complexity required for this project before bidding.
b. Upon request, submit documentation.
2. Installer:
a. Licensed for area of Project.
b. Designate one (1) individual as project foremen who shall be on site at all times during installation and experienced with installation procedures required for this project.
c. Upon request, submit documentation.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Delivery And Acceptance Requirements:
   1. Accept valves on site in shipping containers with labeling in place.

B. Storage And Handling Requirements:
   1. In addition to requirements specified in Division 01:
      a. Stored material shall be readily accessible for inspection by Architect until installed.
      b. Store items subject to moisture damage, such as controls, in dry, heated spaces.
      c. Provide temporary protective coating on cast iron and steel valves.
      d. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
   2. Protect bearings during installation. Thoroughly grease steel shafts to prevent corrosion.

1.5 WARRANTY

A. Manufacturer Warranty:
   1. Provide certificates of warranty for each piece of equipment made out in favor of Owner. Clearly record 'start-up' date of each piece of equipment on certificate.

B. Special Warranty:
   1. Guarantee HVAC systems to be free from noise in operation that may develop from failure to construct system in accordance with Contract Documents.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Components shall bear Manufacturer's name and trade name. Equipment and materials of same general type shall be of same make throughout work to provide uniform appearance, operation, and maintenance.

B. Pipe And Pipe Fittings:
   1. Use domestic made pipe and pipe fittings on Project.
   2. Weld-O-Let and Screw-O-Let fittings are acceptable.

C. Sleeves:
   1. In Framing: Standard weight galvanized iron pipe, Schedule 40 PVC, or 14 ga (2 mm) galvanized sheet metal two sizes larger than bare pipe or insulation on insulated pipe.
   2. In Concrete And Masonry: Sleeves through outside walls, interior shear walls, and footings shall be Schedule 40 PVC pipe w/ rod and sealant where necessary to maintain building envelope.

D. Valves:
   1. Valves of same type shall be of same manufacturer.

PART 3 - EXECUTION

3.1 INSTALLERS

A. Acceptable Installers:
   1. Meet Quality Assurance Installer Qualifications as specified in Part 1 of this specification.

3.2 EXAMINATION

A. Drawings:
   1. HVAC Drawings show general arrangement of piping, ductwork, equipment, etc. Follow as closely as actual building construction and work of other trades will permit.
   2. Consider Architectural and Structural Drawings part of this work insofar as these drawings furnish information relating to design and construction of building. These drawings take precedence over HVAC Drawings.
   3. Because of small scale of Drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions.

B. Verification Of Conditions:
   1. Examine premises to understand conditions that may affect performance of work of this Division before submitting proposals for this work. Examine adjoining work on which mechanical work is dependent for efficiency and report work that requires correction.
   2. No subsequent allowance for time or money will be considered for any consequence related to failure to examine site conditions.
   3. Ensure that items to be furnished fit space available. Make necessary field measurements to ascertain space requirements including those for connections and furnish and install equipment of size and shape so final installation shall suit true intent and meaning of Contract Documents. If approval is received by Addendum or Change Order to use other than originally specified items, be responsible for specified capacities and for ensuring that items to be furnished will fit space available.
   4. Check that slots and openings provided under other Divisions through floors, walls, ceilings, and roofs are properly located. Perform cutting and patching caused by neglecting to coordinate with Divisions providing slots and openings at no additional cost to Owner.

3.3 PREPARATION

A. Changes Due To Equipment Selection:
   1. Where equipment specified or otherwise approved requires different arrangement or connections from that shown in Contract Documents, submit drawings, if requested by Architect, showing proposed installations.
   2. If proposed changes are approved, install equipment to operate properly and in harmony with intent of Contract Documents. Make incidental changes in piping, ductwork, supports, installation, wiring, heaters, panelboards, and as otherwise necessary.
   3. Provide any additional motors, valves, controllers, fittings, and other additional equipment required for proper operation of system resulting from selection of equipment.
   4. Be responsible for the proper location of roughing-in and connections provided under other Divisions.

3.4 INSTALLATION

A. Interface With Other Work:
   1. Furnish sleeves, inserts, supports, and equipment that are to be installed by others in sufficient time to be incorporated into construction as work proceeds. Locate these items and see they are properly installed.
   2. Electrical: Furnish exact location of electrical connections and complete information on motor controls to installer of electrical system.
   3. Testing And Balancing:
      a. Put HVAC systems into full operation and continue their operation during each working day of testing and balancing.
      b. Make changes in pulleys, belts, fan speeds, and dampers or add dampers as required for correct balance as recommended by Testing And Balancing Agency and at no additional cost to Owner.

B. Cut carefully to minimize necessity for repairs to previously installed or existing work. Do not cut beams, columns, or trusses.

C. Locating Equipment:
   1. Arrange pipes, ducts, and equipment to permit ready access to valves, cocks, unions, traps, filters, starters, motors, control components, and to clear openings of doors and access panels.
   2. Adjust locations of pipes, ducts, switches, panels, and equipment to accommodate work to interferences anticipated and encountered.
   3. Install HVAC work to permit removal of equipment and parts of equipment requiring periodic replacement or maintenance without damage to or interference with other parts of equipment or structure.
   4. Determine exact route and location of each pipe and duct before fabrication.
      a. Right-Of-Way:
         1) Lines that pitch shall have right-of-way over those that do not pitch. For example, steam, steam condensate, and drains shall normally have right-of-way.
         2) Lines whose elevations cannot be changed shall have right-of-way over lines whose elevations can be changed.
      b. Offsets, Transitions, and Changes in Direction:
         1) Make offsets, transitions, and changes in direction in pipes and ducts as required to maintain proper head room and pitch of sloping lines whether or not indicated on Drawings.
         2) Furnish and install all traps, air vents, sanitary vents, and devices as required to effect these offsets, transitions, and changes in direction.

D. Piping:
   1. Furnish and install complete system of piping, valved as indicated or as necessary to completely control entire apparatus.
      a. Pipe drawings are diagrammatic and indicate general location and connections. Piping may have to be offset, lowered, or raised as required or directed at site. This does not relieve this Division from responsibility for proper erection of systems of piping in every respect.
      b. Arrange piping to not interfere with removal of other equipment, ducts, or devices, or block access to doors, windows, or access openings.
         1) Arrange so as to facilitate removal of tube bundles.
         2) Provide accessible flanges or ground joint unions, as applicable for type of piping specified, at connections to equipment and on bypasses.
            a) Make connections of dissimilar metals with di-electric unions.
            b) Install valves and unions ahead of traps and strainers. Provide unions on both sides of traps.
         3) Do not use reducing bushings, street elbows, bull head tees, close nipples, or running couplings.
         4) Install piping systems so they may be easily drained. Provide drain valves at low points and manual air vents at high points in hot water heating and cooling water piping.
         5) Install piping to insure noiseless circulation.
         6) Place valves and specialties to permit easy operation and access. Valves shall be regulated, packed, and glands adjusted at completion of work before final acceptance.
      c. Do not install piping in shear walls.
   2. Properly make adequate provisions for expansion, contraction, slope, and anchorage.
      a. Cut piping accurately for fabrication to measurements established at site. Remove burr and cutting slag from pipes.
      b. Work piping into place without springing or forcing. Make piping connections to pumps and other equipment without strain at piping connection. Remove bolts in flanged connections or disconnect piping to demonstrate that piping has been so connected, if requested.
      c. Make changes in direction with proper fittings.
      d. Expansion of Thermoplastic Pipe:
         1) Provide for expansion in every 30 feet of straight run.
         2) Provide 12 inch offset below roof line in each vent line penetrating roof.
   3. Provide sleeves around pipes passing through concrete or masonry floors, walls, partitions, or structural members. Do not place sleeves around soil, waste, or vent lines passing through concrete floors on grade. Seal sleeves with specified sealants.

a. Sleeves through floors shall extend 1/4 inch above floor finish in mechanical equipment rooms. In other rooms, sleeves shall be flush with floor.
b. Sleeves through floors and foundation walls shall be watertight.

4. Provide spring clamp plates (escutcheons) where pipes run through walls, floors, or ceilings and are exposed in finished locations of building. Plates shall be chrome plated heavy brass of plain pattern and shall be set tight on pipe and to building surface.
5. Remove dirt, grease, and other foreign matter from each length of piping before installation.
   a. After each section of piping used for movement of water or steam is installed, flush with clean water, except where specified otherwise.
   b. Arrange temporary flushing connections for each section of piping and arrange for flushing total piping system.
   c. Provide temporary cross connections and water supply for flushing and drainage and remove after completion of work.

E. Penetration Firestops: Install Penetration Firestop System appropriate for penetration at HVAC system penetrations through walls, ceilings, roofs, and top plates of walls.

F. Sealants:
1. Seal openings through building exterior caused by penetrations of elements of HVAC systems.
2. Furnish and install acoustical sealant to seal penetrations through acoustically insulated walls and ceilings.

3.5 REPAIR / RESTORATION

A. Each Section of this Division shall bear expense of cutting, patching, repairing, and replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it.
1. Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown.
2. Surface finishes shall exactly match existing finishes of same materials.

3.6 FIELD QUALITY CONTROL

A. Field Tests:
1. Perform tests on HVAC piping systems. Furnish devices required for testing purposes.

B. Non-Conforming Work:
1. Replace material or workmanship proven defective with sound material at no additional cost to Owner.
2. Repeat tests on new material, if requested.

3.7 SYSTEM START-UP

A. Off-Season Start-up:
1. If Substantial Completion inspection occurs during heating season, schedule spring start-up of cooling systems. If inspection occurs during cooling season, schedule autumn start-up for heating systems.
2. Notify Owner seven days minimum before scheduled start-up.
3. Time will be allowed to completely service, test, check, and off-season start systems. During allowed time, train Owner's representatives in operation and maintenance of system.
4. At end of off-season start-up, furnish Owner with letter confirming that above work has been satisfactorily completed.

B. Preparations that are to be completed before start up and operation include, but are not limited to, following:
1. Dry out electric motors and other equipment to develop and properly maintain constant insulation resistance.

2. Make adjustments to insure that:
   a. Equipment alignments and clearances are adjusted to allowable tolerances.
   b. Nuts and bolts and other types of anchors and fasteners are properly and securely fastened.
   c. Packed, gasketed, and other types of joints are properly made up and are tight and free from leakage.
   d. Miscellaneous alignings, tightenings, and adjustings are completed so systems are tight and free from leakage and equipment performs as intended.
3. Motors and accessories are completely operable.
4. Inspect and test electrical circuitry, connections, and voltages to be properly connected and free from shorts.
5. Adjust drives for proper alignment and tension.
6. Make certain filters in equipment for moving air are new and of specified type.
7. Properly lubricate and run-in bearings in accordance with Manufacturer's directions and recommendations.

3.8 CLEANING

A. Clean exposed piping, ductwork, and equipment.

B. Replace filters in equipment for moving air with new filters of specified type no more than one week before Final Inspection.

3.9 CLOSEOUT ACTIVITIES

A. Instruction Of Owner:
   1. Instruct building maintenance personnel and Stake Physical Facilities Representative in operation and maintenance of mechanical systems utilizing Operation And Maintenance Manual when so doing:
      a. Minimum Instruction Periods:
         1) HVAC: Eight (8) hours.
         2) Temperature Control: Six (6) hours.
         3) Refrigeration: Four (4) hours.
      b. Conduct instruction periods after Substantial Completion inspection when systems are properly working and before final payment is made. None of these instructional periods shall overlap another.

3.10 PROTECTION

A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system. Cap or plug open ends of pipes and equipment to keep dirt and other foreign materials out of system. Do not use plugs of rags, wool, cotton waste, or similar materials.

B. Do not operate pieces of equipment used for moving supply air without proper air filters installed properly in system.

C. After start-up, continue necessary lubrication and be responsible for damage to bearings while equipment is being operated up to Substantial Completion.

END OF SECTION

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SECTION 23 0529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Common hanger and support requirements and procedures for HVAC systems.
   2. Coordinate hanger installation with spray foam schedule.

B. Related Requirements:
   1. Section 05 0523: 'Metal Fastening' for quality and requirements for welding.
   2. Section 07 8400: 'Firestopping' for quality of Penetration Firestop Systems to be used on Project and submittal requirements.
   3. Slots and openings through floors, walls, ceilings, and roofs provided under other Divisions in their respective materials.

C. Products Installed But Not Furnished Under This Section:
   1. Stencils and band colors of gas piping used in HVAC equipment.

D. Related Requirements:
   1. Section 09 9124: ‘Interior Painted Metal’ for providing field painting of identification of piping used with HVAC equipment.
   2. Section 23 0553: 'Identification For HVAC Piping And Equipment’ for HVAC piping and equipment identification signage requirements.
   3. Sections Under 09 9000 Heading: Painting of mechanical items requiring field painting.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Section 09 9124 to coordinate with Section 23 0529 for location of identification of HVAC piping and equipment to be field painted and Section 23 0553 for painting requirements of HVAC piping and equipment.
   2. Section 23 0529 to coordinate with Section 23 0553 for stencil and band color locations and identification requirements of HVAC piping and equipment for field application.

1.3 SUBMITTALS

A. Action Submittals:
   1. Product Data:
      a. Manufacturer's catalog data for each manufactured item.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Manufacturers:
   1. Class Two Quality Standard Approved Manufacturers. See Section 01 6200:
      a. Anvil International, Portsmouth, NH www.anvilintl.com.
      b. Cooper B-Line, Highland, IL www.cooperbline.com.
      c. Erico International, Solon, OH www.erico.com.

d. Hilti Inc, Tulsa, OK www.hilti.com.
e. Minerallac, Hampshire, IL www.minerallac.com.
f. Thomas & Betts, Memphis, TN www.superstrut.com.
g. Unistrut, Wayne, MI www.unistrut.com.

B. Performance:
1. Design Criteria:
a. Support rods for single pipe shall be in accordance with following table:

Rod Diameter	Pipe Size
3/8 inch	2 inches and smaller
1/2 inch	2-1/2 to 3-1/2 inches
5/8 inch	4 to 5 inches
3/4 inch	6 inches
7/8 inch	8 to 12 inches

b. Support rods for multiple pipes supported on steel angle trapeze hangers shall be in accordance with following table:

Rods		Number of Pipes per Hanger for Each Pipe Size						
No.	Diameter	2 Inch	2.5 Inch	3 Inch	4 Inch	5 Inch	6 Inch	8 Inch
2	3/8 Inch	Two	0	0	0	0	0	0
2	1/2 Inch	Three	Three	Two	0	0	0	0
2	5/8 Inch	Six	Four	Three	Two	0	0	0
2	5/8 Inch	Nine	Seven	Five	Three	Two	Two	0
2	5/8 Inch	Twelve	Nine	Seven	Five	Three	Two	Two

1) Size trapeze angles so bending stress is less than 10,000 psi.

C. Materials:
1. Hangers, Rods, Channels, Attachments, And Inserts:
a. Galvanized and ULC approved for service intended.
b. Support horizontal piping from clevis hangers or on roller assemblies with channel supports, except where trapeze type hangers are explicitly shown on Drawings. Hangers shall have double nuts.
c. Class Two Quality Standards:
1) Support insulated pipes with clevis hanger equal to Anvil Fig 260 or roller assembly equal to Anvil Fig 171 with an insulation protection shield equal to Anvil Fig 167. Gauge and length of shield shall be in accordance with Anvil design data.
2) Except uninsulated copper pipes, support uninsulated pipes from clevis hanger equal to Anvil Fig 260. Support uninsulated copper pipe from hanger equal to Anvil Fig CT-65 copper plated hangers and otherwise fully suitable for use with copper tubing.
d. Riser Clamps For Vertical Piping:
1) Class Two Quality Standard: Anvil Figure 261.
e. Furnace / Fan Coil Support Channel:
1) Class One Quality Standard: Unistrut P1000.
2) Acceptable Manufacturers: Hilti, Thomas & Betts.
3) Equal as approved by Architect before installation. See Section 01 6200.
f. Swivel Attachment:
1) Class One Quality Standard: Unistrut EM3127.
2) Acceptable Manufacturers: Hilti, Thomas & Betts.
3) Equal as approved by Architect before installation. See Section 01 6200.

EXECUTION

2.2 INSTALLATION

A. Piping:
1. Properly support piping and make adequate provisions for expansion, contraction, slope, and anchorage.

a. Except for underground pipe, suspend piping from roof trusses or clamp to vertical walls using support channels and clamps. Do not hang pipe from other pipe, equipment, or ductwork. Laying of piping on any building element is not allowed.
b. Supports For Horizontal Piping:
   1) Support metal piping at 96 inches mm on center maximum for pipe 1-1/4 inches or larger and 72 inches on center maximum for pipe 1-1/8 inch or less.
   2) Support thermoplastic pipe at 48 inches on center maximum.
   3) Provide support at each elbow. Install additional support as required.
c. Supports for Vertical Piping:
   1) Place riser clamps at each floor or ceiling level.
   2) Securely support clamps by structural members, which in turn are supported directly from building structure.
   3) Provide clamps as necessary to brace pipe to wall.
d. Insulate hangers for copper pipe from piping by means of at least two layers of Scotch 33 plastic tape.
e. Expansion of Thermoplastic Pipe:
   1) Provide for expansion in every 30 feet of straight run.
   2) Provide 12 inch offset below roof line in each vent line penetrating roof.

END OF SECTION

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SECTION 23 0553

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Products Furnished But not Installed Under This Section:
   1. Identification of HVAC piping and equipment as described in Contract Documents including:
      a. Paint identification for gas piping used in HVAC equipment.
      b. Stencils and band colors for gas piping used in HVAC equipment.

B. Related Requirements:
   1. Section 09 9124: 'Interior Painted Metal' for providing field painting of identification of piping used with HVAC equipment.
   2. Section 22 0529: 'Hangers And Supports For Plumbing' for field installation of pipe stencils and band colors for identification for piping used with HVAC equipment.

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Description:
   1. Abbreviations for Pipe Stencils and Equipment Identification and Band Colors for Pipe Identification:
      a. Apply stenciled symbols and continuous painting as follows:

Pipe Type	Pipe Color	Symbol
Gas	Yellow	GAS

B. Materials:
   1. Category Four Approved Products and Manufacturers. See Section 01 6200 for definitions of Categories:
      a. Products listed in edition of MPI Approved Product List current at time of bidding and later are approved, providing they meet VOC requirements in force where Project is located.
   2. Description:
      a. Ferrous Metal:
         1) New Surfaces: Use MPI(a) INT 5.1B Waterborne Light Industrial Finish system.
   3. Performance Requirements:
      a. New Surfaces: MPI Premium Grade finish requirements.
      b. Maintain specified colors, shades, and contrasts.
   4. Paint (one coat):
      a. Primer:
         1) Ferrous Metal:
            a) MPI 107, 'Primer, Rust-Inhibitive, Water Based'.
               (1) Color: white.
      b. Finish Coat (two coats):
         1) Ferrous Metal:
            a) MPI 153, 'Light Industrial Coating, Interior, Water Based, Semi-Gloss (MPI Gloss Level 5)'.
   5. Labels:
      a. Equipment Identification:
         1) Black formica, with white reveal when engraved.
         2) Lettering to be 3/16 inch high minimum.

PART 3 - EXECUTION

3.1 APPLICATION

A. Labels:
   1. Identify following items with specified labels fastened to equipment with screws (unless noted otherwise):
      a. Thermostats and control panels in mechanical spaces (attach label to wall directly above or below thermostats).
      b. Furnaces.
      c. Condensing units.
      d. Boilers, including pumps and hot water heating specialties.
      e. Glycol fill Unit.
      f. ERVs.
      g. Wall Heaters.
      h. Exhaust fans.
   2. Engrave following data from Equipment Schedules on Drawings onto labels:
      a. Equipment mark.
      b. Room(s) served.
      c. Panel and breaker from which unit is powered.

B. Painting:
   1. New Surfaces:
      a. Remove rust spots by sanding and immediately spot prime. If all traces of rust cannot be removed, apply rust blocker recommended by Paint Manufacturer before applying full primer coat.
   2. Leave equipment in like-new appearance.
   3. Only painted legends, directional arrows, and color bands are acceptable.
   4. Locate identifying legends, directional arrows, and color bands at following points on exposed piping of each piping system:
      a. Adjacent to each item of equipment.
      b. At point of entry and exit where piping goes through wall.
      c. On each riser and junction.
      d. Every 25 feet on long continuous lines.
      e. Stenciled symbols shall be one inch high and black.

END OF SECTION

SECTION 23 0713

DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install thermal wrap duct insulation as described in Contract Documents.

B. Related Requirements:
   1. Section 23 3114: 'Low-Pressure Metal Ducts'.
   2. Section 23 3300: 'Acoustic Duct Accessories' for duct liner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer Contact List:
   1. Certainteed St Gobain, Valley Forge, PA www.certainteed.com.
   2. Johns-Manville, Denver, CO www.jm.com.
   3. Knauf Fiber Glass, Shelbyville, IN www.knauffiberglass.com or Toronto, ON (416) 593-4322.
   4. Manson Insulation Inc, Brossard, QB www.isolationmanson.com.
   5. Owens-Corning, Toledo, OH or Owens-Corning Canada Inc, Willowdale, ON www.owenscorning.com.

2.2 MATERIALS

A. Thermal Wrap Duct Insulation:
   1. 1-1/2 inch or 3 inch thick fiberglass with factory-laminated, reinforced aluminum foil scrim kraft facing and density of 0.75 lb / per cu ft.
   2. Thermal Conductivity: 0.27 BTU in/HR SF deg F at 75 deg F maximum.
   3. Type One Acceptable Products:
      a. Type 75 standard duct insulation by Certainteed St Gobain.
      b. Microlite FSK by Johns-Manville.
      c. Duct Wrap FSK by Knauf Fiber Glass.
      d. Alley Wrap FSK by Manson Insulation Inc.
      e. FRK by Owens-Corning.
      f. Equal as approved by Architect before bidding. See Section 01 6200.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Thermal Wrap Duct Insulation:
   1. Install insulation as follows:
      a. Within Building Insulation Envelope:
         1) 1-1/2 inches thick on rectangular outside air ducts, combustion air ducts, and exhaust air ducts.
         2) 1-1/2 inches thick on all round ducts.
      b. Outside Building Insulation Envelope:

1) 3 inch thick on round air ducts, plenums.
2) 1-1/2 inch thick on rectangular, acoustically lined, supply and return air ducts.

2. Wrap insulation tightly on ductwork with circumferential joints butted and longitudinal joints overlapped minimum 2 inches.
   a. Do not compress insulation except in areas of structural interference. Minimum thickness at corners shall be one inch thick.
   b. Remove insulation from lap before stapling.
   c. Staple seams at approximately 16 inches on center with outward clenching staples.
   d. Seal seams with foil vapor barrier tape or vapor barrier mastic. Seal penetrations of facing to provide vapor tight system.
   e. Wire wrap joints to secure insulation in place.

B. Insulate outside of ceiling diffusers, diffuser drops, and duct silencers same as ductwork.

END OF SECTION

SECTION 23 0719

HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install insulation on above ground refrigerant piping and fittings as described in Contract Documents.
   2. Furnish and install insulation for hot water heating and return piping system as described in Contract Documents.
   3. Furnish and install insulation in Contract Documents for following:
      a. Combustion air PVC piping.
      b. Combustion vent PVC piping

B. Related Requirements:
   1. Section 23 0501: 'General HVAC Requirements'.
   2. Section 23 2113: ‘Hydronic Piping: Above Grade’.
   3. Section 23 2300: ‘Refrigerant Piping’.
   4. Section 23 5135: ‘Air Piping’.

1.2 DELIVERY, STORAGE, AND HANDLING

A. Storage And Handling Requirements:
   1. Keep materials and work dry and free from damage.
   2. Replace wet or damaged materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Manufacturers:
   1. Manufacturer Contact List:
      a. Armacell, Mebane, NC www.armaflex.com.
      b. Childers Products Co, Eastlake, OH www.fosterproducts.com.
      c. Foster Products Corp, Oakdale, MN www.fosterproducts.com.
      d. Johns-Manville, Denver, CO www.jm.com.
      e. Knauf, Shelbyville, IN www.knauffiberglass.com.
      f. Manson, Brossard, BC, Canada www.isolationmanson.com.
      g. Nitron Industries, Thousand Oaks, CA www.nitronindustries.com.
      h. Owens-Corning, Toledo, OH www.owenscorning.com or Owens-Corning Canada Inc, Willowdale, ON (416) 733-1600.
      i. Ramco, Lawrenceville, NJ www.ramco.com.
      j. Nomac, Zebulon, NC www.nomaco.com.
      k. Speedline Corp, Solon, OH www.speedlinepvc.com.

B. Materials:
   1. Refrigeration Piping System:
      a. Thickness:

Pipe Size, Outside Diameter	Insulation Thickness
One inch and smaller	1/2 Inch

1-1/8 to 2 inch	3/4 Inch

1) One inch sheet for fittings as recommended by Manufacturer.
2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
   a) AP Armaflex 25/50 by Armacell.
   b) Nitrolite by Nitron Industries. White only for exterior.
   c) Nomaco K-Flex.

b. Joint Sealer:
1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
   a) Armacell 520 by Armacell.
   b) Namaco K-Flex R-373.

c. Insulation Tape:
1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
   a) Armaflex AP Insul Tape by Armacell.
   b) FT182 Tape by Nitron Industries.
   c) Elastomeric Foamtape by Nomac K-Flex.

d. Exterior Finish (where exposed to exterior UV):
1) For application to non-white, exterior insulation.
2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
   a) WB Armaflex Finish by Armacell.
   b) R-374 Protective Coating by Nomaco K-Flex.

2. Hot-Water-Heat Piping Systems:
a. Thickness:
1) Pipe:
   a) 1-1/2 inch for pipe sizes ≤ 1.5 inch diameter.
   b) 2 inch for pipe sizes > 1.5 inch diameter.
2) Pipe Fittings:
   a) 1-1/2 inch for pipe sizes ≤ 1.5 inch diameter.
   b) 2 inch for pipe sizes > 1.5 inch diameter.
3) Heavy density fiberglass with fire retardant vapor barrier jacket with self-sealing laps.
4) Performance Standard: Fiberglas heavy density with ASJ-SSL jacket by Owens-Corning.
5) Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
   a) Manson.
   b) Johns Manville.
   c) Owens-Corning.

b. Vapor Barrier Adhesive: As recommended by Insulation Manufacturer.
c. Covers For Valves And Fittings:
1) Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
   a) Zeston by Johns Manville.
   b) Speedline.

d. Shields: 22 ga by 12 inch long galvanized steel.
e. Hydraulic Setting Insulating Cement.
1) Class Two Quality Standard: Ramco Finishing Cement 1200.

f. Weather Barrier Mastic:
1) Water based vinyl-acrylic mastic coating.
2) Class Two Quality Standard: Childers / Foster CP-10 / CP-11.

g. Canvas: 4 oz.

C. PVC Combustion Air and Combustion Vent Piping:
1. Flexible Foamed Pipe Insulation:
a. Thickness:
1) 1/2 inch for 2 inch through 3 inch outside diameter pipe.
2) 1/2 inch sheet for fittings as recommended by Manufacturer.

b. Acceptable Products and Manufacturers:
1) Armaflex by Armstrong World Industries Inc, Lancaster, PA (717) 397-0611
2) Insul-Tube by Halstead Industrial Products Group, Greensboro, NC (800) 643-0252
3) ImcoLock or ImcoShield by IMCOA/Nibco Canada Ltd (800) 268-3509

4) Rubatex by Rubatex Corp, Roanoke, VA (800) 782-2839

2. Joint Sealer:
   a. Acceptable Products And Manufacturers:
      1) Armaflex 520 by Armstrong World Industries Inc, Lancaster, PA (717) 397-0611
      2) Construction Adhesive #105 by BFG

PART 3 - EXECUTION

3.1 PREPARATION

A. Before application of insulating materials, brush clean surfaces to be insulated and make free from rust, scale, grease, dirt, moisture, and any other deleterious materials.

B. Use drop cloths over equipment and structure to prevent adhesives and other materials spotting the work.

C. Coordinate PVC air piping insulation with spray foam schedule.

3.2 INSTALLATION

A. Refrigeration System Piping System:
   1. General:
      a. Install insulation in snug contact with pipe.
         1) Insulate flexible pipe connectors.
         2) Insulate thermal expansion valves with insulating tape.
         3) Insulate fittings with sheet insulation and as recommended by Manufacturer.
      b. Slip insulation on tubing before tubing sections and fittings are assembled keeping slitting of insulation to a minimum.
      c. Do not install insulation on lines through clamp assembly of pipe support. Butt insulation up against sides of clamp assembly.
      d. Stagger joints on layered insulation. Seal joints in insulation.
      e. Install insulation exposed outside building so 'slit' joint seams are placed on bottom of pipe.
      f. Paint exterior exposed, non-white insulation with two coats of specified exterior finish.
   2. System Requirements:
      a. Condensing Units: Install insulation on above ground refrigerant suction piping and fittings.

B. PVC Combustion Air and Combustion Vent Piping
   1. Install on combustion air and combustion vent PVC piping in cold space and in attic for 10 feet inside building insulation envelope, and on combustion vent PVC piping above roof.
   2. Stagger joints on layered insulation.
   3. Slip insulation on tubing before tubing sections and fittings are assembled keeping slitting of insulation to minimum.
   4. Seal joints in insulation.
   5. Insulation exposed outside building shall have ‘slit’ joint seams placed on bottom of pipe.
   6. Insulate fittings with sheet insulation and as recommended by Manufacturer.
   7. Paint exterior exposed insulation with two coats of finish recommended by Insulation Manufacturer, colour as selected by Consultant.
   8. Install U/V resistant ties over insulation if slit.

C. Hot Water Heating System:
   1. Pipes:
      a. Butt joints firmly together.
      b. Seal vapor barrier longitudinal seam overlap with vapor barrier adhesive.
      c. Wrap butt joints with 4 inch strip of vapor barrier jacket material cemented with vapor barrier adhesive.
      d. Finish with bands applied at mid-section and at each end of insulation.

2. Valves And Fittings:
   a. Insulate by one of following methods:
      1) With hydraulic setting insulating cement, or equal, to thickness equal to adjoining pipe insulation.
      2) With segments of molded pipe insulation securely wired in place.
   b. Finish fittings and valves with canvas coated with weather barrier mastic or securely fitted Zeston covers.
3. Pipe Hangers: Provide shields at each pipe hanger to protect pipe insulation from crushing.

3.3 FIELD QUALITY CONTROL

A. Non-Conforming Work:
   1. Method of installing insulation shall be subject to approval of Architect. Sloppy or unworkmanlike installations are not acceptable.

3.4 CLEANING

A. Leave premises thoroughly clean and free from insulating debris.

3.5 PROTECTION

A. Protect insulation wherever leak from valve stem or other source might drip on insulated surface, with aluminum cover or shield rolled up at edges and sufficiently large in area and of shape that dripping will not splash on surrounding insulation.

END OF SECTION

SECTION 23 0933

ELECTRIC AND ELECTRONIC CONTROL SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install automatic temperature control system as described in Contract Documents.
   2. Furnish and install conductors and make connections to control devices, motors, and associated equipment.
   3. See ME sheets for control wiring.
   4. See sheets M201, M202 and detail E/M501 for heating schematic and hydronic operation.
   5. Assist in air test and balance procedure.

B. Related Requirements:
   1. Section 01 4546: Duct testing, adjusting, and balancing of ductwork.
   2. Section 23 0501: Common HVAC Requirements.
   3. Section 23 3300: Furnishing and installing of temperature control dampers.
   4. Division 26:
      a. Furnishing and installing of raceway, conduit, and junction boxes, including pull wires, for temperature control system except as noted above.
      b. Power wiring to magnetic starters, disconnect switches, and motors.
      c. Motor starters and disconnect switches, unless integral with packaged equipment.

1.2 SUBMITTALS

A. Action Submittals:
   1. Product Data:
      a. Installer to provide product literature or cut sheets for all products specified in Project.
      b. Installer to provide questions of control equipment locations to Mechanical Engineer prior to installation.

B. Informational Submittals:
   1. Certificates:
      a. Installer must provide ‘Certificate of Sponsorship’ signed from Approved Distributor with bid confirming Installer sponsorship.

C. Closeout Submittals:
   1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
      a. Operations and Maintenance Data:
         1) Leave with O&M Manual specified in Section 23 0501.
      b. Record Documentation:
         1) Installer's 'Certificate of Sponsorship'.

1.3 QUALITY ASSURANCE

A. Qualifications: Requirements of Section 01 4301 applies, but is not limited to the following:
   1. Installer:
      a. Before bidding, obtain sponsorship from a local, Approved Distributor specified under PART 2 PRODUCTS of this specification. Initial requirements for sponsorship are:
         1) Receive LCBS Connect product training from Approved Distributor.
         2) Installer to provide Distributor sponsorship by submitting ‘Certificate of Sponsorship’ as Informational Submittal with bid. Certificate available as Attachment in this Specification.

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Manufacturers:
   1. Manufacturer Contact List:
      a. Air Products & Controls Ltd, Pontiac, MI www.ap-c.com.
      b. Fire-Lite Alarms, Northford, CT www.firelite.com.
      c. Honeywell Inc, Minneapolis, MN www.honeywell.com.
         1) Primary Contact: Chris Brinkerhoff, (801) 550-3344, chris.brinkerhoff@honeywell.com.
      d. ICCA Firex, Carol Stream, IL www.icca.invensys.com.
      e. Insul_Guard, Salt Lake City, UT:
         1) Primary Contact: Dan Craner, (801) 518-3733, insul_guard@comcast.net.
      f. System Sensor, St Charles, IL www.systemsensor.com.
      g. Zimmerman Technologies, Renton, WA:
         1) Primary Contact: Tracy Zimmerman, (425) 255-1906, zimmtech@yahoo.com.

B. Distributors: Obtain LCBS Connect control devices, RP panels, sensors, actuators and other control equipment from following Sponsoring Approved Distributors. See Section 01 4301:
   1. Alberta:
      a. West Excel: (306) 546-2844 bardy@westexcel.ca Bardy Reavie.

C. Performance:
   1. Design Criteria:
      a. Honeywell LCBS Connect control system with cloud based gateway:
         1) General Requirements:
            a) Controls multistage equipment, dehumidification and ventilation with 2 wire connection to controller interface location in occupied space.
            b) Adjustable backlight to controller interface module from 15%-100%en after 30 seconds of setting adjustments.
            c) System controllers can be programmed from the interface module or from the cloud service.
            d) LCBS Connect controller utilizes echelon communication network with the controller located near the mechanical equipment and the system interface located in the occupied space.
            e) System shall control outdoor ventilation air based upon system occupancy of electric / electronic actuation of dampers.
            f) CO2 sensors will open ventilation dampers only when CO2 exceeds 1200 ppm with ppm monitored by cloud service.
            g) LCBS Connect devices access via internet Chrome browser via gateway.
            h) Wired room temperature sensors may be added as specified.
         2) System Requirements:
            a) Up to 3 Heat/2 Cool Heat Pumps; Up to 3 Heat/2 Cool Conventional Systems.
            b) Tri-Lingual display (Selectable for English, Spanish, or French).
            c) 18 to 30 Vac.
            d) 50 Hz; 60 Hz.
            e) System switch to include Auto changeover for Heat-Cool.
            f) 7-Day Programming.
            g) 365-Day Event Scheduling.
            h) Display Security Lockout options.
            i) Minimum/ Maximum Temperature Range Stops.
            j) Configurable over-ride option.
            k) Remote Access via internet.
            l) Dehumidification setting range 40 to 80% RH.
      b. Honeywell TrueZone panel enabled device(s):
         1) General Requirements: Zone Panel:
            a) Work in conjunction with LCBS Connect.
            b) Control multiple zones on single fan coil unit (gas fired furnace with air conditioning or air handling unit with heat pump).

c) Keypad programming & checkout.
d) Work with conventional, heat pump or dual fuel applications.
e) Push wire terminals.
f) Add-a-zone panel expandable.

2) Dampers:
a) Bypass damper installs in any orientation at any angle.
b) Bypass damper provides constant pressure relief regardless of blower speed.
c) Bypass damper provides visual damper percentage open.
d) Zone damper powered by 24VAC circuit from zone panel.
e) Zone damper adjustable range stops for consistent bleed setting.
f) Zone damper LED indicator lights (red closed, green open/ 3 wire applications).
g) Zone damper terminals have push terminals.

D. Components:
1. Controller, Wall Module:
a. Controller and Display Kit:
1) Category Four Approved Product. See Section 01 6200 for definitions of Categories:
a) Part Number Honeywell YCRL6438SR1000 consisting of following:
(1) Unitary Controller: Honeywell CRL6438SR1000
(2) Wall Module: Honeywell TS120
b) Wall Cover Plate: Honeywell. 50002883-001.
c) Discharge Air / Return Air Sensors: Honeywell C7041B2005 20k ohms.
d) Outdoor Air Sensor: Honeywell C7041F2006.
e) Indoor Air Sensor:
(1) Sylk bus network; Honeywell TR40.
f) Averaging sensor:
(1) Sylk bus network; Honeywell TR40.
b. Internet Gateway Module(s): One (1) module per thirty (30) controllers.
1) Category Four Approved Product. See Section 01 6200 for definitions of Categories:
a) LCBS Connect Gateway Module: Honeywell LGW1000.
2. Hydronic Module:
a. See detail E/M501 for O/A duct sensors:
1) Category Four Approved Product. See Section 01 6200 for definitions of Categories:
a) Honeywell Outdoor Air Sensor C7041B (6 inch to 12 inch duct size)
b) Honeywell Outdoor Air Sensor C7041C (18 inch duct size)
c) Honeywell Resistance Type 20KNTC
3. Zone panel and Components:
a. Zone Panel: Honeywell TrueZone HZ322.
b. Zone Panel: Honeywell TrueZone HZ432.
c. Zone Expansion Controller X4, where required: Honeywell TAZ-4.
d. Zone Panel Transformer: AT175F1023.
e. Zone Discharge Air Temperature Sensor: Honeywell C7735A1000.
f. Zone Damper(s): Honeywell ARD (damper size) TZ round damper.
g. Zone Damper(s): Honeywell ZD (damper size) TZ rectangular damper.
h. Zone Bypass Damper: Honeywell CPRD (damper size).
4. Sealant Compound:
a. Description:
1) Non hardening waterproof, vapor proof, self-adhesive for hot or cold application for sealing conduit openings against drafts, dust moisture and noise.
b. Category Four Approved Product. See Section 01 6200 for definitions of Categories:
1) Duct Seal Compound No. DS-130 by Gardner Bender, Menomonee Falls , WI. www.gardnerbender.com.
2) Thumb-Tite Sealing Compound No. 4216-92 by Nu-Calgon, St. Louis, MO www.nucalgon.com.
5. Guard For Cultural Center Sensors:
a. Match color of sensor.
b. Category Four Approved Product. See Section 01 6200 for definitions of Categories:
1) MSI-244 controller guard with integral wood base by Zimmerman Technologies.
2) WMG 1 controller guard by Insul_Guard.
6. Transformer:

a. 120 / 24 V, 50VA Honeywell AT150F.
b. 120 / 24 V, 75VA Honeywell AT175F.

7. Damper Actuators:
   a. Electric type equipped for Class I wiring.
   b. Shall not consume power during Unoccupied cycle or use chemicals or expandable media.
   c. Have built in spring return.
   d. Category Four Approved Product. See Section 01 6200 for definitions of Categories:
      1) Honeywell MS8105A1030/U.
      2) Honeywell MS8105A1130 w/ End switch.
8. Conductors:
   a. Color-coded and No. 16 and No. 12 AWG Type TWN, TFN, or THHN, stranded.
   b. Controller Cable: 12, 8, or 4 conductor, 18AWG solid copper wire, insulated with high-density polyethylene. Conductors parallel enclosed in brown PVC jacket (22 AWG cable not allowed).
   c. Echelon Network Ebus Communicating Cable:
      1) Class Two Quality Standard. See Section 01 6200:
         a) CAT 4, 22 gauge (0.025 in) (0.645 mm), twisted pair, non-plenum and non-shielded cable.
9. Local Relay (RP) Panels For Chapel And Cultural Center Systems:
   a. 16-ga (1.59 mm) screw cover, painted sheet metal. Box with cover and knockouts, pre-wired terminal strips, relay, and transformer.
   b. Provide Labels with Distributor contact information on each panel.
   c. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      1) Standard: LDS Model RP-6.
10. CO_2 Return Air Sensor:
    a. Duct mount with display.
    b. Category Four Approved Product. See Section 01 6200 for definitions of Categories:
       1) Honeywell: C7232B1006.

E. Operation Sequences:
   1. Programmable controller shall control Unoccupied and Occupied status of fan system based on adjustable seven-day program. Fan shall run continuously in Occupied Mode and cycle in Unoccupied Mode.
   2. Adjustable heating and cooling set points shall control space temperature by activating either heating or cooling equipment. Programmable controller provides automatic change over between heating and cooling.
   3. Controller provides optional override by allowing timed override of program by pushing override on controller touch screen. This shall activate controller to Occupied Mode and system shall control to Occupied set point.
   4. Minimum outdoor ventilation air damper, spring return type, shall open in controller Occupied Mode and remain closed in Unoccupied Mode.
   5. At outdoor air temperature reading in duct work below 32ºF (0ºC), start boiler system in lead/lag configuration. Boiler system to shut down when outdoor air temperature reading in duct work is above 32ºF (0ºC).
   6. Systems with CO_2 sensor to control minimum, spring return type, outdoor ventilation air damper:
      a. Damper shall open in controller Occupied Mode only when CO_2 sensor setpoint of 1200 ppm is reached. Damper shall close if CO_2 level drops below 1100 ppm.
      b. Damper shall remain closed in controller Unoccupied Mode.
   7. Systems with Energy Recovery Ventilator (ERV) and Pre-Heat Coil:
      a. ERV shall activate in controller Occupied Mode and remain inactive in Unoccupied Mode.
      b. Ventilation Pre-Heat coil shall activate (modulate control valve) to maintain off coil discharge temperature of 23ºF (-5ºC).
      c. Systems with CO_2 sensor to control outdoor ventilation air damper, ERV in controller shall activate ONLY when TWO conditions are present:
         1) Controller is in Occupied Mode.
         2) CO_2 sensor setpoint of 1200 ppm is reached.

PART 3 - EXECUTION

3.1 INSTALLERS

A. Acceptable Installers. See Section 01 4301:
   1. Roan Electric Ltd., Box 18 Site 2 RR2, Okotoks, AB (403) 938-7078 – Martin Leany.
   2. Tech Select Electrical Ltd., #2-3613-15A Street SE, Calgary, AB (403) 287-2850 – Frank Pratt.
   3. AirTech Heating and Air Conditioning Ltd., 451-39th Street North, Lethbridge, AB (403) 894-4567 – Kevin Vanderwal.

3.2 INSTALLATION

A. Interface With Other Work:
   1. Calibrate room controllers as required during air test and balance. Insulate sensor J-box with fiberglass insulation; expandable/ foam insulation is NOT acceptable.
   2. Instruct air test and balance personnel in proper use and setting of control system components.
   3. Install low voltage electrical wiring in accordance with Division 26 of these Specifications.

B. Echelon Communication: Ebus
   1. Ebus cable needs to be installed at least 12 inches (300 mm) from lighting, motors, or low voltage switching cables

C. Zone Panel:
   1. Zone panel shall be mounted by mechanical equipment with associated LCBS module in close proximity but mounted 24 inches (610 mm) apart.
   2. Zone panel shall be mounted at eye level and accessible for visual inspection.
   3. Install discharge air sensor 6 feet (1.80 m) downstream from a/c coil.
   4. Install OA sensor in fresh air duct.
   5. TOD relay for fresh air damper which is not part of zone panel shall be mounted in close proximity to panel and clearly labeled such.
   6. Zone panel shall be programmed for appropriate amount of zones and control.
   7. Zone dampers shall use three (3) wires for LED damper display.
   8. Power for zone transformer shall come from mechanical equipment for service switch disconnect.
   9. Zone and bypass dampers shall have actuation component positioned such as for visual damper position inspection.
   10. Set minimum zone damper position to 30 percent or setting number 3.

D. Mount damper actuators and actuator linkages external of airflow. Make certain dampers operate freely without binding or with actuator housing moving.

E. Paste copy of record control wiring diagram on back of relay panel door cover for each multiple furnace system.

3.3 FIELD QUALITY CONTROL

A. Field Tests:
   1. Calibrate, adjust, and set controls for proper operation, operate systems, and be prepared to prove operation of any part of control system. This work is to be completed before pre-substantial completion inspection.
   2. Test each individual heating, cooling, and damper control for proper operation using control system.

3.4 SYSTEM STARTUP

A. For systems with LCBS Controller.

1. Contractor is responsible for a fully functioning control system accessible via internet web browser. Contractor is responsible to coordinate Network start up with assistance from local IT technician. Local IT technician shall provide available ports on network switch for LCBS gateway.
2. Contractor is responsible configuring all controllers with proper zone names, zone scheduling, proper Church conference / holiday scheduling, all to be coordinated with local FM manager. Set proper clock setting including day/month/year.
3. Set Heating / Cooling to proper stages
4. Set heat cycle rates to 9 cph and cooling to 4 cph.
5. Set DO1 relay to “Occupancy”.
6. Set System switch operation to “Automatic” changeover.
7. Set fan switch operation to “ON”.
8. Set minimum UnOcc start time for all days. No days shall be scheduled Unconfigured.
9. Set Occupied start times to match meeting start times; provided by local FM manager.
10. Place all zone over-ride durations to one (1) hour except for Bishop and Stake area which shall be set to two (2) hours.
11. Set Occupied default heating setpoints to 70 degrees, cooling setpoints to 74 degrees.
12. Set Unoccupied default heating setpoint to 60 degrees, cooling setpoints to 90 degrees.
13. Set each zone to applicable Holiday scheduling for General & Stake Conferences.

B. For systems with TrueZONE Zone Panel:
   1. Contractor responsible for fully functioning zoning system connected to LCBS controller system.
   2. Contractor responsible to configuring of zone panel.
   3. Contractor responsible to coordinate Network start up with assistance from air balancer.

3.5 ADJUSTING

A. LCBS controller configuration settings; the following are configuration guidelines for consistent installations:
   1. Temperature Units — Fahrenheit/ Celsius
   2. Equipment Type — Conventional/heat pump.
      a. Stages of Heat — 1,2
      b. Stages of Cool — 1,2
      c. Fan operation in heat mode — Enable Fan w/ Heat
   3. Equipment Options
      a. Leave at Default
      b. Heating Cycles per Hour — 6-9 cph
      c. Cooling Cycles per Hour — 3-4 cph
   4. Recovery
      a. Leave at Default
   5. Economizer / DLC
      a. Configure as required by control equipment.
   6. Sensor Selection
      a. Set according to averaging sensors
      b. Set to multi sensor “Smart” when averaging.
      c. Set Occupancy Sensor to “Disable”.
   7. Terminal Assignment
      a. Set according to equipment
      b. Set Terminal DO1 to Occupancy to control fresh air damper based upon scheduled occupancy or over-ride.
   8. Dehumidification
      a. Leave at default
      b. See Accessory Loops
   9. Miscellaneous
      a. Leave at default
   10. Sensor setting
      a. Leave at default
      b. Set as Required
   11. Accessory Loops – Set as required
      a. Hot water valve

b. Dehumidification
c. Other

12. Configure Zone Name (display on Home Screen).
13. Set Password to ABCD.
14. Set Occupied Setpoint
15. Set Unoccupied Setpoint
16. Set Schedule
17. MENU/ Holiday-Event Scheduler / Custom Events/ Create new event.
    a. Eastern Time Zone:
        1) First Sunday in April: Occupied Chapel from 11:30 am – 6:00 pm / every year.
        2) First Sunday in April: Unoccupied all other zones for all day / every year.
        3) First Sunday in October: Occupied Chapel from 11:30 am – 6:00 pm / every year.
        4) First Sunday in October: Unoccupied all other zones for all day / every year.
    b. Central Time Zone:
        1) First Sunday in April: Occupied Chapel from 10:30 am – 5:00 pm / every year.
        2) First Sunday in April: Unoccupied all other zones for all day / every year.
        3) First Sunday in October: Occupied Chapel from 10:30 am – 5:00 pm / every year.
        4) First Sunday in October: Unoccupied all other zones for all day / every year.
    c. Mountain Time Zone:
        1) First Sunday in April: Unoccupied all zones for all day / every year.
        2) First Sunday in April: Unoccupied all zones for all day / every year.
        3) First Sunday in October: Unoccupied all zones for all day / every year.
        4) First Sunday in October: Unoccupied all zones for all day / every year.
    d. Pacific Time Zone
        1) First Sunday in April: Occupied Chapel from 8:30 am – 3:00 pm / every year.
        2) First Sunday in April: Unoccupied all other zones for all day / every year.
        3) First Sunday in October: Occupied Chapel from 8:30 am – 3:00 pm / every year.
        4) First Sunday in October: Unoccupied all other zones for all day / every year.

B. Zone Panel Configuration:
1. Configuration:
    a. Conventional or Heatpump.
    b. Cooling stages: (match equipment).
    c. Heat stages: (match equipment).
    d. RF enabled: (NO).
    e. Zones Installed: (match number of zones).
    f. Heat Staging Control: (percent Zones).
2. Advanced Configuration:
    a. Heat Fan Control (HVAC).
    b. Purge Time: (2 minutes).
    c. Fan in Purge (HVAC):
    d. Purge Dampers: (Unchanged).
    e. Changeover delay: (15 minutes).
    f. DA temperature Sensor: (Yes).
    g. DA temperature High Limit (140 degree).
    h. DA Low Limit: (35 degree).
    i. DAT MSTG Inhibit (Yes).
    j. MSTG OT Lockout (No).
3. Save Changes.

3.6 CLOSEOUT ACTIVITIES

A. Instruction Of Owner:
1. Include as part of training required in Section 23 0501, following training:
    a. Training shall be by personnel of installing company and utilize operator’s manuals and as-built documentation.
    b. Provide training in (2) two sessions including LCBS Connect sight & smart Apps for up to six (6) hours total:
        1) First session will occur between system completion and Substantial Completion.

2) Second session will occur within forty-five (45) days of Substantial Completion when agreed upon by Owner.

c. Training shall include sequence of operation review, selection of displays, modification of schedules and setpoints, troubleshooting of sensors, etc, as follows:
   1) Control System Overview:
      a) Show access to system through both individual controllers and Internet browser and how network works. Scheduling building at minimum for Stake and General Conference, special events.
   2) Controller Programming from Keypad: Instructions on developing setpoints and schedules and adjusting local zone temperatures.
   3) Web Internet training with local Facilities Manager during two (2) sessions.
      a) Review all features accessible from the 'Settings' tab including Alarm points, user access, scheduling and humidity setpoints (where applied).

END OF SECTION

ATTACHMENTS

CERTIFICATE OF SPONSORSHIP

Electric and Electronic Control System for HVAC Installer

PROJECT INFORMATION (To be filled out by Installer - available from project specification):

Project Name: _____

Project Number: _____

Project Address: _____

INSTALLER INFORMATION (To be filled out by Installer):

Installer Name: _____

Installer Firm: _____

Installer Address: _____

I acknowledge and confirm the above listed Installer has received training and exhibit LCBS Connect System skills and is qualified to install the automation control system as specified for Project identified above. Our company will stand behind the Installer meeting the legal specified performance requirements.

Sponsoring Approved Honeywell Distributor Name: _____

Signature: _____ Printed Signature: _____

Date: _____

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SECTION 23 1123

FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Perform excavation and backfill required for work of this Section.
   2. Furnish and install gas piping and fittings within building and from building to meter including connection to meter as described in Contract Documents.

B. Related Requirements:
   1. Sections Under 09 9000 Heading: 'Paints And Coatings' for painting of exterior piping.
   2. Section 23 0501: 'Common HVAC Requirements'.
   3. Section 23 0553: 'Identification for HVAC Piping and Equipment'.
   4. Section 31 2316: 'Excavation' for procedure and quality of excavation.
   5. Section 31 2323: 'Fill" for procedure and quality of backfill and compaction.
   6. Section 33 5100: 'Natural-Gas Distribution' for gas line from meter to main.

1.2 REFERENCES

A. Reference Standards:
   1. American National Standards Institute / CSA Group:
      a. ANSI LC 4-2012 (2017) / CSA 6.32-2012 (R2016), ‘Press-Connect Metallic Fittings for Use in Fuel Gas Distribution Systems’.
   2. ASTM International:
      a. ASTM A53/A53M-12, ‘Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless’.
      b. ASTM A234/A234M-16, ‘Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service’.
      c. ASTM D2513-16a, ‘Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings’.
   3. CSA Group (Canadian Standards Association):
      a. CSA B149.1-15, ‘Natural Gas and Propane Installation Code'.
   4. International Code Council (ICC):
      a. ICC IFGC-2015: 'International Fuel Gas Code'.

1.3 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Conform to requirements of Canadian Standards Association CSA B149.1.

B. Qualifications:
   1. Welders:
      a. Welders shall be certified and bear evidence of certification thirty (30) days before commencing work on project.
      b. If there is doubt as to proficiency of welder, Owner's Representative may require welder to take another test. This shall be done at no cost to Owner. Certification shall be by Pittsburgh Testing Laboratories or other approved authority.
   2. Pipe Installers:
      a. Polyethylene pipe installers shall be properly trained and certified in procedure for joining polyethylene pipe.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Storage And Handling Requirements:
   1. Do not store polyethylene pipe so it is exposed to sunlight.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Manufacturers:
   1. Manufacturer Contact List:
      a. BrassCraft, Novi, MI www.brasscraft.com.
      b. Cimberio Valve Co Inc, Malvern, PA www.cimberio.com.
      c. ConBraCo Industries, Inc, Matthews, NC www.conbraco.com or ConBraCo / Honeywell Ltd, Scarborough, ON (416) 293-8111.
      d. Dormont Manufacturing Company, Export, PA www.dormont.com.
      e. Jenkins-NH-Canada, Brantford, ON www.jenkins-nh-canada.com.
      f. Jomar International, Madison Heights, MI www.jomar.com.
      g. California Valves (formally KOSO) by Pacific Seismic Products Inc, Lancaster, CA, Distributed by Strand Earthquake Consultants www.strandearthquake.net.
      h. Viega LLC, Broomfield, CO www.viega.com.
      i. Watts Regulator Co, North Andover, MA www.wattsreg.com or Watts Industries (Canada) Inc, Burlington, ON (888) 208-8927.

B. Materials:
   1. Above-Ground Pipe:
      a. Black carbon steel, butt welded, Schedule 40 pipe meeting requirements of A53/A53M.
   2. Above-Ground Pipe Fittings:
      a. Welded forged steel fittings meeting requirements of ASTM A234/A234M.
      b. Standard weight malleable iron screwed.
   3. Below-Ground Pipe And Fittings: Polyethylene pipe and fittings meeting requirements of ASTM D2513 with No. 14 coated copper trace wire.
   4. Valves:
      a. 125 psi bronze body ball valve, UL listed.
      b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
         1) CIM 102.1 by Cimbrio Valve.
         2) Apollo Series 80-100 by ConBraCo.
         3) 'Red Cap' R602 by Jenkins NH Canada.
         4) Model T-204 by Jomar International.
         5) Model B-6000-UL by Watts Regulator.
   5. Cocks:
      a. Gauge Cocks: Conbraco Series 50-56 bronze gauge cock.
   6. Flexible Connector:
      a. Type 304 stainless steel corrugated tube coated for corrosion protection.
      b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
         1) Dormont Supr-Safe.
         2) BrassCraft Procoat.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Steel pipe installed through air plenums, in walls:
   1. Pipes 2-1/2 inches and larger shall have welded fittings and joints.
   2. Other steel pipe may have screwed or welded fittings.

B. Lay underground pipe in accordance with Manufacturer's recommendations and local gas utility company regulations and specifications.
   1. Provide 24 inch minimum steel pipe between vertical rise of riser and end of polyethylene line if anode-less riser is not used. Use plastic-to-steel transition or compression fitting between end of polyethylene line and steel meter riser. Provide cathodic protection for steel riser or use anode-less riser.
   2. Place tracer wire along side of polyethylene pipe from meter to point where pipe rises inside building.
   3. Place 4 inches of sand around gas line buried underground.
   4. Do not install gas piping under building floor slabs-on-grade.

C. After gas meter, valves, etc, gas piping should rise inside outside wall and not be visible to public.

D. On lines serving gas-fired equipment, install gas cocks adjacent to equipment outside of equipment cabinet and easily accessible.

E. Install 6 inch long minimum dirt leg, with pipe cap, on vertical gas drop serving each gas-fired equipment unit.

F. Use fittings for changes of direction in pipe and for branch runouts.

G. Visible gas piping inside building shall be painted continuous yellow and labeled. Exterior gas piping shall be painted grey.

3.2 FIELD QUALITY CONTROL

A. Field tests:
   1. Subject all portions of gas piping system, in sections or in entirety, to air pressure of 75 psig and prove airtight for four (4) hours.
   2. Disconnect equipment not suitable for 75 psig pressure from piping system during test period.

END OF SECTION

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SECTION 23 2113

HYDRONIC PIPING: Above Grade

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install hydronic heating and cooling piping and specialties as described in Contract Documents.

B. Related Requirements:
   1. Section 23 0501: 'Common HVAC Requirements'.
   2. Section 23 0719: 'HVAC Piping Insulation' for Hot Water Heat Piping Insulation.
   3. Section 23 5224: 'Natural Gas Condensing Boilers'.
   4. Division 26: Electrical service and connections.

1.2 REFERENCES

A. Reference Standards:
   1. ASTM International:
      a. ASTM A53/A53M-18, 'Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc-Coated, Welded and Seamless'.
      b. ASTM A234/A234M-18a, 'Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service'.
   2. American Society of Mechanical Engineers:
      a. ASME B16.22-2018, ''Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings'.

1.3 SUBMITTALS

A. Maintenance Materials Submittals:
   1. Tools:
      a. Use glycol tester to verify specified glycol concentrations in system. Leave tester with Owner at conclusion of Project.
      b. Tester shall be Misco 7084VP by Misco Products Division, Cleveland, OH www.misco.com.

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Manufacturers:
   1. Manufacturer Contact List:
      a. Armstrong International, Three Rivers, MI www.armstrong-intl.com.
      b. Bell & Gossett, Morton Grove, IL www.bellgossett.com.
      c. Center Line by Crane Valve, Conroe, TX www.cranevalve.com.
      d. ConBraco Industries, Matthews, NC www.conbraco.com.
      e. Crane, Cullman, AL www.cranevalve.com.
      f. Dow Chemical, Midland, MI www.dow.com.
      g. Febco, Denver, Co www.repmasters.com.
      h. Hammond Valve, New Berlin, WI www.hammondvalve.com.
      i. Handy & Harman Products Div, Fairfield, CT www.handyharman.com.
      j. Harris Products Group, Mason, OH www.harrisproductsgroup.com.

k. Milwaukee Valve Co, New Berlin, WI www.milwaukeevalve.com.
l. Mueller Steam Specialty, Saint Pauls, NC www.muellersteam.com
m. Nibco Inc, Elkhart, IN www.nibco.com.
n. Stockham, Cullman, AL www.stockham.com.
o. Taco Inc, Cranston, RI www.taco-hvac.com.
p. Thrush Co Inc, Peru, IN www.thrushco.com.
q. Victaulic Company of America, Easton, PA www.victaulic.com.
r. Watts Regulator Co, North Andover, MA www.wattsreg.com.

B. Materials
1. Steel Pipe:
a. Types of Pipe:
1) Schedule 40 Black Carbon Steel Pipe meeting requirements of ASTM A53/A53M, Type E or F.
a) Uses: Chemical Treatment for chilled water and hot water space heating
2) Schedule 40 Mechanical Grooved Pipe:
a) Uses: Chilled water and hot water space heating.
3) Schedule 80 Black Steel Pipe meeting requirements of ASTM A53/A53M, Type F, Weight Class XS.
a) Uses: Drain, overflow, and vent piping in connection with heating systems, including pump base drain lines, safety valve drains, safety valve vents, and tank vents.
b. Fittings:
1) Schedule 40 Black Carbon Steel Pipe: Standard weight wrought carbon steel meeting requirements of ASTM A234/A234M.
2) Schedule 40 Mechanical Grooved Pipe: Fittings by Victaulic.
3) Schedule 80 Black Steel Pipe: 300 psi Welded.
c. Connections:
1) Less than One inch: Threaded.
2) One to 2-1/2 inches:
a) Screwed.
b) Roll grooved by Victaulic.
3) 2-1/2 inch And Larger:
a) Welded.
b) Roll grooved system by Victaulic.
4) Gaskets For Roll Grooved Joints:
a) Class Two Quality Standards:
b) Victaulic Grade E, EPDM, temperature rated minus 30 deg F to 230 deg F.
c) Equal as approved by Architect before installation. See Section 01 6200.
2. EthyleneGlycol:
a. Category Four Approved Product. See Section 01 6200 for definitions of Categories.
1) Dow Frost by Dow Chemical.
3. Circuit Balancing Valves And Venturis:
a. Function capability of flow measurement.
b. Flow balancing.
c. Positive shut off.
d. Valves shall have two scales, one for pre-setting valve and one for determining flow rate during actual balancing.
e. Provide provisions for connecting differential pressure meter. Each meter connection shall have shut off valves.
f. Include tamper proof and memory features.
g. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
1) Armstrong: CBV.
2) Bell & Gossett: Circuit Setter Plus.
3) Flow Design Inc: Accusetter.
4) Taco: Circuit Setter Series ACUF.
4. Pressure Reducing Valve:
a. Diaphragm type designed for closed loop pressurization. Factory set at 12 psi with adjustable range of eight to 25 psi. Rated at 125 psig working pressure and 225 psi maximum operating temperature.

b. Cast iron body, brass trim, and built in strainer. 3/4 inch NPT connections.
c. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
1) Armstrong: RD50.
2) Bell & Gossett: Model No. B712.
3) ConBraCo: 36C.
4) Taco: 335.
5) Thrush: 12F.

5. Valves:
a. Reduced Pressure Back Flow Preventer Valve:
1) Designed to provide separation of hot water heating system water from domestic cold water supply in accordance with Code.
2) Rated flow at 30 psi, pressure drop rated for 175 psi inlet pressure, and 140 deg F maximum operating temperature.
3) Brass body construction with 3/4 inch NPT connections.
4) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
a) ConBraco: 40-200.
b) Febco: 825DBV.
c) Watts: 909RPDA.
b. Manual Air Vent Valve:
1) Designed to provide manual venting at baseboard units with screwdriver type slot.
2) Rated for 125 psig working pressure and 225 deg F maximum operating temperature.
3) Brass body construction with chrome plated exterior and 1/8 inch MNPT connection
4) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
a) Bell & Gossett: 4V.
b) Taco: 417 COINVENT.
c) Thrush: 5.
c. Butterfly Valves:
1) Operable in any quadrant, shall operate properly with flow in either direction, and fully suitable for throttling and tight shut-off service.
2) Full lug-wafer type with lugs tapped on both sides.
3) 150 psig working pressure and minus 20 deg F to 250 deg F.
4) Body: Ductile iron or cast iron.
5) Seat: EPT Nordel or EPDM (rubber lined).
6) Stem:
a) 304, 316, or 416 stainless steel.
b) Diameter not to be reduced at bearings.
7) Disc: Bronze or bronze alloy, bubble tight at 150 psig.
8) Bushings: Reinforced teflon, nylon, or sintered bronze with PTFE.
9) Operating Mechanisms: Infinite throttling handle with provision for locking in any position and with position stop.
10) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
a) Centerline: Series 200.
b) ConBraCo Apollo: 143 Series.
c) Crane: Quartermaster.
d) Milwaukee: ML233E.
e) Nibco: LD or GD.
f) Victaulic: Series 300 (With grooved pipe only).
d. Manual Air Vent Ball Valve:
1) Designed for use as a high point vent.
2) Rated for 150 lb working pressure water, oil, gas, and steam.
3) Bronze body with solder end connections, teflon stem and seats, and bubble tight shut off. 3/8 inch size with tee handle.
4) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
a) ConBraCo Apollo: 70-200.
b) Hammond: 8701.
c) Milwaukee: BA150-TH.
d) Nibco: S580-70.
e. Check Valves:
1) Swing Check Valves:
a) Provision for re-grinding without removal of the valve from the line.

b) 2 Inch And Smaller: All bronze, 125 psi swp at 350 deg F.
c) 2-1/2 Inch And Larger: Flanged iron body, bronze mounted, 125 psig swp at 450 deg F.
d) Quality Standards:
(1) 2 Inch And Smaller: Stockham B319, Milwaukee 509-T.
(2) 2-1/2 Inch And Larger: Stockham G931, Milwaukee F2974.
e) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
(1) Crane.
(2) Milwaukee.
(3) Stockham.
(4) Victaulic.

2) Non-Slam Check Valves:
a) Silent, spring loaded.
b) 125 psi swp.
c) Silent, semi-steel body.
d) Bronze trim and discs.
e) Bronze seats with center guide and renewable with reseating with special tools.
f) Guided spring.
g) Operable in horizontal, vertical, angular, or upside down position.
h) Quality Standards: ITT by Bell & Gossett, Victaulic Series 716.
i) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
(1) Bell & Gossett.
(2) Milwaukee.
(3) Mueller.
(4) Nibco.
(5) Victaulic.

f. Ball Valves:
1) Designed for shut off service.
2) High temperature service type rated at 150 deg F steam working pressure and 350 deg F maximum temperature.
3) Three piece swing out bronze body construction with full port, screwed end connections, and teflon seats.
4) Provide extended stem on insulated line.
5) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
a) ConBraCo Apollo: 82-100.
b) Hammond: 8604.
c) Milwaukee: BA-300.
d) Nibco: T595-Y.
e) Victaulic: Series 726.
f) Watts: B6800.

g. Combination Ball Valve, Hose Connection, And Cap:
1) Category Four Approved Product. See Section 01 6200 for definitions of Categories.
a) ConBraCo Apollo: 78-100.

h. Triple Duty Valve:
1) Straight Pattern
2) Non-slam check valve.
3) Balance valve with calibrated adjustment.
4) Shut-off valve.
5) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
a) Armstrong: FTV-S.
b) Bell & Gossett: 3DS.
c) Taco: MPV.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Piping:
   1. Use either steel or copper pipe and fittings, but not both.
   2. Use teflon tape and pipe dope for lubricating threads on all threaded connections. To join copper pipes, apply flux, heat joints to remove excess flux and solder, and cool joints in accordance with Manufacturer's recommendations.
   3. Install unions on downstream side of shut-off valves, specialty valves, and meters, and on both sides of coils, baseboard units, and other heating equipment. Also install unions on both ends of radiation piping where piping goes from floor level into steel pipe troughs in floor slab.
   4. Anchor or hang piping so pipe weight does not rest on flexible connectors.
   5. Install roll grooved systems in accordance with Manufacturer's requirements.

B. Incorporate provisions for manual introduction of ethylene glycol into system at highest point. Add ethylene glycol until concentration is high enough to prevent water from freezing at winter design temperature for Project.
   1. Percent by Weight Temp Deg F
      a. 50 minus 41

C. Labels:
   1. Label valves, pumps, flow meters, and other equipment items with equipment mark number shown on Drawings or with space served. (Chapel, etc.)
   2. Label head / feet and flow gpm for pumps.
   3. Label flow gpm for flow meters.
   4. Labels shall be 2 inch by 3 inch laminated plastic, black with white engraved letters, and attached with brass, beaded chain.

3.2 FIELD QUALITY CONTROL

A. Field Tests:
   1. Subject hydronic piping systems, in sections or entirety, to water pressure of 125 psig and prove tight for period of four hours. Disconnect equipment not suitable for 125 psig pressure from piping system during test period.

3.3 CLEANING

A. Remove and clean strainers, including those at air separators and suction diffusers, before preliminary balancing of each water system and before final balancing of each water system.

B. Cleaning of Hot Water Heating System Piping:
   1. Give Architect seven days written notice of date of cleaning procedures.
   2. Hot Water Heating System:
      a. After it has been determined system is tight and has been flushed, heat system water to 160 deg F and circulate for 24 hours.
      b. After cleaning, drain system, clean strainers, fill with fresh water, and thoroughly flush until pH of water is 8.

END OF SECTION

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SECTION 23 2114

HYDRONIC PIPING SYSTEM SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install hydronic piping system specialties described in Contract Documents.

B. Related Requirements:
   1. Section 23 0501: Common HVAC Requirements.
   2. Section 23 0513: Common Motor Requirements for HVAC Equipment.

PART 2 - PRODUCTS

2.1 ACCESSORIES

A. Manufacturers:
   1. Manufacturer Contact List:
      a. Armstrong Pumps Inc, North Tonawanda, NY www.armstrongpumps.com.
      b. Ashcroft, Stratford, CT www.ashcroftinc.com.
      c. Aurora Pump, North Aurora, IL www.aurorapump.com.
      d. Bell & Gossett, Morton Grove, IL www.bellgossett.com.
      e. Center Line by Crane Valve, Conroe, TX www.cranevalve.com.
      f. ConBraCo Industries, Matthews, NC www.conbraco.com.
      g. Crane Valves, Cullman, AL www.cranevalve.com.
      h. Essex Brass Corp, Warren, MI www.essexbrass.com.
      i. Flex-Hose Corp, East Syracuse, NY www.flexhose.com.
      j. Grundfos Pumps Corp, Fresno, CA www.us.grundfos.com.
      k. Hyspan Precision Products, Chula Vista, CA www.hyspan.com.
      l. John C. Ernst Co Inc, Sparta, NJ www.john-ernst.com.
      m. Marsh Instruments, Newell, WV www.marshbellofram.com.
      n. Metraflex Co, Chicago, IL www.metraflex.com.
      o. Powell Valves, Cincinnati, OH www.powellvalves.com.
      p. Taco Inc, Cranston, RI www.taco-hvac.com.
      q. Thrush Company Inc, Peru, IN www.thrushco.com.
      r. HO Trerice Co, Oak Park, MI www.hotco.com.
      s. Unistrut Corp, Wayne, MI www.tyco-unistrut.com.
      t. Universal Metal Hose, Chicago, IL www.universalmetalhose.com.
      u. Weinman Pumps, Piqua, OH www.cranepumps.com.
      v. Weiss Instruments Corp, Holtsville, NY www.weissinstruments.com.
      w. Weksler Instruments Corp, Boca Raton, FL www.wekslerglass.com.

B. Materials:
   1. Compression Tank:
      a. Bear 'U' symbol, ASME Code stamp, and National Board number. Rated 125 psig working pressure and 300 deg F maximum temperature.
      b. All steel construction complete with gauge glass tappings, fill and drain connections, and exterior rust proof coating.
      c. Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories.
         1) Armstrong Pumps.
         2) Bell & Gossett.
         3) Taco Series PS.

4) Thrush XT Series.

2. Compression Tank Air Control Fitting:
   a. Rated at 125 psig working pressure complete with manual vent and fill stem of length based on compression tank diameter.
   b. Cast iron body, brass plug, and copper tube construction.
   c. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
      1) Armstrong Pumps: TMA.
      2) Bell & Gossett: ATF16.
      3) Taco: Series 400.
      4) Thrush: 2X.
3. Compression Tank Drain Fitting:
   a. Designed to admit air into and drain water from compression tank.
   b. Rated at 125 psig working pressure and 240 deg F maximum operating temperature.
   c. Brass body construction with 3/4 inch hose connection and 1/2 inch MNPT tank connection.
   d. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
      1) Armstrong: TDV.
      2) Bell & Gossett: DT-2.
      3) Taco: 440.
      4) Thrush: 2X.
4. Compression Tank Liquid Level Sight Glass:
   a. Rated for 175 psi working pressure.
   b. Brass body construction complete with water gauge glass, cocks, guard base, bottom drain fitting, 1/2 inch NPT valve connections, and 5/8 inch glass tube.
   c. Verify center-to-center of tank connections with Tank Manufacturer used.
   d. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
      1) ConBraco: 20-104.
      2) Crane: EFI3.
      3) Essex Brass: No. 3.
5. Compression Tank Hangers:
   a. Class Two Quality Standard. See Section 01 6200.
      1) P-1000 Channel by Unistrut.
6. Air Separation Tanks:
   a. Designed and certified to effectively separate not less than 80 percent of the entrained air on first passage of water and not less than 80 percent of residual air on subsequent passage of water.
   b. Air separation shall be affected by means of reduced water velocity within vessel.
   c. Separated air shall be continuously vented to compression tank.
   d. Constructed, tested, and stamped in accordance with ASME Code for Unfired Pressure Vessels for working pressure of 125 psig or 150 percent of system operating pressure, whichever is greater.
   e. Separators shall not have strainers.
   f. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
      1) Armstrong Pumps.
      2) Rolairtrols by Bell & Gossett.
      3) Air Separator Series AC by Taco.
7. Cocks:
   a. Gauge Cocks:
      1) Brass Tee handle.
      2) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
         a) Ashcroft: 1082.
         b) Ernst: 123BR.
         c) Trerice: 865.
         d) Equal by MarshBellofram, Powell, or Weksler.
   b. Balancing Cocks: Use a specified ball valve.
8. Pumps:
   a. Circulator Pumps:
      1) Rated for 125 psi maximum working pressure and 225 deg F maximum operating seal temperature.
      2) In-line centrifugal type with cast iron body, bronze impeller, carbon seals, flexible coupling, flanged connections, and quiet operating, ring mounted motor.

3) Motor: 1750 rpm maximum with 120 V, single phase, 60 Hertz electrical connections and built-in overload protection.
4) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
   a) Armstrong: See Drawings for Model #.
   b) Bell & Gossett: Equal.
   c) Grundfos: Equal.
   d) Taco: Equal.
   e) Thrush: Equal.
   f) Weinman: Equal.

b. Base-Mounted, End Suction, Solid Volute, Flexible Connected Pumps:
1) Cast-iron volute, bronze impeller, heat-treated carbon steel shaft, bronze casing wearing rings, cast iron companion flanges, grease lubricated ball bearings, flexible coupler, reinforced steel base plate, mechanical seals, and suction diffuser.
2) Seals shall be for 225 deg F.
3) Uses: Hot Water Space Heating.
4) Approved Products:
   a) Armstrong: See Drawings for Model #.
   b) Aurora: Equal.
   c) Bell & Gossett: Equal.
   d) Taco: Equal.
   e) Weinman: Equal.

9. Gauges:
a. Thermometers:
1) 9 inch adjustable, angle, red reading, mercury type with cast aluminum case and 3-1/2 inch chrome-plated brass separable socket.
2) Range: 30 deg F to 240 deg F.
3) Performance Standard: BX by HO Trerice.
4) Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories.
   a) HO Trerice.
   b) Weiss A9VU35.
   c) Weksler.

b. Pressure Gauges:
1) Cast aluminum case.
2) Chrome plated ring.
3) Clear glass window.
4) Phosphor bronze alloy steel bourdon tube.
5) 1/2 percent scale range accuracy.
6) 4-1/2 inch diameter dial face.
7) Pressure Ranges:
   a) Suit service intended.
   b) High-pressure limit of gauges approximately 200 percent of expected maximum pressure at gauge location.
   c) Gauges at pump suction: 0 psig to 100 psig.
   d) Other gauges: Have low-pressure limit of 0 psig.
8) Performance Standard: No. 500 by HO Trerice.
9) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
   a) MarshBellofram.
   b) HO Trerice.
   c) Weiss.
   d) Weksler.

10. Pump Suction Diffuser:
a. Cast iron angle type body with inlet vanes.
b. Fine mesh start-up disposable strainer.
c. Stainless steel final strainer.
d. Removable magnetic insert.
e. Adjust support foot.
f. Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories.
1) Armstrong.
2) Bell & Gossett.

3) Taco Series SD.

11. Flexible Connectors:
    a. Braided sleeve over corrugated flexible inner tube, both of type 321 stainless steel.
    b. Minimum length of 12 inches.
    c. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
        1) Anaconda by Universal Metal Hose.
        2) U S Hose Corp.
12. Bellows Type Expansion Joints And Guides:
    a. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
        1) Series 8500 by Hyspan.
        2) Model HP by Metraflex.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide pressure snubbers on pump gauges.

B. Connect to pipe with 1/4 inch connections utilizing cocks.

C. Install flexible connectors in straight line without offset.

D. Install expansion joints in supply and return lines 1-1/2 inches in diameter and larger every 50 feet of pipe length without change of direction. Install guides in accordance with Manufacturer's recommendations.

E. Hang compression tank as high as possible above boiler.

F. Install 1/2 inch male hose end connection to manual air vent line. Locate in accessible areas, but not in walkway.

END OF SECTION

SECTION 23 2300

REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install piping and specialties for refrigeration systems as described in Contract Documents.

B. Related Requirements:
   1. Section 23 0501: 'Common HVAC Requirements'.
   2. Section 23 0719: 'Refrigerant Piping Insulation'.
   3. Section 23 6214: 'Compressor Units: Air Conditioning (5 Ton or less)'.

1.2 REFERENCES

A. Association Publications:
   1. Vibration Isolation and Seismic Control Manufacturers Association (VISCMA):
      a. VISCMA 102-12, 'Vibration Isolation Specification Guidelines for Mechanical, Electrical, and Plumbing Systems'.

B. Definitions:
   1. Refrigerant: Absorbs heat by a change of state (evaporation) from liquid to a gas, and releases heat by a change of state (condenses) from gas back to a liquid.
   2. Vibration Isolation: Vibration reduction in which an isolation system is placed between the source of unwanted vibration and an item which needs to be shielded from the vibration.

C. Reference Standards:
   1. American National Standards Institute (ANSI) / American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
      a. ANSI/ASHRAE 15-2016 and 34-2016, 'Safety Standard and Designation and Classification of Refrigerants'.
   2. American National Standards Institute / American Welding Society:
      a. ANSI/AWS A5.8M/A5.8-2011, 'Specification for Filler Metals for Brazing and Braze Welding'.
   3. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
      a. 2011 ASHRAE Handbook - HVAC Applications.
         1) Chapter 48, 'Noise and Vibration Control'.
   4. ASTM International:
      a. ASTM A36/A36M-14, 'Standard Specification for Carbon Structural Steel'.
      b. ASTM B280-18, 'Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service'.
   5. Canadian Standards Association:
      a. CSA B52-18, 'Mechanical Refrigeration Code'.
   6. National Fire Protection Association / American National Standards Institute:
      a. NFPA 90A: ‘Installation of Air-Conditioning and Ventilating Systems' (2018 or most recent edition adopted by AHJ).
   7. Underwriters Laboratories:
      a. UL 2182, 'Refrigerants' (April 2006).

1.3 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Show each individual equipment and piping support.

B. Informational Submittals:
1. Qualification Statements: Technician certificate for use of R410a refrigerants.

1.4 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
1. Refrigerants:
a. Underwriters Laboratories / Underwriters Laboratories of Canada:
1) Comply with requirements of UL 2182.

B. Qualifications. Section 01 4301 applies, but is not limited to the following:
1. Installer: Refrigerant piping shall be installed by refrigeration contractor licensed by Province and by technicians certified in use of R410a refrigerants.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Manufacturers:
1. Manufacturer Contact List:
a. Airtec, Fall River, MA, www.noventcaps.com.
b. Cooper Industries, Houston, TX www.cooperindustries.com.
c. Cush-A-Clamp by ZSI Manufacturing, Canton, MI www.cushaclamp.com.
d. Elkhart Products Corp, Elkhart, IN www.elkhartproducts.com.
e. Emerson Climate Technologies, St Louis, MO www.emersonflowcontrols.com.
f. Handy & Harman Products Division, Fairfield, CT www.handy-1.com.
g. Harris Products Group, Cincinnati, OH www.harrisproductsgroup.com.
h. Henry Valve Co, Melrose Park, IL www.henrytech.com.
i. Hilti Inc, Tulsa, OK www.hilti.com.
j. Hydra-Zorb Co, Auburn Hills, MI www.hydra-zorb.com.
k. JB Industries, Aurora, IL www.jbind.com.
l. Mueller Steam Specialty, St Pauls, NC www.muellersteam.com.
m. Nibco Inc, Elkhart, IN www.nibco.com.
n. Packless Industries, Waco, TX www.packless.com.
o. Parker Corp, Cleveland, OH www.parker.com.
p. Sporlan Valve Co, Washington, MO www.sporlan.com.
q. Sherwood Valves, Washington, PA www.sherwoodvalve.com.
r. Thomas & Betts, Memphis, TN www.superstrut.com.
s. Unistrut, Div of Atkore International, Inc., Harvey, IL www.unistrut.com.
t. Universal Metal Hose, Chicago, IL www.universalmetalhose.com.
u. Vibration Mountings & Controls, Bloomingdale, NJ www.vmc-kdc.com.
v. Virginia KMP Corp, Dallas, TX www.virginiakmp.com.

B. Materials:
1. Refrigerant Piping:
a. Meet requirements of ASTM B280, hard drawn straight lengths. Soft copper tubing not permitted.
b. Do not use pre-charged refrigerant lines.
2. Refrigerant Fittings:
a. Wrought copper with long radius elbows.
b. Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
1) Mueller Streamline.
2) Nibco Inc.
3) Elkhart.

3. Suction Line Traps:
   a. Manufactured standard one-piece traps.
   b. Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
      1) Mueller Streamline.
      2) Nibco Inc.
      3) Elkhart.
4. Tee Access:
   a. Brass:
      1) Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
         a) JB Industries: Part #A3 Series with Factory Cap and Valve Core.
5. Connection Material:
   a. Brazing Rods in accordance with ANSI/AWS A5.8M/A5.8:
      1) Copper to Copper Connections:
         a) Classification BCuP-4 Copper Phosphorus (6 percent silver).
         b) Classification BCuP-5 Copper Phosphorus (15 percent silver).
      2) Copper to Brass or Copper to Steel Connections: Classification BAg-5 Silver (45 percent silver).
      3) Do not use rods containing Cadmium.
   b. Flux:
      1) Type Two Acceptable Products:
         a) Stay-Silv White Brazing Flux by Harris Products Group.
         b) High quality silver solder flux by Handy & Harmon.
         c) Equal as approved by Architect before use. See Section 01 6200.
6. Valves:
   a. Manual Refrigerant Shut-Off Valves:
      1) Ball valves designed for refrigeration service and full line size.
      2) Valve shall have cap seals.
      3) Valves with hand wheels are not acceptable.
      4) Provide service valve on each liquid and suction line at compressor.
      5) If service valves come as integral part of condensing unit, additional service valves shall not be required.
      6) Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
         a) Henry.
         b) Mueller.
         c) Sherwood.
         d) Virginia.
7. Filter-Drier:
   a. On lines 3/4 inch outside diameter and larger, filter-drier shall be replaceable core type with Schraeder type valve.
   b. On lines smaller than 3/4 inch outside diameter, filter-drier shall be sealed type with brazed end connections.
   c. Size shall be full line size.
   d. Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
      1) Emerson Climate Technologies.
      2) Mueller.
      3) Parker.
      4) Sporlan.
      5) Virginia.
8. Sight Glass:
   a. Combination moisture and liquid indicator with protection cap.
   b. Sight glass shall be full line size.
   c. Sight glass connections and sight glass body shall be solid copper or brass, no copper-coated steel sight glasses allowed.
   d. Category Four Approved Product. See Section 01 6200 for definitions of Categories:
      1) HMI by Emerson Climate Technologies.
9. Flexible Connectors:
   a. Designed for refrigerant service with bronze seamless corrugated hose and bronze braiding.
   b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:

1) Vibration Absorber Model VAF by Packless Industries.
2) Vibration Absorbers by Virginia KMP Corp.
3) Anaconda 'Vibration Eliminators' by Universal Metal Hose.
4) Style 'BF' Spring-flex freon connectors by Vibration Mountings.

10. Refrigerant Piping Supports:
    a. Base, Angles, And Uprights: Steel meeting requirements of ASTM A36.
    b. Securing Channels:
        1) At Free-Standing Pipe Support:
            a) Class One Quality Standard: P-1000 channels by Unistrut.
            b) Acceptable Manufacturers: Hilti, Thomas & Betts.
            c) Equal as approved by Architect before installation. See Section 01 6200.
        2) At Wall Support:
            a) Class One Quality Standard: P-3300 channels by Unistrut.
            b) Acceptable Manufacturers: Hilti, Thomas & Betts.
            c) Equal as approved by Architect before installation. See Section 01 6200.
        3) At Suspended Support:
            a) Class One Quality Standard: P-1001 channels by Unistrut.
            b) Acceptable Manufacturers: Hilti, Thomas & Betts.
            c) Equal as approved by Architect before installation. See Section 01 6200.
        4) Angle Fittings:
            a) Class One Quality Standard: P-2626 90 degree angle by Unistrut.
            b) Acceptable Manufacturers: Hilti, Thomas & Betts.
            c) Equal as approved by Architect before installation. See Section 01 6200.
    c. Pipe Clamps:
        1) Type Two Acceptable Manufacturers:
            a) Hydra-Zorb.
            b) ZSI Cush-A-Clamp.
            c) Hilti Cush-A-Clamp.
            d) Equal as approved by Architect before installation. See Section 01 6200.
    d. Protective Cover: 18 ga steel, hot-dipped galvanized.
11. Locking Refrigerant Cap:
    a. Provide and install on charging valves:
        1) Class One Quality Standard: 'No Vent' locking refrigerant cap.
        2) Acceptable Manufacturers: Airtec.
        3) Equal as approved by Architect before installation. See Section 01 6200.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refrigerant Lines:
1. Install as high in upper mechanical areas as possible. Do not install underground or in tunnels.
2. Slope suction lines down toward compressor one inch/10 feet. Locate traps at vertical rises against flow in suction lines.

B. Connections:
1. Refrigeration system connections shall be copper-to-copper, copper-to-brass, or copper-to-steel type properly cleaned and brazed with specified rods. Use flux only where necessary. No soft solder (tin, lead, antimony) connections will be allowed in system.
2. Braze manual refrigerant shut-off valve, sight glass, and flexible connections.
3. Circulate dry nitrogen through tubes being brazed to eliminate formation of copper oxide during brazing operation.

C. Specialties:
1. Install valves and specialties in accessible locations. Install refrigeration distributors and suction outlet at same end of coil.
2. Install thermostatic bulb as close to cooling coil as possible. Do not install on vertical lines.

3. Install equalizing line in straight section of suction line, downstream of and reasonably close to thermostatic bulb. Do not install on vertical lines.
4. Provide flexible connectors in each liquid line and suction line at both condensing unit and evaporator on systems larger than five tons. Anchor pipe near each flexible connector.

D. Refrigerant Supports:
1. Support Spacing:
   a. Piping 1-1/4 inch And Larger: 8 feet on center maximum.
   b. Piping 1-1/8 inch And Smaller: 6 feet on center maximum.
   c. Support each elbow.
2. Isolate pipe from supports and clamps with Hydrozorb or Cush-A-Clamp systems.
3. Run protective cover continuous from condensing units to risers or penetrations at building wall.

3.2 FIELD QUALITY CONTROL

A. Field Tests:
1. Make evacuation and leak tests in presence of Architect's Engineer after completing refrigeration piping systems. Positive pressure test will not suffice for procedure outlined below.
   a. Draw vacuum on each entire system with two stage vacuum pump. Draw vacuum to 300 microns using micron vacuum gauge capable of reading from atmosphere to 10 microns. Do not use cooling compressor to evacuate system nor operate it while system is under high vacuum.
   b. Break vacuum with nitrogen and re-establish vacuum test. Vacuum shall hold for 30 minutes at 300 microns without vacuum pump running.
   c. Conduct tests at 70 deg F ambient temperature minimum.
   d. Do not run systems until above tests have been made and systems started up as specified. Inform Owner's Representative of status of systems at time of final inspection and schedule start-up and testing if prevented by outdoor conditions before this time.
   e. After testing, fully charge system with refrigerant and conduct test with Halide Leak Detector.
   f. Recover all refrigerant in accordance with applicable codes. Do not allow any refrigerant to escape to atmosphere.

B. Non-Conforming Work:
1. If it is observed that refrigerant lines are being or have been brazed without proper circulation of nitrogen through lines, all refrigerant lines installed up to that point in time shall be removed and replaced at no additional cost to Owner.

END OF SECTION

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SECTION 23 2600

CONDENSATE DRAIN PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Coordinate installation of condensate drain piping with Section 22 0501 as described in Contract Documents.

B. Related Requirements:
   1. Section 22 0501: 'Common Plumbing Requirements'.
   2. Section 23 0501: 'Common HVAC Requirements'.

1.2 REFERENCES

A. Reference Standards:
   1. ASTM International:

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Materials:
   1. Condensate Drains:
      a. Schedule 40 PVC for condensate drains from furnace combustion chambers and furnace cooling coils.
   2. Solvent Cement and Adhesive Primer:
      a. Use PVC solvent cement that has a VOC content of 510 g/L or less if required by local AHJ if required.
      b. Use adhesive primer that has a VOC content of 550 g/L or less if required by local AHJ if required.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Condensate Drains:
   1. Support piping and protect from damage.
   2. Do not combine PVC condensate drain piping from furnace combustion chamber with copper condensate drain piping from cooling coil.

END OF SECTION

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SECTION 23 3001

COMMON DUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. General procedures and requirements for ductwork.
   2. Repair leaks in ductwork, as identified by duct testing, at no additional cost to Owner.
   3. Coordinate duct hangers with spray foam installation.

B. Related Requirements:
   1. Section 01 4546: 'Duct Testing, Adjusting, and Balancing' for ductwork.
   2. Section 07 9219: 'Acoustical Joint Sealants' for quality of acoustic sealant.
   3. Section 23 0501: 'Common HVAC Requirements'.

1.2 REFERENCES

A. Reference Standards:
   1. Sheet Metal And Air Conditioning Contractors' National Association / American National Standards Institute:
      a. SMACNA, ‘HVAC Duct Construction Standards - Metal and Flexible' (4th Edition).

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference: Schedule conference immediately before installation of ductwork.

1.4 SUBMITTALS

A. Action Submittals:
   1. Product Data: Specification data on sealer and gauze proposed for sealing ductwork.
   2. Samples: Sealer and gauze proposed for sealing ductwork.

B. Informational Submittals:
   1. Manufacturer Instructions:
      a. Installation manuals providing detailed instructions on assembly, joint sealing, and system pressure testing for leaks.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Performance:
   1. Design Criteria:
      a. Standard Ducts: Construction details not specifically called out in Contract Documents shall conform to applicable requirements of SMACNA, ‘HVAC Duct Construction Standards - Metal and Flexible'.

B. Materials:
   1. Duct Hangers:

a. One inch by 18 ga galvanized steel straps or steel rods as shown on Drawings, and spaced not more than 96 inches apart. Do not use wire hangers.
b. Attaching screws at trusses shall be 2 inch No. 10 round head wood screws. Nails not allowed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. During installation, protect open ends of ducts by covering with plastic sheet tied in place to prevent entrance of debris and dirt.

B. Make necessary allowances and provisions in installation of sheet metal ducts for structural conditions of building. Revisions in layout and configuration may be allowed, with prior written approval of Architect. Maintain required airflows in suggesting revisions.

C. Hangers And Supports:
1. Install pair of hangers as required by spacing indicated in table on Drawings.
2. Install upper ends of hanger securely to floor or roof construction above by method shown on Drawings.
3. Attach strap hangers to ducts with cadmium-plated screws. Use of pop rivets or other means will not be accepted.
4. Secure vertical ducts passing through floors by extending bracing angles to rest firmly on floors without loose blocking or shimming. Support vertical ducts, which do not pass through floors, by using bands bolted to walls, columns, etc. Size, spacing, and method of attachment to vertical ducts shall be same as specified for hanger bands on horizontal ducts.

3.2 CLEANING

A. Clean interior of duct systems before final completion.

END OF SECTION

SECTION 23 3114

LOW-PRESSURE METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install above-grade low-pressure steel ducts and related items as described in Contract Documents.

B. Related Requirements:
   1. Section 01 4546: 'Duct Testing, Adjusting, And Balancing' for duct test, balance, and adjust air duct systems services provided by Owner.
   2. Section 23 0713: 'Duct Insulation' for thermal Insulation for ducts, plenum chambers, and casings.
   3. Section 23 3001: 'Common Duct Requirements'.
   4. Section 23 0933: ‘Electric And Electronic Control System For HVAC':
      a. Temperature control damper actuators and actuator linkages.

1.2 REFERENCES

A. Association Publications:
   1. Sheet Metal And Air Conditioning Contractors' National Association / American National Standards Institute:
   2. SMACNA, ‘HVAC Duct Construction Standards - Metal and Flexible' (4th edition).

B. Reference Standards:
   1. ASTM International:
      a. ASTM A653/A653M-18, 'Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process'.
      b. ASTM E84-18b, ‘Standard Test Method for Surface Burning Characteristics of Building Materials'.
   2. Underwriters Laboratories of Canada:
      a. ULC 102-18: ‘Method of Test for Surface Burning Characteristics of Building Materials and Assemblies' (ULC S102).

1.3 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Duct Sealer:
      a. Meet Class A flame spread rating in accordance with ULC-S102.2.
      b. Handle, store, and apply materials in compliance with applicable regulations and material safety data sheets (MSDS).

1.4 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements:
   1. Duct Sealer:
      a. Handle, store, and apply materials in compliance with applicable regulations and material safety data sheets (MSDS).
      b. Handle to prevent inclusion of foreign matter, damage by water, or breakage.

c. Store in a cool dry location, but never under 35 deg F or subjected to sustained temperatures exceeding 110 deg F or as per Manufacturer's written recommendations.
d. Do use sealants that have exceeded shelf life of product.

1.5 FIELD CONDITIONS

A. Ambient Conditions:
1. Duct Sealer:
a. Do not apply under 35 deg F or subjected to sustained temperatures exceeding 110 deg F or as per Manufacturer's written recommendations.
b. Do not apply when rain or freezing temperatures will occur within seventy two (72) hours.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Materials:
1. Sheet Metal:
a. Fabricate ducts, plenum chambers and casings of zinc-coated, lock-forming quality steel sheets meeting requirements A653/A653M, with G 60 coating.
2. Duct Sealer For Interior Ducts:
a. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
1) Duct Butter or ButterTak by Cain Manufacturing Co Inc, Pelham, AL www.cainmfg.com.
2) DP 1010, DP 1030 or DP 1015 by Design Polymerics, Fountain Valley, CA www.designpoly.com.
3) PROseal, FIBERseal, EVERseal, or EZ-seal by Ductmate Industries, Inc., Charleroi, PA www.ductmate.com.
4) SAS by Duro Dyne, Bay Shore, NY or Duro Dyne Canada, Lachine, QB www.durodyne.com.
5) Iron Grip 601 by Hardcast Inc, Wylie, TX www.hardcast.com.
6) MTS100 or MTS 200 by Hercules Mighty Tough, Denver CO, www.herculesindustries.com.
7) 15-325 by Miracle / Kingco, Div ITW TACC, Rockland, MA www.taccint.com.
8) 44-39 by Mon-Eco Industries Inc, East Brunswick, NJ www.mon-ecoindustries.com.
9) Airseal Zero by Polymer Adhesive Sealant Systems Inc, Weatherford, TX www.polymeradhesives.com.
10) Airseal #22 Water Base Duct Sealer by Polymer Adhesive Sealant Systems Inc, Weatherford, TX www.polymeradhesives.com.

B. Fabrication:
1. General:
a. Straight and smooth on inside with joints neatly finished.
b. Duct drops to diffusers shall be round, square, or rectangular to accommodate diffuser neck. Drops shall be same gauge as branch duct. Seal joints air tight.
2. Standard Ducts:
a. General:
1) Ducts shall be large enough to accommodate inside acoustic duct liner. Dimensions shown on Drawings are net clear inside dimensions after duct liner has been installed.
b. Rectangular Duct:
1) Duct panels through 48 inch dimension having acoustic duct liner need not be cross-broken or beaded. Cross-break unlined ducts, duct panels larger than 48 inch vertical and horizontal sheet metal barriers, duct offsets, and elbows, or bead 12 inches on center.
a) Apply cross-breaking to sheet metal between standing seams or reinforcing angles.

b) Center of cross-break shall be of required height to assure surfaces being rigid.
c) Internally line square and rectangular drops. Externally insulate round drops.

2) Duct with height or width over 36 inches shall be fabricated using SMACNA T-24 flange joints or of pre-fabricated systems as follows:
a) Ducts with sides over 36 inches up to 48 inches: Transverse duct joint system by Ductmate **/** 25, Elgen, Ward, or WDCI (SMACNA Class 'F' joint).
b) Ducts 48 inch And Larger: Ductmate **/** 35, Elgen, or WDCI (SMACNA Class 'J' transverse joint).
c) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
(1) Ductmate Industries Inc, Charleroi, PA www.ductmate.com or Ductmate Canada Ltd, Burlington, ON (905) 332-7678.
(2) Ward Industries Inc, Bensonville, IL www.wardind.com.
(3) Elgen Manufacturing Company, Inc., East Ruterford, NJ www.elgenmfg.com.

c. Round Duct:
1) Spiral Seam:
a) 28 ga minimum for ducts up to and including 14 inches in diameter.
b) 26 ga minimum for ducts over 14 inches and up to and including 26 inches in diameter.
2) Longitudinal Seam:
a) 28 ga minimum for ducts up to and including 8 inches in diameter.
b) 26 ga minimum for ducts over 8 inches and up to 14 inches in diameter.
c) 24 ga minimum for ducts over 14 inches up to and including 26 inches in diameter.

PART 3 - EXECUTION

3.1 PREPARATION

A. Metal duct surface must be clean and free of moisture, contamination and foreign matter before applying duct sealer for interior and exterior ducts.

3.2 INSTALLATION

A. Install internal ends of slip joints in direction of flow. Seal transverse and longitudinal joints air tight using specified duct sealer as per Manufacturer's written instructions. Cover horizontal and longitudinal joints on exterior ducts with two layers of specified tape installed with specified adhesive.

B. Securely anchor ducts and plenums to building structure with specified duct hangers attached with screws. Do not hang more than one duct from a duct hanger. Brace and install ducts so they shall be free of vibration under all conditions of operation.

C. Ducts shall not bear on top of structural members.

D. Paint ductwork visible through registers, grilles, and diffusers flat black.

E. Properly flash where duct plenum meets exterior louvers. Line interior of plenum with peel and stick membrane flashing to maintain building envelope.

F. Under no conditions will pipes, rods, or wires be allowed to penetrate ducts.

3.3 FIELD QUALITY CONTROL

A. Field Tests:
1. Air Test and Balance Testing as specified in Section 01 4546: 'Duct Testing, Adjusting, and Balancing'.

B. Non-Conforming Work:
   1. Reseal transverse joint duct leaks and seal longitudinal duct joint leaks discovered during air test and balance procedures at no additional cost to Owner.

END OF SECTION

SECTION 23 3300

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install duct accessories in specified ductwork as described in Contract Documents.

B. Related Requirements:
   1. Section 23 0933: 'Electric And Electronic Control System For HVAC' for temperature control damper actuators and actuator linkages.
   2. Section 23 3001: 'Common Duct Requirements'.

1.2 REFERENCES

A. Reference Standards:
   1. ASTM International:
      a. ASTM A653/A653M-18, 'Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process'.
      b. ASTM C1071-16, 'Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)'.
      c. ASTM C1338-14, ‘Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings'.

PART 2 - PRODUCTS

2.1 ACCESSORIES

A. Manufacturers:
   1. Manufacturer Contact List:
      a. AGM Industries, Brockton, MA www.agmind.com.
      b. Air Balance Inc, Holland, OH www.airbalance.com.
      c. Air Filters Inc, Baltimore, MD www.afinc.com.
      d. Air-Rite Manufacturing, Bountiful, UT (801) 295-2529.
      e. American Warming & Ventilating, Holland, OH www.american-warming.com.
      f. Arrow United Industries, Wyalusing, PA www.arrowunited.com.
      g. Cain Manufacturing Company Inc, Pelham, AL www.cainmfg.com.
      h. C & S Air Products, Fort Worth, TX www.csairproducts.com.
      i. CertainTeed Corp, Valley Forge, PA www.certainteed.com.
      j. Cesco Products, Florence, KY www.cescoproducts.com.
      k. Daniel Manufacturing, Ogden, UT (801) 622-5924.
      l. Design Polymerics, Fountain Valley, CA www.designpoly.com.
      m. Ductmate Industries Inc, East Charleroi, PA www.ductmate.com.
      n. Duro Dyne, Bay Shore, NY www.durodyne.com.
      o. Dyn Air Inc. Lachine, QB www.dynair.ca
      p. Elgen Manufacturing Company, Inc. East Rutherford, NJ www.elgenmfg.com
      q. Flexmaster USA Inc, Houston, TX www.flexmasterusa.com.
      r. Greenheck Corp, Schofield, WI www.greenheck.com.
      s. Gripnail Corp, East Providence, RI www.gripnail.com.
      t. Hardcast Inc, Wylie, TX www.hardcast.com.
      u. Hercules Industries, Denver, CO, www.herculesindustries.com.

v. Honeywell Inc, Minneapolis, MN www.honeywell.com.
w. Industrial Acoustics Co, Bronx, NY www.industrialacoustics.com.
x. Johns-Manville, Denver, CO www.jm.com.
y. Kees Inc, Elkhart Lake, WI www.kees.com.
z. Knauf Fiber Glass, Shelbyville, IN www.knauffiberglass.com.
aa. Manson Insulation Inc, Brossard, QB www.isolationmanson.com.
bb. Metco Inc, Salt Lake City, UT (801) 467-1572 www.metcospiral.com.
cc. Miracle / Kingco, Rockland, MA www.taccint.com.
dd. Mon-Eco Industries Inc, East Brunswick, NJ www.mon-ecoindustries.com.
ee. Nailor Industries Inc, Houston, TX www.nailor.com.
ff. Owens Corning, Toledo, OH www.owenscorning.com.
gg. Polymer Adhesive Sealant Systems Inc, Irving, TX www.polymeradhesives.com.
hh. Pottorff Company, Fort Worth, TX www.pottorff.com.
ii. Ruskin Manufacturing, Kansas City, MO www.ruskin.com.
jj. Sheet Metal Connectors Inc, Minneapolis, MN www.smconnectors.com.
kk. Tamco, Stittsville, ON www.tamco.ca.
ll. Techno Adhesive, Cincinnati, OH www.technoadhesives.com.
mm. Titus, Richardson, TX (972) 699-1030. www.titus-hvac.com
nn. McGill AirSeal, Columbus, OH www.mcgillairseal.com.
oo. United Enertech Corp, Chattanooga, TN www.unitedenertech.com.
pp. Utemp Inc, Salt Lake City, UT (801) 978-9265.
qq. Ventfabrics Inc, Chicago, IL www.ventfabrics.com.
rr. Ward Industries, Grand Rapids MI www.wardind.com.
ss. Young Regulator Co, Cleveland, OH www.youngregulator.com.

B. Materials:
1. Acoustical Liner System:
a. Duct Liner:
1) One inch thick, 1-1/2 lb density fiberglass conforming to requirements of ASTM C1071. Liner will not support microbial growth when tested in accordance with ASTM C1338.
2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
a) ToughGard by CertainTeed.
b) Duct Liner E-M by Knauf Fiber Glass.
c) Akousti-Liner by Manson Insulation.
d) Quiet R by Owens Corning.
e) Linacoustic RC by Johns-Manville.
b. Adhesive:
1) Category Four Approved Water-Based Products. See Section 01 6200 for definitions of Categories:
a) Cain: Hydrotak.
b) Design Polymerics: DP2501 or DP2502 (CMCL-2501).
c) Duro Dyne: WSA.
d) Elgen: A-410-WB.
e) Hardcast: Coil-Tack.
f) Hercules: Mighty Tough Adhesives MTA500 or MTA600.
g) Miracle / Kingco: PF-101.
h) Mon-Eco: 22-67 or 22-76.
i) Polymer Adhesive: Glasstack #35.
j) Techno Adhesive: 133.
k) McGill AirSeal: Uni-tack.
2) Category Four Approved Solvent-Based (non-flammable) Products. See Section 01 6200 for definitions of Categories:
a) Cain: Safetak.
b) Duro Dyne: FPG.
c) Hardcast: Glas-Grip 648-NFSE.
d) Miracle / Kingco: PF-91.
e) Mon-Eco: 22-24.
f) Polymer Adhesive: Q-Tack.
g) Techno Adhesive: 'Non-Flam' 106.
c. Fasteners:

1) Adhesively secured fasteners not allowed.
2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
   a) AGM Industries: 'DynaPoint' Series RP-9 pin.
   b) Cain.
   c) Duro Dyne.
   d) Gripnail: May be used if each nail is installed by 'Grip Nail Air Hammer' or by 'Automatic Fastener Equipment' in accordance with Manufacturer's recommendations.

2. Flexible Equipment Connections:
   a. 30 oz closely woven UL approved glass fabric double coated with neoprene.
   b. Fire retardant, waterproof, air-tight, resistant to acids and grease, and withstand constant temperatures of 200 deg F.
   c. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      1) Cain: N-100.
      2) Duro Dyne: MFN.
      3) Dyn Air: CPN with G-90 galvanized off-set seam.
      4) Elgen: ZLN / SDN.
      5) Ventfabrics: Ventglas.
      6) Ductmate: ProFlex.
3. Duct Access Doors:
   a. General:
      1) Factory built insulated access door with hinges and sash locks, as necessary. Construction shall be galvanized sheet metal, 24 ga minimum.
      2) Fire and smoke damper access doors shall have minimum clear opening of 12 inches square or larger as shown on Drawings.
   b. Rectangular Ducts:
      1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
         a) Air Balance: Fire/Seal FSA 100.
         b) Air-Rite: Model HAD-2.
         c) Cesco: HDD.
         d) Elgen: TAB Type / Hinge and Cam.
         e) Flexmaster: Spin Door.
         f) Kees: ADH-D.
         g) Nailor: 08SH.
         h) Pottorff: 60-HAD.
         i) Ruskin: ADH-24.
         j) United Enertech: L-95.
   c. Round Ducts:
      1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
         a) Ductmate: ‘Sandwich’ Access Door.
         b) Elgen: Sandwich Access Door.
         c) Kees: ADL-R.
         d) Nailor: 0809.
         e) Pottorff: RAD.
         f) Ruskin: ADR.
         g) Ward: DSA.
4. Dampers And Damper Accessories:
   a. Locking Quadrant Damper Regulators:
      1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
         a) Duro Dyne: KS-385.
         b) Dyn Air: QPS-385.
         c) Elgen: EQR-4.
         d) Ventfabrics: Ventline 555.
         e) Young: No. 1.
   b. Concealed Ceiling Damper Regulators (see Drawing details):
      1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
         a) Cain.
         b) Duro Dyne.
         c) Elgen.
         d) Metco Inc.

e) Ventfabrics: 666 Ventlok.
f) Young: 301 – see Drawing details for preferred mounting locations.

c. Volume Dampers:
1) Rectangular Duct:
a) Factory-manufactured 16 ga galvanized steel, single blade and opposed blade type with 3/8 inch axles and end bearings. Blade width 8 inches maximum. Blades shall have 1/8 inch clearance all around.
b) Damper shall operate within acoustical duct liner.
c) Provide channel spacer equal to thickness of duct liner.
d) Dampers above removable ceiling and in Mechanical Rooms shall have locking quadrant on bottom or side of duct. Otherwise, furnish with concealed ceiling damper regulator and cover plate.
e) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
(1) Air-Rite: Model CD-2.
(2) American Warming: VC-2-AA.
(3) Arrow: OBDAF-207.
(4) C & S: AC40.
(5) Cesco: AGO.
(6) Daniel: CD-OB.
(7) Greenheck: VCD-20.
(8) Nailor: 1810 or 1820.
(9) Pottorff: CD-42.
(10) Ruskin: MD-35.
(11) United Enertech: MD-115.
(12) Utemp: CD-OB.
2) Round Duct:
a) Factory-manufactured 20 ga galvanized steel, single blade with 3/8 inch axles and end bearings.
b) For use in outside air ducts.
c) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
(1) Air Balance: Model AC-22.
(2) Air-Rite: Model CD-8.
(3) American Warming: V-22.
(4) Arrow: Type-70.
(5) C & S: AC21R.
(6) Cesco: MGG.
(7) Nailor: 1890.
(8) Pottorff: CD-21R.
(9) Ruskin: MDRS-25.
(10) United Enertech: RD.

d. Motorized Outside Air Dampers:
1) General:
a) Low leakage type. AMCA certified.
b) Make provision for damper actuators and actuator linkages to be mounted external of air flow.
2) Rectangular Ducts:
a) Damper Blades:
(1) Steel or aluminum airfoil type with mechanically locked blade seals, 8 inch blade width maximum measured perpendicular to axis of damper.
(2) Jamb seals shall be flexible metal compression type.
(3) Opposed or single blade type.
b) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
(1) Air Balance: AC 526.
(2) American Warming: AC526.
(3) Arrow: AFD-20.
(4) C & S: AC50.
(5) Cesco: AGO3.

(6) Nailor: 2020.
(7) Pottorff: CD-52.
(8) Ruskin: CD-60.
(9) Tamco: Series 1000.
(10) United Enertech: CD-150 or CD-160.

3) Round Ducts:
a) Damper Blades:
(1) Steel with mechanically locked blade seals.
(2) Blade seals shall be neoprene or polyethylene.
(3) Single blade type.
b) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
(1) Air Balance: AC 25.
(2) American Warming: VC25.
(3) Arrow: Type 70 or 75.
(4) C & S: AC25R.
(5) Cesco: AGG.
(6) Nailor: 1090.
(7) Pottorff: CD-25R.
(8) Ruskin: CD25.
(9) Tamco: Square-to-Round Series 1000.
(10) United Enertech: RI.

e. Backdraft Dampers:
1) Backdraft blades shall be nonmetallic neoprene coated fiberglass type.
2) Stop shall be galvanized steel screen or expanded metal, 1/2 inch mesh.
3) Frame shall be galvanized steel or extruded aluminum alloy.
4) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
a) Air-Rite: Model BDD-3.
b) American Warming: BD-15.
c) C & S: BD30.
d) Pottorff: BD-51.
e) Ruskin: NMS2.
f) Utemp: BFEA.

5. Air Turns:
a. Single thickness vanes. Double thickness vanes not acceptable.
b. 4-1/2 inch wide vane rail. Junior vane rail not acceptable.

6. Branch Tap for Flexible Ductwork:
a. Factory-manufactured rectangular-to-round 45 degree leading tap fabricated of 24 ga zinc-coated lock-forming quality steel sheets meeting requirements of ASTM A653, with G-90 coating.
b. One inch wide mounting flange with die formed corner clips, pre-punched mounting holes, and adhesive coated gasket.
c. Manual Volume Damper:
1) Single blade, 22 ga minimum
2) 3/8 inch minimum square rod with brass damper bearings at each end.
3) Heavy-duty locking quadrant on 1-1/2 inch high stand-off mounting bracket attached to side of round duct.
d. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
1) ST-1HD by Air-Rite:
a) Nylon damper bearings approved for Air-Rite.
2) STO by Flexmaster.
3) HET by Sheet Metal Connectors.

C. Fabrication:
1. Duct Liner:
a. Install mat finish surface on airstream side. Secure insulation to cleaned sheet metal duct with continuous 100 percent coat of adhesive and with 3/4 inch long mechanical fasteners 12 inches on center maximum unless detailed otherwise on Drawings. Pin all duct liner.

b. Accurately cut liner and thoroughly coat ends with adhesive. Butt joints tightly. Top and bottom sections of insulation shall overlap sides. If liner is all one piece, folded corners shall be tight against metal. Ends shall butt tightly together.
c. Coat longitudinal and transverse edges of liner with adhesive.

2. Air Turns:
a. Permanently install vanes arranged to permit air to make abrupt turn without appreciable turbulence, in 90 degree elbows of above ground supply and return ductwork.
b. Quiet and free from vibration when system is in operation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Duct Liner:
1. Furnish and install acoustic lining in following types of rectangular ducts unless noted otherwise on Contract Documents:
a. Supply air.
b. Return air.
c. Mixed air.
d. Transfer air.
e. Relief air.
f. Exhaust air.
g. Elbows, fittings, and diffuser drops greater than 12 inches in length.
2. Do not install acoustic lining in round ducts.

B. Flexible Connections: Install flexible inlet and outlet duct connections to each furnace.

C. Access Doors In Ducts:
1. Install at each manual outside air damper and at each motorized damper. Locate doors within 6 inches of installed dampers.
2. Install within 6 inches of fire dampers and in Mechanical Room if possible. Install on side of duct that allows easiest access to damper.

D. Dampers And Damper Accessories:
1. Install concealed ceiling damper regulators.
a. Extend damper adjustment control to Service Platform handrail as detailed.
b. Do not install damper regulators for dampers located directly above removable ceilings or in Mechanical Rooms.
2. Provide each take-off with an adjustable volume damper to balance that branch.
a. Anchor dampers securely to duct.
b. Install dampers in main ducts within insulation.
c. Dampers in branch ducts shall fit against sheet metal walls, bottom and top of duct, and be securely fastened. Cut duct liner to allow damper to fit against sheet metal.
d. Where concealed ceiling damper regulators are installed, extend control adjustment to Service Platform as detailed.
3. Install motorized dampers.

END OF SECTION

SECTION 23 3316

FIRE AND SMOKE DAMPERS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install fire dampers where HVAC is penetrating rated room Hydronic 159 as described in Contract Documents.

B. Related Requirements:
   1. Section 23 3001: 'Common Duct Requirements'.

1.2 REFERENCES

A. Reference Standards:
   1. Underwriters Laboratories (UL):
      a. UL 555: 'Fire Dampers' (7th Edition).
   2. Standards Council of Canada:
      a. CAN/ULC S112-10(R2016), ‘Standard Methods of Test of Fire-Damper Assemblies’.
      b. CAN/ULC S112.1-10(R2016), 'Standard for Leakage Rated Dampers for Use in Smoke Control Systems’.
      c. CAN/ULC S112.2-07(R2016), 'Standard of Fire Test of Ceiling Firestop Flap Assemblies'.
   3. 2019 National Building Code – Alberta Edition

1.3 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Dampers shall conform to NFPA and SMACNA requirements and bear ULC label.
   2. Dampers shall be approved by fire authorities having jurisdiction where so required.
   3. Wall and floor fire dampers shall conform to CAN/ULC 112.
   4. Ceiling fire dampers shall conform to CAN/ULC 112.2.

1.4 SUBMITTALS

A. Maintenance Material Submittals:
   1. Extra Stock Materials:
      a. Leave six (6) fusible links of each rating type used on Project with Owner.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Manufacturers:
   1. Manufacturer Contact List:
      a. Air Balance Inc, Holland, OH www.airbalance.com.
      b. Cesco Products, Florence, KY www.cescoproducts.com.
      c. Greenheck Corp, Schofield, WI www.greenheck.com or Greenheck Corp/ E H Price Ltd, Winnipeg, MB (204) 669-4220.
      d. Honeywell Inc, Minneapolis, MN www.honeywell.com.

e. Nailor Industries, Houston, TX www.nailor.com.
f. Pottorff, Fort Worth, TN www.pottorff-hvac.com.
g. Prefco Products Inc, Buckingham, PA www.prefco-hvac.com.
h. Ruskin Manufacturing, Kansas City, MO www.ruskin.com.
i. Safe-Air / Dowco, Cicero, IL www.safeair-dowco.com.
j. United Enertech Corp, Chattanooga, TN www.unitedenertech.com.

B. Manufactured Units:
1. Fire Dampers:
a. Walls And Floors (Type 1):
1) Type 'B.'
2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
a) Air Balance: Model 119B.
b) Cesco: Model 15SB.
c) Greenheck: Model FD150XB.
d) Nailor: Model 0120H.
e) Pottorff: Model VFD-10.
f) Ruskin: Model DIBD20.
g) Safe-Air: Model 150B Sleeved.
h) United Enertech: FDD-SB.
b. Ceilings (Type 2):
1) Radiation type ceiling fire damper.
2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
a) Air Balance: Model 289.
b) Cesco: Model RCI.
c) Greenheck: Model CRD-60B.
d) Nailor: Model 0716 or 0722.
e) Pottorff: Model CFD-20.
f) Ruskin: Model CFD-LDS Series.
g) Safe-Air: Model 410A.
h) United Enertech: C-S/R.

C. Fabrication:
1. General:
a. 16 ga frames.
b. Integral sleeves, except for Type 2 Fire Dampers.
2. Type 1 Dampers: Fabricate with blades out of airstream.

D. Operation Sequences:
1. Types 1 And 2: Dampers shall close when temperatures at damper exceed 165 deg F link unless indicated otherwise on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Placement:
1. Fire Dampers (Types 1 and 2): Install in ducts where ducts penetrate fire-rated walls and floors and at registers, grilles, and diffusers penetrating fire rated assemblies.

END OF SECTION

SECTION 23 3346

FLEXIBLE DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install supply air branch duct runouts to diffusers as described in Contract Documents.

B. Related Requirements:
   1. Section 23 3001: Common Duct Requirements.

1.2 REFERENCES

A. Reference Standards:
   1. National Fire Protection Association / American National Standards Institute:
      a. NFPA 90A: 'Installation of Air-Conditioning and Ventilating Systems' (2018 or most recent edition adopted by AHJ).
   2. Underwriters Laboratories:
      a. UL 181, 'Factory-Made Ducts and Air Connectors' (11th Edition).
      b. UL 181B, 'Closure Systems for Use With Flexible Air Ducts and Air Connectors' (3rd Edition).
   3. ULC.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Manufacturers:
   1. Manufacturer Contact List:
      a. JP Lamborn Co., Fresno CA www.jplflex.com.
      b. Flexmaster USA Inc, Houston, TX www.flexmasterusa.com or Flexmaster Canada Ltd, Richmond Hill, ON (905) 731-9411.
      c. Thermaflex by Flexible Technologies, Abbeville, SC or Mississauga, ON www.thermaflex.net.

B. Materials:
   1. Ducts:
      a. Formable, flexible, circular duct which shall retain its cross-section, shape, rigidity, and shall not restrict airflow after bending.
      b. Insulation:
         1) Nominal 1-1/2 inches, 3/4 lb per cu ft density fiberglass insulation with air-tight, polyethylene or polyester core, sheathed in seamless vapor barrier jacket factory installed over flexible assembly.
      c. Assembly, including insulation and vapor barrier, shall meet Class I requirement of NFPA 90A and be UL 181 rated, with flame spread of 25 or less and smoke developed rating of 50 or under.
      d. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
         1) PR-25 by JP Lambornes.
         2) Flex-Vent KP by Thermaflex by Flexible Technologies.
         3) Type 1B Insulated by Flexmaster.

2. Cinch Bands: Nylon, 3/8 inch removable and reusable type.
   a. Listed and labeled in accordance with Standard UL 181B and labeled 'UL 181 B-C'.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct in fully extended condition free of sags and kinks, using 72 inch maximum lengths.

B. Make duct connections by coating exterior of duct collar for 3 inches with duct sealer and securing duct in place over sheet metal collar with specified cinch bands.

END OF SECTION

SECTION 23 3401

EXHAUST FANS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install exhaust fans as described in Contract Documents.

B. Related Requirements:
   1. Section 23 3001: 'Common Duct Requirements'.
   2. Division 26: Control device and electrical connection.

1.2 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Bear AMCA seal and ULC label.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer Contact List:
   1. Acme Engineering & Manufacturing Corp, Muskogee, OK www.acmefan.com.
   2. Broan-Nu Tone LLC, Harford, WI www.broan.com.
   3. Carnes Co., Verona, MI www.carnes.com.
   4. Loren Cook Co., Springfield, MO www.lorencook.com.
   5. Soler & Palau (S&P USA Ventilation Systems, LLC), Jacksonville FL www.solerpalau-usa.com.

2.2 MANUFACTURED UNITS

A. Ceiling Mounted Exhaust Fans:
   1. Acoustically insulated housings. Sound level rating of 5.0 sones maximum for CFM and static pressure listed on Contract Drawings.
   2. Include chatterproof integral back-draft damper with no metal-to-metal contact.
   3. True centrifugal wheels.
   4. Entire fan, motor, and wheel assembly shall be easily removable without disturbing housing.
   5. Suitably ground motors and mount on rubber-in shear vibration isolators.
   6. Provide connection to duct work as detailed.
   7. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      a. Acme: VQ.
      b. Broan: LoSone.
      c. Carnes: VCD.
      d. Cook: Gemini.
      e. Soler & Palau: FF.
      f. Greenheck: SP

PART 3 - EXECUTION

3.1 INSTALLATION

A. Anchor fan units securely to structure or to curb.

END OF SECTION

SECTION 23 3713

DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install diffusers, registers, and grilles connected to ductwork as described in Contract Documents. Refer to schedules in Drawings for colours and additional information.

B. Related Requirements:
   1. Section 23 3001: 'General Duct Requirements'.

1.2 SUBMITTALS

A. Maintenance Material Submittals:
   1. Tools: Leave tool for removing core of each different type of grille for building custodian.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer Contact List:
   1. Carnes Co, Verona, MI www.carnes.com.
   2. J & J Register, Grand Rapids, MI www.jandjreg.com.
   3. Krueger Air System Components, Richardson, TX www.krueger-hvac.com.
   4. Metal*Aire by Metal Industries Inc, Clearwater, FL www.metalaire.com.
   5. Nailor Industries Inc, Houston, TX or Weston, ON www.nailor.com.
   6. E H Price Ltd, Winnipeg, MB (204) 669-4220.
   7. Titus, Richardson, TX www.titus-hvac.com.
   8. Tuttle & Bailey, Richardson, TX www.tuttleandbailey.com.

2.2 MANUFACTURED UNITS

A. Ceiling Return And Transfer Grilles:
   1. Finish: Off-white baked enamel.
   2. 1/2 inch spacing.
   3. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      a. Carnes: RSLA.
      b. J & J: S90H.
      c. Krueger: S85H.
      d. Metal*Aire: SRH.
      e. Nailor: 6155H.
      f. Price: 535.
      g. Titus: 355RL or 355 RS.
      h. Tuttle & Bailey: T75D.

B. High Side Wall Return Grilles:
   1. Finish: Off-white baked enamel.
   2. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      a. Metal*Aire: 41C.

b. Krueger: 5810.
c. Nailor: 51RC.
d. Price: RCG.
e. Titus: 1700.
f. Tuttle & Bailey: AVF.

C. Side Wall Supply Grilles And Registers:
1. Finish: See schedule.
2. Removable core.
3. Double deflection.
4. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
a. Krueger: 5815.
b. Metal*Aire: 42C.
c. Nailor: 51RCD.
d. Price: RCG-DVS.
e. Titus: 1707.
f. Tuttle & Bailey: AVF.

D. Low Sidewall Return Grilles:
1. Finish: See schedule.
2. 38 or 45 degree deflection.
3. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
a. Carnes: RSHA.
b. J & J: S-590.
c. Krueger: S480H.
d. Metal*Aire: HD-RH.
e. Nailor: 6145H-HD.
f. Price: 91.
g. Titus: 33RL or 33RS.
h. Tuttle & Bailey: T115D.

E. Ceiling Diffusers:
1. Finish: Off-white baked enamel.
2. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
a. Carnes: SKSA.
b. J & J: R-1400.
c. Krueger: SH.
d. Metal*Aire: 5500S.
e. Nailor: 65OOB.
f. Price: SMD-6.
g. Titus: TDC-6.
h. Tuttle & Bailey: M.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Anchor securely into openings. Secure frames to ductwork by using four sheet metal screws, one per side.

3.2 ADJUSTING

A. Set sidewall supply register blades at 15 degrees upward deflection.

END OF SECTION

SECTION 23 3714

LOUVERS AND VENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install louvers connected to ductwork as described in Contract Documents.

B. Products Furnished But Not Installed Under This Section:
   1. Architectural louvers not connected to ductwork – see Storage Shed.

C. Related Requirements:
   1. Section 06 2001: 'Common Finish Carpentry Requirements' for installation of architectural louvers not connected to ductwork.
   2. Section 23 3001: 'General Duct Requirements'.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer Contact List:
   1. Airolite Co, Marietta, OH www.airolite.com.
   2. Air-Rite Manufacturing, Bountiful, UT www.air-ritemfg.com.
   3. Energy Technology Products LTD, Edmonton, AB (780) 468-1110.
   4. DKG Construction, LTD., Waterdown, ON 289-895-9729.
   5. E H Price.
   6. SF435 by Western Ventilation Products Ltd, Calgary, AB www.westvent.com.

2.2 MANUFACTURED UNITS

A. Louvers:
   1. General:
      a. Extruded aluminum, with blades welded or screwed into frames.
      b. Frames shall have mitered corners.
      c. Louvers shall be recessed, flanged, stationary, or removable as noted on Contract Documents.
      d. Finish:
         1) Polyvinyledene Fluoride (PVF_2) Resin-base finish (Kynar 500 or Hylar 5000) containing 70 percent minimum PVF_2 in resin portion of formula. Thermo-cured two coat system consisting of corrosion inhibiting epoxy primer and top coat factory applied over properly pre-treated metal.
         2) Color as selected by Architect from Manufacturer's standard colors – see Finish Schedule A601.
   2. Louvers Connected To Ductwork:
      a. 1/2 inch mesh 16 ga aluminum bird screen.
      b. Flange option.
      c. Drainable.
      d. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
         1) DE635 by E H Price.
         2) Equal by Airolite.
         3) Equal by Air-Rite Manufacturing.

4) Equal by Carnes.
5) Equal by Industrial Louvers.

3. Architectural Louvers:
   a. Aluminum bird screen.
   b. Flange option.
   c. Drainable.
   d. Class One Quality Standards:
      1) DE635 by E H Price.
      2) Equal by Airolite.
      3) Equal by Air-Rite Manufacturing.
      4) Equal by Carnes.
      5) Equal by Industrial Louvers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Anchor securely into openings.

B. Where louvers touch masonry or dissimilar metals, protect with heavy coat of asphaltum paint.

C. Seal around louvers to maintain building envelope – see details.

D. Coordinate weep holes and flexible flashing location with louver flange extents to ensure water exit from rainscreen.

END OF SECTION

SECTION 23 4100

AIR FILTERS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install filters used in mechanical equipment.

B. Related Requirements:
   1. Section 23 3001: 'Common Duct Requirements'.
   2. Section 23 7223: ' Packaged Air-To-Air Energy Recovery Units'.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Furnace Filters: One inch thick throw-away type as recommended by Furnace Manufacturer.

B. Energy Recovery Units: Two inch thick pleated throw-away type as recommended by Energy Recovery Unit Manufacturer with ANSI/ASHRAE 52.2 MERV rating of 6 or higher.

C. Intake Louver Filters: Pleated throw-away type with ANSI/ASHRAE 52.2 MERV rating of 4 rating.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide ample access for filter removal.

3.2 FIELD QUALITY CONTROL

A. Inspection: At date of Substantial Completion, air filters shall be new, clean, and approved by Owner's representative.

END OF SECTION

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SECTION 23 5135

AIR PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install heating equipment exhaust piping and combustion air intake piping as described in Contract Documents.
   2. Confirm air piping requirements with Equipment Model #'s and coordinate with jack flashing – see Architectural.
   3. Coordinate air piping installation with spray foam schedule.

B. Related Requirements:
   1. Section 07 6310: 'Steep Slope Roof Flashing: Asphalt Tile' for pipe flashing used on steep slope asphalt tile roofs only.
   2. Sections Under 09 9000 Heading: Painting.
   3. Section 22 3423: 'Gas Domestic Water Heaters'.
   4. Section 23 0501: 'Common HVAC Requirements'.
   5. Section 23 0719: 'HVAC Piping Insulation'.
   6. Section 23 5417: 'Gas-Fired Furnaces'.

1.2 REFERENCES

A. Reference Standards:
   1. ASTM International:
      a. ASTM D1785-12, 'Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120'.
      b. ASTM D2564-12, 'Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems'.
      c. ASTM D2661-11, 'Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings'.
      d. ASTM D2665-14, 'Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings'.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Manufacturers:
   1. Manufacturer Contact List:
      a. Armaflex by Armacell, Mebane, NC www.armaflex.com.
      b. Nomaco, Youngsville, NC www.nomacokflex.com.

B. Materials:
   1. Air Piping: System 636 gas vent to meet current gas code.
   2. Solvent Cement and Adhesive Primer:
      a. Meet requirements of current gas code.
   3. Flexible Foamed Pipe Insulation:
      a. Thickness:
         1) 1/2 inch for 2 through 3 inch outside diameter pipe.
         2) 1/2 inch sheet for fittings as recommended by Manufacturer.

b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
   1) Tubolit by Armaflex.
   2) ImcoLock or Therma-Cel by Nomaco K-Flex.

4. Insulation Joint Sealer:
   a. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      1) 520 by Armaflex.
      2) R-320 by Nomaco K-Flex.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation For Condensing Furnaces:
   1. Run individual vent and individual combustion intake piping from each furnace to concentric roof termination kit provided by Furnace Manufacturer. Slope lines downward toward furnace.
   2. Slope combustion chamber drain downward to funnel drain. Anchor to wall with wall clamps, allowing free movement through clamp for expansion.
   3. Use concentric roof termination kit provided by Furnace Manufacturer. Install vent and combustion air intake piping at clearance and distances required by Furnace Manufacturer.
   4. Attach factory-supplied neoprene coupling to combustion-air inlet and secure with clamp.
   5. Ensure that factory-supplied perforated metal disc is installed in flexible coupling, unless its removal is required.
   6. York Furnaces: Install air piping on side of furnace in horizontal or vertical installation.

B. Installation For Condensing Water Heaters:
   1. Run individual vent and individual combustion intake piping from each water heater to roof termination as recommended by Water Heater Manufacturer. Concentric roof termination kit may be used if approved by and provided by Water Heater Manufacturer. Slope lines downward toward water heater.
   2. Slope combustion chamber exhaust drain downward to floor drain.

C. Support:
   1. Support concentric roof termination kit at ceiling or roof line with 20 ga sheet metal straps as detailed on Drawings. Support horizontal and sloping sections of pipe with 1 inch wide 20 ga galvanized steel straps. Anchor securely to structure, not allowing pipe to sway.

D. Insulation:
   1. General:
      a. Install insulation in snug contact with pipe and in accordance with Manufacturer's recommendations.
      b. Slip insulation on piping before piping sections and fittings are assembled keeping slitting of insulation to a minimum.
      c. Joints:
         1) Place 'slit' joint seams of insulation exposed outside building on bottom of pipe.
         2) Stagger joints on layered insulation.
         3) Seal joints in insulation.
      d. Paint exterior exposed insulation with two coats of finish recommended by Insulation Manufacturer, color selected by Architect. Provide UV resistant ties over insulation if slit.
   2. Install specified insulation on System 636 air piping serving mechanical equipment as follows
      a. Combustion air and Combustion vent 636 piping above roof line, at cold vent slot, and extending 10 feet (3050mm) into equipment platform – see details.
      b. Insulate fittings with sheet insulation and as recommended by Manufacturer.

END OF SECTION

SECTION 23 5224

NATURAL GAS CONDENSING BOILERS

PART 1 - GENERAL

1.1 SUMMARY

A. Products Supplied But Not Installed Under This Section:
   1. Boiler complete with accessories.

B. Related Requirements:
   1. Section 23 0501: Common HVAC Requirements.
   2. Section 23 2113: Hydronics Piping and boiler installation.
   3. Division 26: Electrical service and connections.

1.2 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Constructed in accordance with ASME low pressure code and listed in CGA Directory of Certified Appliance and accessories.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Manufacturers:
   1. Manufacturer Contact List:
      a. Buderus Hydronic Systems Inc, Londonderry, NH www.buderus.net.
      b. Lochinvar Boilers Corporation, Nashville, TN, www.lockinvar.com.

B. Performance:
   1. Design Criteria:
      a. Condensing boilers capable to provide high combustion rating of 93.4%.
      b. Boiler shall be for hot water heating service.

C. Boiler:
   1. Condensing boiler with high performance aluminum or copper-fin heat exchanger.
   2. Thermally insulated boiler block.
   3. Modulating premix gas burner for quiet, energy efficient operation.
   4. Fully assembled at the factory.
   5. Balanced flue operation.
   6. Condensate trap included.
   7. Sealed combustion chamber.
   8. Panel-mounted water temperature gauges.
   9. Adjustable temperature high-limit c/w manual reset.
   10. Adjustable aquastat.
   11. ASME Pressure Relief Valve.
   12. Built-in Combustion air fans.
   13. Main gas pressure regulator and remote manifold gas pressure tap.
   14. Water flow switch.
   15. Maximum 160 psi working pressure.

16. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
    a. Equal by Buderus Hydronic Systems.
    b. Series FTX by Lochinvar - see Drawings for Model #.

D. Operation:
1. Boiler Controls:
    a. Intelligent control system with built in Energy Management System (EMS)
    b. Include optional module that enables direct communication with building management system.
    c. Logamatic 4000 Control for Buderus Boilers or sequential and Diagnostic Control Panel for Lochinvar Boilers.
2. Gas Train:
    a. Factory Mutual standard, without center block and bleed, and consisting of:
        1) Main lubricated plug valve with handle.
        2) Main gas pressure regulator.
        3) Modulating gas valve.
        4) Fluid power safety gas valve.
        5) Three gas pressure gauge connections with 1/4 inch FNTP with plug.
        6) Low-pressure gas switch.
        7) High-pressure gas switch.
        8) Pilot solenoid valve.
        9) Pilot gas pressure regulator and carefully supported pilot line.
        10) Pilot gas shut-off cock.
3. Ball Valves:
    a. 400 lbs W.O.G. 150 lb steam WP, 350 deg F, teflon seats.
    b. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
        1) Jenkins-NH-Canada.
        2) BA300 by Milwaukee Valve.
        3) T-595-Y by Nibco.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide unions so valves and regulators may be removed, minimum of three unions on main gas train. Support gas train minimum two places.

B. Install ball valves:
1. On boiler drain line.
2. In cold water make-up line to boiler. Locate valve so water glass can be observed when adding water to boiler.

C. Run drain line from water column to within 12 inches of floor.

D. Pipe pressure relief valve discharge to within 18 inches of finished floor.

E. Low Water Cut-Offs: Install ball type drain valves and run drain lines from low water cut-offs to within 12 inches of floor.

END OF SECTION

SECTION 23 5417

GAS-FIRED FURNACES

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install horizontal gas-fired condensing furnaces as described in Contract Documents.

B. Related Sections:
   1. Section 23 0501: 'Common HVAC Requirements'.
   2. Section 23 1123: 'Facility Natural Gas Piping'.
   3. Section 23 2300: 'Refrigerant Piping'.
   4. Section 23 4100: 'Air Filters'.
   5. Section 23 5135: ‘Air Piping’.
   6. Section 23 6214: 'Compressor Units: Air Conditioning (5 Ton or less)' for DX Cooling.

1.2 SUBMITTALS

A. Informational Submittals:
   1. Manufacturer Reports: Equipment check-out sheets.

B. Special Procedure Submittals:
   1. Installer must register with Manufacturer before submitting Manufacturer Warranty:
      a. Installer to contact Owner’s Representative (FM Group or Project Manager) for following MANDATORY information to be given to Manufacturer before Manufacturer will issue Manufacturer’s ‘Special LDS Warranty’ included with Closing Submittal:
         1) This must be given to Manufacturer:
            a) Name of Owner (name of FM Group) ____Calgary AB FM Group_____
            b) Mailing Address (FM office address) _7040 Farrell Road SE, Room 109, Calgary, Alberta, T0K 2N0____
            c) Building Property ID (unique 7 digit identifier) ____500-7688_____
            d) Project site address: ___530 Seton Passage SE, Calgary, AB_____
            e) Model Number of each Unit _____
            f) Serial Number of each Unit _____
            g) Date of Installation / Startup _____
      b. Product Data for Prerequisite EQ 1:
         1) Documentation indicating that units comply with ANSI/ASHRAE 62.1, Section 5 - 'Systems and Equipment'.
      c. Product Data for Credit EQ 4.1:
         1) For solvent cements and adhesive primers, including printed statement of VOC content.

C. Closeout Submittals:
   1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
      a. Warranty Documentation:
         1) Final, executed copy of Manufacturer’s ‘Special LDS Warranty’ including required Owner / Manufacturer mandatory information.
      b. Record Documentation:
         1) Manufacturers Documentation:
            a) Equipment checkout sheet: Complete and sign all items for each unit.

1.3 WARRANTY

A. Manufacturer's Warranty:
   1. Provide Manufacturer's 'Special LDS Warranty' for the following:
      a. Provide fifteen (15) year minimum limited warranty of heat exchanger.
      b. Provide five (5) year limited warranty on parts.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Manufacturers:
   1. Manufacturer Contact List:
      a. Lennox Industries:
         1) For pricing and information contact: Lennox National Account @ 1-800-367-6285.
         2) Lennox National Contact: Cody Jackson (801) 736-8904 Cody.Jackson@LennoxInd.com.
      b. York International:
         1) Brian Michael (405) 419-6230 brian.k.michael@jci.com.

B. Design Criteria:
   1. Rated at 92 percent minimum AFUE (Annual Fuel Utilization Efficiency) calculated in accordance with DOE test procedures.

C. Manufactured Units:
   1. Furnaces:
      a. Factory assembled units certified by CGA complete with blower section, furnace section, steel casing, piped, and wired.
      b. Blower section shall consist of cabinet, blower, and motor.
         1) Cabinet shall be of 22 ga minimum cold rolled steel and have finish coat of baked-on enamel.
         2) Blower shall be Class 1, full DIDW, statically and dynamically balanced.
      c. Automatic controls shall consist of:
         1) Manual gas shut-off valve.
         2) Operating automatic gas valve.
         3) Solid-state type fan and thermal limit controls.
         4) 24-volt transformer.
         5) Hot surface ignition system.
      d. Blower shall be driven by multi-speed direct driven motor.
      e. Furnace section shall be enclosed in 22 ga minimum enameled steel casing lined with foil covered insulation.
      f. Heat Exchanger: Aluminized steel.
      g. Gas Burners: Aluminized steel.
      h. 636 intake of outside air and 636 combustion product exhaust, with sealed combustion, direct vent system.
      i. Concentric roof termination kit for roof mounting.
      j. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
         1) Standard Furnaces:
            a) Lennox: equal
            b) York: TM9E.
         2) Two Stage Heat with ECM motor:
            a) Lennox: equal
            b) York: TM9V.
         3) See Schedule in Drawings.
   2. Cooling Coil:
      a. Cooling coil shall consist of heavy gauge steel cabinet with baked-on enamel finish to match furnace:

1) Coil shall have aluminum fins bonded to seamless copper or aluminum tubing.
2) Coil shall be ARI rated. Provide drain pans with connections at one end.
3) Use thermal expansion valve.

b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
1) Horizontal:
a) Lennox: equal
b) York: CM.
2) See Schedule in Drawings.

2.2 ACCESSORIES

A. Filter Frame:
1. Build filter frame external to furnace as detailed on Contract Drawings.

B. Vibration Isolators:
1. Horizontal Installation:
a. Neoprene hanger type with load of 75 lbs maximum.
b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
1) RH by Kinetics Noise Control, Dublin, OH www.kineticsnoise.com.
2) Mason Industries, Hauppage, NY www.mason-ind.com.
3) RH by Vibration Mounting & Controls, Bloomingdale, NJ www.vmc-kdc.com.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Vibration Isolators:
1. Install vibration isolator on each hanger rod supporting horizontal furnace.

3.2 FIELD QUALITY CONTROL

A. Manufacturer Services:
1. Furnace installer shall:
a. Verify proper gas orifice size.
b. Clock gas meter for rated input.
c. Verify and set gas pressure at furnace.
d. Check and measure temperature rise.
e. Check safety controls for proper operation.
f. Check combustion vent sizes and combustion air sizes.
2. Furnace installer shall start up, check out, and adjust furnaces using equipment check-out sheet provided by Manufacturer. Complete and sign all items on sheet.
3. Furnace installer to provide written confirmation that furnaces are sloped properly for heat exchangers as well as drip pans are sloped to outfall drain.

END OF SECTION

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SECTION 23 6214

COMPRESSOR UNITS: Air Conditioning (5 Ton or less)

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install compressor units as described in contract documents.

B. Related Sections:
   1. Section 23 0501: 'Common HVAC Requirements'.
   2. Section 23 2300: 'Refrigerant Piping'.
   3. Section 23 5417: 'Gas-Fired Furnaces'.

1.2 REFERENCES

A. Definitions:
   1. Compressor: Pump that increases vapor (refrigerant or air) pressure from one level to a higher level of pressure.
   2. Compressor Unit: Outside section of an air conditioning system which pumps vaporized refrigerant from the evaporator, compresses it, liquefies it in the condenser and returns it to the evaporator coil. The outdoor portion of a split system air conditioner contains the compressor and outdoor coil.
   3. Condenser: Device used to condense refrigerant in a cooling system.
   4. Condenser Coils: In a compressor unit, the coil dissipates heat from the refrigerant, changing the refrigerant from vapor to liquid.
   5. Refrigerant: Absorbs heat by a change of state (evaporation) from liquid to a gas, and releases heat by a change of state (condenses) from gas back to a liquid.
   6. SEER (Seasonal Energy Efficiency Ratio): Measure of cooling efficiency for air conditioners and heat pumps. A ratio of total cooling in comparison to electrical energy input in watts per hour. Higher the seer, the more energy efficient the unit. Since 2006, the minimum SEER required by the Department of Energy is 13.00 and 15.00+ SEER is considered high efficiency.
   7. Split System: Combination of an outdoor unit (air conditioner or heat pump) with an indoor unit (furnace or air handler). Split systems must be matched for optimum efficiency.

B. Reference Standards:
   1. Air-Conditioning, Heating, and Refrigeration Institute:
      a. AHRI Standard 210/240-2017, ‘Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump Equipment’ (formerly ARI Standard 210/240).
   2. American National Standards Institute / American Society of Heating, Refrigerating and Air-Conditioning Engineers:
      a. ANSI/ASHRAE 15-2016 and 34-2016, 'Safety Standard and Designation and Classification of Refrigerants'.

1.3 SUBMITTALS

A. Informational Submittals:
   1. Tests and Evaluation Reports:
      a. Manufacturer Reports: Equipment check-out sheets.

B. Special Procedure Submittals:
   1. Installer must register with Manufacturer before submitting Manufacturer Warranty:

a. Installer to contact Owner's Representative (FM Group or Project Manager) for following MANDATORY information to be given to Manufacturer before Manufacturer will issue Manufacturer's 'Special Church Warranty' included with Closing Submittal:
   1) This must be given to Manufacturer:
      a) Name of Owner (name of FM Group) ____Calgary AB FM Group_____
      b) Mailing Address (FM office address) _7040 Farrell Road SE, Room 109, Calgary, Alberta, T0K 2N0____
      c) Building Property ID (unique 7 digit identifier) ____500-7688_____
      d) Project site address: ___530 Seton Passage SE, Calgary, AB_____
      e) Model Number of each Unit _____
      f) Serial Number of each Unit _____
      g) Date of Installation / Startup _____

2. Qualification Statements:
   a. Technician certificate for use in R410a refrigerants.

C. Closeout Submittals:
1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
   a. Warranty Documentation:
      1) Final, executed copy of Manufacturer's 'Special Church Warranty' including required Owner / Manufacturer mandatory information.
   b. Record Documentation:
      1) Manufacturers Documentation:
         a) Equipment checkout sheet: Complete and sign all items for each unit.

1.4 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
1. Each unit shall be UL / ULC or ETL labeled.
2. Comply with ANSI/AHRI Standard 210/240.
3. Refrigeration compressor, coils, and specialties shall be designed to operate with CFC·free refrigerants.

B. Qualifications. Section 01 4301 applies, but is not limited to the following:
1. Installer: Refrigerant piping shall be installed by refrigeration contractor licensed by Province and by technicians certified in use of R410a refrigerants.

1.5 WARRANTY

A. Manufacturer's Warranty:
1. Provide Manufacturer's 'Special Church Warranty' for the following:
   a. Provide ten (10) year limited warranty on compressor.
   b. Provide five (5) year limited warranty on parts from date of 'start-up'.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Manufacturers:
1. Manufacturer Contact List:
   a. Lennox Industries:
      1) For pricing and information call Lennox National Account at (800) 367-6285.
      2) Lennox National Contact: Cody Jackson (801) 736-8904 Cody.Jackson@LennoxInd.com.
   b. York International:
      1) Brian Michael (405) 419-6230 brian.k.michael@jci.com.

B. Performance:
   1. Capacities: SEER rating as defined by AHRI shall be 13.0 or greater.

C. Manufactured Units:
   1. Compressor Units (5 Tons or Less):
      a. General:
         1) Units shall be operable down to 0 deg F outdoor temperature.
         2) Use R-410a refrigerant.
         3) Only one liquid line, one suction line, and one power connection shall be made to each compressor. Provide charging valves.
      b. Condenser Coils:
         1) Aluminum plate fins mechanically bonded to seamless copper tubes or 'Spine Fin' trade mark system which has aluminum fins epoxy bonded to aluminum tubes or micro-channel.
         2) Provide stamped louver coil guard for unit.
      c. Fans:
         1) Direct driven propeller type.
         2) Fan motor shall be single or two speed, thermostatically controlled, permanently lubricated, and designed with permanent protection.
         3) Motors shall be resiliently mounted.
         4) Each fan shall have a safety guard.
      d. Compressor:
         1) Each condenser unit shall have only one compressor.
         2) Design with following features:
            a) Externally mounted brass service valves with charging connections.
            b) Crankcase heater.
            c) Resilient rubber mounts.
            d) Compressor motor-overload protection.
            e) Single speed.
      e. Controls:
         1) Factory wired and located in separate enclosure.
         2) Following three paragraphs may not be factory installed and will therefore have to be field installed.
         3) Safety devices:
            a) High and low pressure cutout.
            b) Condenser fan motor-overload devices.
         4) Anti-cycle timers to prevent units from starting up again for five minutes after any power interruption.
         5) Head pressure type low ambient kit.
      f. Casing:
         1) Fully weatherproof for outdoor installation. Finish shall be weather resistant.
      g. Openings shall be provided for power and refrigerant connections.
      h. Panels shall be removable for servicing.
      i. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
         1) Lennox: equal
         2) York: TCG.
         3) See Schedule in Drawings.

2.2 ACCESSORIES

A. Vibration Isolators:
   1. 4 inches square by 3/4 inch thick minimum neoprene type vibration isolation pads.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification Of Conditions:
   1. Notify Architect of unsuitable conditions in writing
   2. Commencement of Work by Installer is considered acceptance of substrate.

3.2 INSTALLATION

A. General:
   1. Set compressor units level on concrete slab on vibration isolation pads located at each corner of unit.

3.3 FIELD QUALITY CONTROL

A. Manufacturer Services:
   1. Compressor units shall be started up, checked out, and adjusted by compressor unit Installer.
   2. Use equipment checkout sheet provided by Manufacturer:
      a. Complete and sign all items on sheet.

END OF SECTION

SECTION 23 7223

PACKAGED AIR-TO-AIR ENERGY RECOVERY UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install air-to-air Energy Recovery Ventilation units as described in Contract Documents

B. Related Requirements:
   1. Section 23 0501: 'Common HVAC Requirements'.
   2. Section 23 3114: 'Low-Pressure Metal Ducts'.
   3. Section 23 4100: 'Air filters'.

1.2 REFERENCES

A. Reference Standard:
   1. American National Standards Institute (ANSI) / American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
      a. ANSI/ASHRAE 84-2013, 'Method of Testing Air-to-Air Heat/Energy Exchangers'.
   2. National Fire Protection Association / American National Standards Institute:
      a. NFPA 90A: ‘Standard for the Installation of Air-Conditioning and Ventilating Systems' (2018 Edition).
      b. NFPA 90B: ‘Standard for the Installation of Warm Air Heating and Air-Conditioning Systems' 2018 Edition).

1.3 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. ASHRAE Compliance:
      a. Capacity ratings for air-to-air energy recovery equipment shall comply with ANSI/ASHRAE 84, 'Method of Testing Air-to-Air Heat Exchangers'.

1.4 WARRANTY

A. Special Warranty:
   1. Warranty energy transfer element for ten years from date of substantial completion of Project.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Category Four Approved Manufactures. See Section 01 6200 for definitions of Categories:
   1. RenewAire LLC, Madison, WI www.renewaire.com.
   2. See Schedule in Drawings.

2.2 MANUFACTURED UNITS

A. Energy Recovery Units:
   1. Basis of Design Product:
      a. Basis of design for this Project is Energy Recovery Ventilation by RenewAire (model number(s) as shown on Contract Drawings).
   2. Performance:
      a. Capacities:
         1) Element rated by Manufacturer using method described in ANSI/ASHRAE 84. Exceed 70 percent temperature efficiency.
         2) Applicable for range of ventilation up to 1100 CFM in each air stream without disposition of dust in elements.
   3. Construction:
      a. Fixed plate element.
      b. 20 ga galvanized steel case with lapped corners.
      c. Leveling legs.
      d. Access door to blowers, energy transfer elements, and filters.
         1) Gasketed to provide air tight seal.
         2) Insulated with 1/4 inch Rubatex.
         3) Attached to unit using stainless steel fasteners.
   4. Duct Openings: Four each 1/2 inch by 1/2 inch square duct collars suitable for connection to duct work.
   5. Duct Openings: Four each 12 inch round duct collars suitable for connection to duct work.
   6. Blowers:
      a. Forward curved blades directionally driven by open, drip-proof PSC motor rated for continuous duty.
      b. Motor: 2-3/4 horse power, 115 VAC, single phase, 60 hertz.
      c. Baked enamel finish.
   7. 24 VAC control voltage.
   8. Vibration isolation suspension.

2.3 SOURCE QUALITY CONTROL

A. Tests:
   1. Provide evidence of independent testing of core by Underwriters Laboratory (UL), verifying maximum flame spread index (FSI) of 25 and maximum smoke development index (SDI) of 50. Meet NFPA 90A and NFPA 90B requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Basis of Design Product:
   1. RenewAire:
      a. Suspend and Vibration isolate Energy Recovery Units from structure.
      b. Coordinate with Control Drawings.
      c. Coordinate motorized dampers and balancing dampers with Drawings and details.

END OF SECTION

SECTION 23 8333

ELECTRIC RADIANT HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install wall heaters with remote T-Stat Control as described in Contract Documents.

B. Related Requirements:
   1. Section 23 0501: 'Common HVAC Requirements'.
   2. Division 26: Electrical service and connections.

1.2 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Units shall be ULC listed and comply with CEC and CSA.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Manufacturers:
   1. Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
      a. Berko, Marley Electric Co, Bennettsville. SC www.berkomeh.com.
      b. QMark, Marley Electric Co, Bennettsville, SC www.qmarkmeh.com.
      c. Raywall, Johnson, TN www.raywall.com.
      d. Chromalox.

B. Wall Heaters:
   1. Fan type and box for semi-recessed mounting in wall framing.
   2. Sheet metal casing – minimum 20ga (0.95mm).
   3. Heating element shall be encased in steel finned casting and protected by thermal switch.
   4. Fan motor shall be permanently lubricated, and dust protected bearings.
   5. Fan shall be vibration free.
   6. Units shall be controlled automatically by remote thermostat.
   7. ULC / CSA listed.
   8. Open coil element or enclosed in steel casing.
   9. Thermal cutout with indicator light and one time thermal fuse.
   10. Finish: White - Baked-on enamel.
   11. Design Standard: Chromalox RFI840D21 / RFLVC21.

PART 3 - EXECUTION: Not Used

END OF SECTION

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DIVISION 26: ELECTRICAL

26 0500 COMMON WORK RESULTS FOR ELECTRICAL

26 0501 COMMON ELECTRICAL REQUIREMENTS
26 0503 ELECTRICAL UTILITY SERVICES
26 0519 LINE-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
26 0523 CONTROL-VOLTAGE ELECTRICAL CABLES
26 0526 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
26 0533 RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS
26 0613 ELECTRICAL EQUIPMENT MOUNTING HEIGHT SCHEDULE
26 0924 LIGHTING CONTROL SYSTEM

26 2000 LOW-VOLTAGE ELECTRICAL TRANSMISSION

26 2417 CIRCUIT-BREAKER PANELBOARDS
26 2726 WIRING DEVICES
26 2816 ENCLOSED SWITCHES AND CIRCUIT BREAKERS

26 4000 ELECTRICAL PROTECTION

26 4100 FACILITY LIGHTNING PROTECTION
26 4301 SURGE PROTECTIVE DEVICES

26 5000 LIGHTING

26 5100 INTERIOR LIGHTING
26 5121 INTERIOR LIGHTING: LED DIMMING DRIVERS
26 5200 EMERGENCY LIGHTING
26 5600 EXTERIOR LIGHTING

END OF TABLE OF CONTENTS

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SECTION 26 0501

COMMON ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes but Not Limited to:
   1. General electrical system requirements and procedures.
   2. Perform excavating and backfilling work required by work of this Division as described in Contract Documents.
   3. Make electrical connections to equipment provided under other Sections.
   4. Furnish and install Penetration Firestop Systems at electrical system penetrations as described in Contract Documents.

B. Products Furnished but Not Installed Under This Section:
   1. Anchor bolts and templates for exterior lighting equipment bases.

C. Related Requirements:
   1. Section 07 8400: 'Firestopping' for quality of Penetration Firestop Systems to be used on Project and submittal requirements.
   2. Section 31 2316: 'Excavation' for criteria for performance of excavating.
   3. Section 31 2323: 'Fill' for criteria for performance of backfilling.

1.2 REFERENCES

A. Reference Standards:
   1. National Fire Protection Association / American National Standards Institute:
      a. NFPA 70, 'National Electrical Code (NEC)' (2017 or most recent edition adopted by AHJ).
   2. National Electrical Manufacturing Association Standards (NEMA):
      a. NEMA 250-2018, 'Enclosure for Electrical Equipment (1000 Volts Maximum)'.
      b. CEC 2018
      c. ABC 2019

1.3 SUBMITTALS

A. Action Submittals:
   1. Product Data:
      a. Provide following information for each item of equipment:
         1) Catalog Sheets.
         2) Assembly details or dimension drawings.
         3) Installation instructions.
         4) Manufacturer's name and catalog number.
         5) Name of local supplier.
      b. Furnish such information for following equipment:
         1) Section 26 2417: 'Circuit-Breaker Panelboards'.
         2) Section 26 2726: 'Wiring Devices' for lighting control and dimmer equipment.
         3) Section 26 2816: 'Enclosed Switches And Circuit Breakers'.
         4) Section 26 5100: 'Interior Lighting Fixtures'.
         5) Section 26 5200: 'Emergency Lighting' for battery units.
         6) Section 26 5600: 'Exterior Lighting' for fixtures, poles, and associated control equipment.
      c. Do not purchase equipment before approval of product data.
   2. Shop Drawings:

a. Submit on Panelboards:
b. Indicate precise equipment to be used, including all options specified. Indicate wording and format of nameplates where applicable. Submit in three-ring binder with hard cover.

B. Informational Submittals:
1. Test and Evaluation Reports:
a. Report of site tests, before Substantial Completion.
2. Qualification Statement:
a. Electrical Subcontractor:
1) Provide Qualification documentation if requested by Architect or Owner.
b. Installer:
1) Provide Qualification documentation if requested by Architect or Owner.

C. Closeout Submittals:
1. Include following in Operations and Maintenance Manual specified in Section 01 7800:
a. Operations and Maintenance Data:
1) Provide operating and maintenance instructions for each item of equipment submitted under Product Data.
b. Record Documentation:
1) Manufacturers documentation:
a) Manufacturer's literature.
b) Include copy of approved shop drawings.
c) One year warranty letter dated 45 days post substantial completion.

1.4 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
1. NEC and local ordinances and regulations shall govern unless more stringent requirements are specified.
2. Material and equipment provided shall meet standards of NEMA or UL, or ULC, CSA, or EEMAC and bear their label wherever standards have been established and label service is available.

B. Qualifications: Requirements of Section 01 4301 applies, but not limited to following:
1. Electrical Subcontractor:
a. Company specializing in performing work of this section.
1) Minimum five (5) years' experience in electrical installations.
2) Minimum five (5) satisfactorily completed installations in past three (3) years of projects similar in size, scope, and complexity required for this project before bidding.
b. Upon request, submit documentation.
2. Installer:
a. Licensed for area of Project.
b. Designate one (1) individual as project foremen who shall be on site at all times during installation and experienced with installation procedures required for this project.
c. Upon request, submit documentation.

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Performance:
1. Design Criteria:
a. Materials and equipment provided under following Sections shall be by same Manufacturer:
1) Section 26 2417: Panelboards.
2) Section 26 2816: Enclosed Switches and Circuit Breakers.

PART 3 - EXECUTION

3.1 INSTALLERS

A. Acceptable Installers:
   1. Meet Quality Assurance Installer Qualifications as specified in Part 1 of this specification.

3.2 EXAMINATION

A. Verification of Conditions:
   1. Confirm dimensions, ratings, and specifications of equipment to be installed and coordinate these with site dimensions and with other Sections.

3.3 INSTALLATION

A. General:
   1. Locations of electrical equipment shown on Drawings are approximate only. Field verify actual locations for proper installation.
   2. Coordinate electrical equipment locations and conduit runs with those providing equipment to be served before installation or rough in.
      a. Notify Architect of conflicts before beginning work.
      b. Coordinate locations of power and lighting outlets in mechanical rooms and other areas with mechanical equipment, piping, ductwork, cabinets, etc, so they will be readily accessible and functional.
   3. Work related to other trades which is required under this Division, such as cutting and patching, trenching, and backfilling, shall be performed according to standards specified in applicable Sections.
   4. Electrical tender price shall be based on all drawings not electrical alone. If discrepancies occur between drawings the higher cost option will be assumed for the tender submission.

B. Install Penetration Firestop System appropriate for penetration at electrical system penetrations through walls, ceilings, and top plates of walls.

3.4 FIELD QUALITY CONTROL

A. Field Tests:
   1. Test systems and demonstrate equipment as working and operating properly. Notify Architect before test. Rectify defects at no additional cost to Owner.
   2. Measure current for each phase of each motor under actual final load operation, i.e. after air balance is completed for fan units, etc. Record this information along with full-load nameplate current rating and size of thermal overload unit installed for each motor.

3.5 CLOSEOUT ACTIVITIES

A. Training:
   1. Provide competent instructor for eight (8) hours to train Owner's maintenance personnel in operation and maintenance of Electrical Equipment and Systems. Factory representatives shall assist this instruction as necessary. Schedule instruction period at time of final inspection.

END OF SECTION

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SECTION 26 0503

ELECTRICAL UTILITY SERVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Includes but Not Limited To:
   1. Furnish and install service as described in Contract Documents and as required by local serving agency.
   2. Complete cost of service.

B. Related Requirements:
   1. Section 26 0501: Common Electrical Requirements.
   2. Local Utility shall furnish and install primary underground service including transformer, conductors, ground grid, current transformers, metering conductors, and meter.
   3. See Electrical Site Plan SD301 for scope of work.
   4. Contractor to provide secondary service to building, and coordinate with Local Utility for primary service installation and schedule.

PART 2 - PRODUCTS: Not Used

PART 3 - EXECUTION

3.1 INSTALLATION

A. Interface with Other Work: Coordinate with serving agency on all items, especially service entrance fittings, meter sockets, and current transformer (C/T) boxes where required.

END OF SECTION

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SECTION 26 0519

LINE-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Quality of conductors used on Project except as excluded below.

B. Related Requirements:
   1. Section 23 0933: 'Electric and Electronic Control System for HVAC' for conductors and cables for temperature control system.
   2. Section 26 0501: 'Common Electrical Requirements'.

1.2 REFERENCES

A. Definitions:
   1. Line Voltage: Over 70 Volts.

B. Reference Standards:
   1. National Fire Protection Association:
      a. NFPA 70, 'National Electric Code (NEC)' (2017 or most recent edition adopted by AHJ including all applicable amendments and supplements).
      b. CEC 2018
      c. ABC 2019
      d. Can ULC S 524

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Line Voltage Conductors:
   1. Copper with AWG sizes as shown:
      a. Minimum size shall be No. 12 except where specified otherwise.
      b. Conductor size No. 8 and larger shall be stranded.
   2. Insulation:
      a. Standard Conductor Size No. 10 And Smaller: 600V type THWN or XHHW (75 deg F (24 deg C)).
      b. Standard Conductor Size No. 8 And Larger: 600V Type THW, THWN, or XHHW (75 deg F (24 deg C)).
      c. Higher temperature insulation as required by NFPA 70 or local codes.
   3. Colors:
      a. 208Y / 120 V System:
         1) Black: Phase A.
         2) Red: Phase B.
         3) Blue: Phase C.
         4) Green: Ground.
         5) White: Neutral.
      b. 480Y / 277 Volt System:
         1) Brown: Phase A.
         2) Orange: Phase B.
         3) Yellow: Phase C.

4) Gray: Neutral.
5) Green: Ground.

c. Conductors size No. 10 and smaller shall be colored full length. Tagging or other methods for coding of conductors size No. 10 and smaller not allowed.
d. For feeder conductors larger than No. 10 at pull boxes, gutters, and panels, use painted or taped band or color tag color-coded as specified above.
e. Conductors feeding VFD's from motor to VFD shall be VFD rated 1000Volt.

B. Line Voltage Cables:
1. Non-Metallic Sheathed Cable (NMD-7) and Metal Clad Cable (MC) may be used as restricted below:
a. Copper conductors.
b. Sizes #12 through #8.
c. Use only in indoor dry locations where:
1) Not subject to damage.
2) Not in contact with earth.
d. Not in concrete.
e. Not where exposed or not concealed.
f. Not over suspended ceilings.
g. As restricted by NFPA 70 Article 334.
h. In concealed spaces only.(Walls)

C. Cord Sets for Ranges: Three pole, 4 wire grounding, 125/250V, NEMA 14-50P plug, 48 inch (1 200 mm) cord length minimum.

D. Standard Connectors:
1. Conductors No. 8 And Smaller: Steel spring wire connectors.
2. Conductors Larger Than No. 8: Pressure type terminal lugs.
3. Connections Outside Building: Watertight steel spring wire connections with waterproof, non-hardening sealant.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
1. Conductors and cables shall be continuous from outlet to outlet.
2. Do not use direct burial cable.

B. Line Voltage Conductors:
1. Install conductors in raceway where indicated on Contract Drawings. Run conductors of different voltage systems in separate conduits.
2. Route circuits at own discretion, however, circuiting shall be as shown in Panel Schedules. Group circuit homeruns to panels as shown on Contract Drawings.
3. Neutrals:
a. On three-phase, 4-wire systems, do not use common neutral for more than three circuits.
b. On single-phase, 3-wire systems, do not use common neutral for more than two circuits.
c. Run separate neutrals for each circuit where specifically noted on Contract Drawings.
d. Where common neutral is run for two or three home run circuits, connect phase conductors to breakers in panel which are attached to separate phase legs:
1) Provide breaker tie so that all circuits that share common neutral are simultaneously disconnected.
2) Neutral conductors shall be of same size as phase conductors unless specifically noted otherwise.
4. Pulling Conductors:
a. Do not pull conductors into conduit until raceway system is complete and cabinets and outlet boxes are free of foreign matter and moisture.

b. Do not use heavy mechanical means for pulling conductors.
c. Use only listed wire pulling lubricants.

C. Line Voltage Cables:
1. Route circuits at own discretion, however, circuiting and numbering shall be as shown in Panel Schedules.
2. Support cables using approved staples, cable ties, straps, hangers, or similar fittings, spaced as required.
3. Where installing in framing, do not bore holes in joists or beams outside center 1/3 of member depth or within 24 inches (600 mm) of bearing points. Do not bore holes in vertical framing members outside center 1/3 of member width. Holes shall be one inch diameter maximum.
4. Conceal cables within ceilings and walls of finished areas. Cables may be exposed in unfinished areas but not run on floors of mechanical equipment spaces or in such a way that they obstruct access to, operation of, or servicing of equipment.
5. Install exposed cables parallel to or at right angles to building structure lines.
6. Keep cables 6 inches (150 mm) minimum from hot water pipes.
7. Do not support cables from mechanical ducts or duct supports without Architect's written approval.
8. Prohibited procedures:
   a. Boring holes for installation of cables in vertical truss members.
   b. Notching of structural members for installation of cables.
9. Coordinate wiring route with HVAC duct drop locations.

END OF SECTION

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SECTION 26 0523

CONTROL-VOLTAGE ELECTRICAL CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install control-voltage electrical cables as described in Contract Documents.

B. Related Requirements:
   1. Section 23 0933: 'Electric And Electronic Control System For HVAC' for cables for Temperature Control System cables.
   2. Section 26 0501: 'Common Electrical Requirements'.
   3. Section 26 0924: 'Lighting Control System'.
   4. Section 27 1116: 'Communications Cabinets, Racks, Frames, and Enclosures'.
   5. Section 27 1501: 'Communications Horizontal Cabling' for voice and data system cables.
   6. Section 27 4117: 'Video Systems' for cables.
   7. Section 27 5117: 'Audio Systems' for cables.
   8. Section 28 3101: 'Fire Detection And Alarm System' for cables.

1.2 REFERENCES

A. Definitions:
   1. Control Voltage: 70 Volts and under.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Manufacturers:
   1. Category Four Approved Cable Manufacturers. See Section 01 6200 for definitions of Categories:
      a. Alpha Wire Co, Elizabeth, NJ www.alphawire.com.
      b. Belden Wire & Cable Co, Richmond, IN www.belden.com.
      c. Liberty Wire & Cable, Colorado Springs, CO www.libertycable.com.
      d. West Penn Wire Corp, Washington, PA www.westpenn-cdt.com.

B. Components:
   1. Building Control System Cables.
      a. CAT 6 plenum rated, 24 AWG, solid bare copper, four pair, UTP, white cable jacket.
      b. Sheath Colors:
         1) Lighting Control: Yellow.
      c. Meet requirements of EIA / TIA 568 Standard.
   2. Lighting Control Cables and Conductors:
      a. Provide cable per Lighting Control Panel Manufacturer's recommendations and requirements.
      b. Lighting Control Cables ran in same raceway as line voltage cables shall have same insulation voltage rating as line voltage conductors.
      c. Cable Jacket shall be yellow.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
1. Cables shall be continuous and without splices from source to outlet.
2. Conceal cables within ceilings and walls of finished areas. Cables may be exposed in unfinished areas but not run on floors of mechanical equipment spaces or in such a way that they obstruct access to, operation of, or servicing of equipment unless otherwise indicated in Contract Drawings.
3. Run exposed and armored cables parallel to or at right angles to building structure lines.
4. Keep cables 6 inch (150 mm) minimum from hot water pipes.
5. Support cables using approved staples, cable ties, straps, hangers, or similar fittings spaced every 3 feet (900 mm).
6. Where installing in framing, do not bore holes in joists or beams outside center 1/3 of member depth or within 24 inches (600 mm) of bearing points. Do not bore holes in vertical framing members outside center 1/3 of member width. Holes shall be 1/2 inch (13 mm) diameter maximum.
7. Bundle only cables of same systems together.
8. Do not run cables within 10 inches (255 mm) of line voltage conductors/raceways.
9. Extend cables 18 inches (450 mm) from wall or ceiling at all outlet locations. Extend cables to twice vertical length of cabinet at each cabinet location.
10. Pulling cables into conduit:
    a. Do not pull cables until raceway system is complete and cabinets and outlet boxes are free of foreign matter and moisture.
    b. Do not use heavy mechanical means for pulling cables.
    c. Use only listed wire pulling lubricants.
11. Prohibited procedures:
    a. Boring holes for installation of cables in vertical truss members.
    b. Notching of structural members for installation of cables.

B. Control Cables:
1. For cables not installed in raceway, do not run cables within 10 inches (255 mm) of line voltage conductors / raceways. Also, maintain 10 inches (255 mm) minimum between following exposed cable groups:
    a. Microphone cables.
    b. CAT-6, sound system control, telephone, video, or ATC cables.
    c. Loudspeaker cables.

END OF SECTION

SECTION 26 0526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install grounding for electrical installation as described in Contract Documents except as excluded below.

B. Related Requirements:
   1. Section 03 3111: 'Cast-In-Place Structural Concrete'.
      a. Pre-installation conference held jointly with other concrete related sections.
   2. Section 26 0501: 'Common Electrical Requirements'.
   3. Section 26 4301: 'Surge Protection Devices'.

1.2 REFERENCES

A. Reference Standards:
   1. Institute of Electrical and. Electronics Engineers (IEEE):
      a. IEEE 837-2014, 'Standard for Qualifying Permanent Connections Used in Substation Grounding'.
      b. 2018 CEC
      c. 2019 ABC
   2. National Fire Protection Association:
      a. NFPA 70, 'National Electric Code (NEC)' (2017 or most recent edition adopted by AHJ including all applicable amendments and supplements).
      b. NFPA 780, 'Standard for the Installation of Lightning Protection Systems' (2014 or latest approved edition).
      c. Can ULC S524
   3. Telecommunications Industry Association:
      a. TIA-942 A, 'Telecommunications Infrastructure Standard for Data Centers' (2014).
   4. Section 27 1116: 'Communications Cabinets, Racks, Frames, and Enclosures'.
   5. Section 27 1501: 'Communications Horizontal Cabling' for cables for Telephone and Data Systems.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:
   1. Participate in pre-installation conference as specified in Section 03 3111.
   2. In addition to agenda items specified in Section 01 3100 and 31 3111, review following:
      a. Review Architect's inspection of grounding conductor installation before placement of concrete.

1.4 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Requirements of Section 27 1501 applies, but is not limited to following:
      a. Cable assemblies shall be UL / CE Listed and CSA Certified. Cables shall be a distinctive green or green/yellow in color, and all jackets shall be UL, VW-1 flame rated.

b. Grounding shall conform to all required Commercial Building Grounding and Bonding Requirements for Telecommunications, Electrical Codes, and Manufacturer's grounding requirements.
2. Systems shall be installed per NFPA 780 and NFPA 70.
3. All Bonds shall comply with most current version of IEEE 837 Standard.

B. Qualifications: Requirements of Section 01 4301 applies, but is not limited to following:
1. Installers Qualifications:
a. Grounding and Bonding:
1) Licensed electrical contractor shall perform installation and termination of main bonding conductor to building service entrance ground.
2) Licensed in Province that Work is to be performed.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Manufacturers:
1. Type One Acceptable Products:
a. 'Cadweld' by Erico International, Solon, OH www.erico.com.
b. 'ThermOweld' by Continental Industries, Tulsa, NE www.conind.com.
c. Equal as approved by Architect before bidding. See Section 01 6200.

B. Performance:
1. Design Criteria:
a. Size materials as shown on Drawings and in accordance with CEC 2018 and other local applicable codes.
b. Bonding System Workmanship:
1) The ground / earthing system shall be designed for high reliability and shall meet following criteria:
a) Local electrical codes shall be adhered to.
b) All grounding / earthing conductors shall be copper.
c) Regulatory Agency Sustainability Approvals requirements are required.
c. Rack and Cabinet Grounding / Earthing:
1) Equipment and racks shall be bonded in accordance with methods prescribed in TIA-942.
2) All grounding backbone should be #6 AWG copper cable.
3) In telecommunications spaces with small number of racks or cabinets, rack/cabinet grounding /earthing jumper cable directly to telecommunications ground bus is permitted. Large spaces shall utilize mesh Common Bonding network, or overhead grounding backbone.
4) Equipment racks, housings, messenger cables, and raceways:
a) Connect cabinets, racks, frames and terminal boards to single-point ground which is connected to building ground system proper sized, bonded and tested green insulated copper grounding conductor.

C. Materials:
1. Grounding And Bonding Jumper Conductors: Bare copper or with green insulation.
2. Make grounding conductor connections to ground rods and foundation ground loop using approved bolted clamps listed for such use.
3. Service Grounding Connections And Cable Splices: Make by exothermic process.
4. Telecommunications ground bus bar (TGB): copper.
a. Grounding bus bar:
1) Technology Room shall be provided with telecommunications ground bus bar (TGB).
2) Ground loop current potential is minimized between telecommunications equipment and electrical system to which it is attached.

b. All racks, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, etc. entering or residing in Technology Room shall be grounded to respective TGB using minimum #6 AWG stranded copper bonding conductor and compression connectors.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Interface With Other Work: Coordinate with Section 03 3111 in installing grounding conductor and placing concrete. Do not allow placement of concrete before Architect's inspection of grounding conductor installation.

B. Grounding conductors and bonding jumper conductors shall be continuous from terminal to terminal without splice. Provide grounding for following.
   1. Electrical service, its equipment and enclosures.
   2. Conduits and other conductor enclosures.
   3. Neutral or identified conductor of interior wiring system.
   4. Main panelboard, power and lighting panelboards.
   5. Non-current-carrying metal parts of fixed equipment such as motors, starter and controller cabinets, instrument cases, and lighting fixtures.
   6. Lightning protection down conductors including but not limited to conductor from steeple.
   7. All cables and conduits to contain ground wire.

C. Provide 10 foot copper ground rods minimum 3 looped with #3/0 bare copper or to meet current 2018 CEC code requirements back to main electrical service. Extend No. #2/0 copper conductor to main panel as shown on Drawings. Provide concrete-encased electrode system by embedding 20 feet (6.10 m) minimum of No. 2/0 bare copper conductor in concrete footing that is in direct contact with the earth, 2 inches (50 mm) minimum below concrete surface. Extend No. 2/0 copper conductor to main panel as shown on Drawings

D. Ground identified common conductor of electrical system at secondary side of main transformer supplying building. Ground identified grounded (neutral) conductor of electrical system on supply side of main service disconnect.

E. Pull grounding conductors in non-metallic raceways, in flexible steel conduit exceeding 72 inches (1 800 mm) in length, and in flexible conduit connecting to mechanical equipment.

F. Provide grounding bushings on all feeder conduit entrances into panelboards and equipment enclosures.

G. Bond conduit grounding bushings to enclosures with minimum #10 AWG conductor.

H. Connect equipment grounds to building system ground.
   1. Use same size equipment grounding conductors as Phased conductors up through #10 AWG.
   2. Use CEC Table 16 and section 10 and all other applicable sections for others unless noted otherwise in Drawings.

I. Run separate insulated grounding cable from each equipment cabinet to electrical panel. Do not use intermediate connections or splices. Affix directly to cabinet.

J. On motors, connect ground conductors to conduit with approved grounding bushing and to metal frame with bolted solderless lug.

K. Ground cabinet of transformers to conduit and ground wires, if installed. Bond transformer secondary neutral conductor to cabinet.

L. Ground buss shall be 1/4 inch (6.4 mm) thick x 2 inches (50 mm) high x 12 inches (305 mm) long installed with insulated standoffs at location directed and at all communication racks.

M. Ground rack to TGB using #6 copper conductor and compression connector.

3.2 FIELD QUALITY CONTROL

A. Field Inspections:
   1. Notify Architect for inspection two (2) days minimum before placing concrete over grounding conductor.
   2. Grounding Well integrity shall be tested separately for integrity.

END OF SECTION

SECTION 26 0533

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Quality of material and installation procedures for raceway, boxes, and fittings used on Project but furnished under other Divisions.
   2. Furnish and install raceway, conduit, and boxes used on Project not specified to be installed under other Divisions.
   3. Furnish and install air-vapor barrier boxes as described in Contract Documents.
   4. Furnish and install main electrical service raceway as described in Contract Documents and comply with electrical utility company requirements.
   5. Furnish and install main telephone service raceway as described in Contract Documents and comply with telephone company requirements.
   6. Furnish and install internet service raceway as described in Contract Documents and comply with internet service company requirements.

B. Related Requirements:
   1. See Section 07 8400: 'Firestopping' for raceways penetrating fire rated walls, ceilings, and barriers'.
   2. Section 23 0933: 'Electric and Electronic Control System for HVAC' for concealed raceway and extensions for temperature control system.
   3. Section 26 0501: 'Common Electrical Requirements' for general electrical requirements'.
   4. Section 26 0503: 'Electrical Utility Services' for electrical primary underground service requirements.
   5. Section 27 1501: 'Communications Horizontal Cabling' for raceway for telephone and data systems.
   6. Section 27 4117: 'Video Systems' for system wiring.
   7. Section 27 5117: 'Audio Systems' for sound system wiring.
   8. Section 28 3101: 'Fire Detection And Alarm System' for clarification of raceway and conduit requirements for detection and alarm system.

1.2 REFERENCES

A. Reference Standards:
   1. National Fire Protection Association:
      a. NFPA 70, 'National Electric Code (NEC)' (2017 or most recent edition adopted by AHJ including all applicable amendments and supplements).
   2. CEC 2018
   3. ABC 2019

PART 2 - PRODUCTS

2.1 SYSTEM

A. Manufacturers:
   1. Manufacturer Contact List:
      a. Cooper B-Line, Highland, IL www.b-line.com.
      b. Hubbell Incorporated, Milford, CT www.hubbell-wiring.com or Hubbell Canada Inc, Pickering, ON (905) 839-4332.

c. Square D, Palatine, IL www.squared.com.
d. Thomas & Betts, Memphis, TN www.tnb.com or Thomas & Betts Ltd, Iberville, PQ (450) 347-5318.
e. Walker Systems Inc, Williamstown, WV (800) 240-2601 or Walker Systems Inc / Wiremold Canada Inc, Fergus, ON (519) 843-4332.
f. Wiremold Co, West Hartford, CT www.wiremold.com.

B. Materials:
1. Raceway And Conduit:
a. Sizes:
1) 3/4 inch (19 mm) for exterior use, unless indicated otherwise.
2) 1/2 inch (13 mm) for interior use, unless indicated otherwise.
b. Types: Usage of each type is restricted as specified below by product.
1) Galvanized rigid steel or galvanized intermediate metal conduit (IMC) is allowed for use in all areas. Where in contact with earth or concrete, wrap buried galvanized rigid steel and galvanized IMC conduit and fittings completely with vinyl tape.
2) Galvanized Electrical Metallic Tubing (EMT), Flexible Steel Conduit, and Metal Clad Cable (MC):
a) Allowed for use only in indoor dry locations where it is:
(1) Not subject to damage.
(2) Not in contact with earth.
(3) Not in concrete.
b) For metal conduit systems, flexible steel conduit is required for final connections to indoor mechanical equipment.
3) Schedule 40 Polyvinyl Chloride (PVC) Conduit:
a) Allowed for use only underground or below concrete with galvanized rigid steel or IMC elbows and risers.
4) Listed, Liquid-Tight Flexible Metal Conduit:
a) Use in outdoor final connections to mechanical equipment, length not to exceed 36 inches (900 mm).
5) Pre-wired 3/8 Inch (9.5 mm) Flexible Fixture Whips: Allowed only for connection to recessed lighting fixtures, lengths not to exceed 72 inches (1 800 mm).
c. Prohibited Raceway Materials:
1) Aluminum conduit.
2) Armored cable type AC (BX) cable.
2. Raceway And Conduit Fittings:
a. Rigid Steel Conduit And IMC: Threaded and designed for conduit use.
b. EMT:
1) Compression type.
2) Steel set screw housing type.
c. PVC Conduit:
1) PVC type. Use PVC adapters at all boxes.
2) PVC components, (conduit, fittings, cement) shall be from same Manufacturer.
d. Flexible Steel Conduit: Screw-in type.
e. Liquid-tight Flexible Metal Conduit: Sealtite type.
f. Expansion fittings shall be equal to OZ Type AX sized to raceway and including bonding jumper.
g. Prohibited Fitting Materials:
1) Crimp-on, tap-on, indenter type fittings.
2) Cast set-screw fittings for EMT.
3) Spray (aerosol) PVC cement.
3. Outlet Boxes:
a. Galvanized steel of proper size and shape are acceptable for all systems. Where metal boxes are used, provide following:
1) Provide metal supports and other accessories for installation of each box.
2) Equip ceiling and bracket fixture boxes with fixture studs where required.
3) Equip outlets in plastered, paneled, and furred finishes with plaster rings and extensions to bring box flush with finish surface.
b. Non-metallic boxes may be used only for control voltage wiring systems.
c. Telephone / data outlet boxes shall be single device outlet boxes.

d. HVAC Instrumentation And Control:
   1) Junction boxes in mechanical equipment areas shall be 4 inches (100 mm) square.
   2) Boxes for remote temperature sensor devices shall be recessed single device.
   3) Boxes for thermostats shall be 4 inches (100 mm) square with raised single device cover.

4. Air-Vapor Barrier Boxes:
   a. Pre-molded polyethylene box installed in all exterior framing walls (thermal envelope) around recessed outlet boxes.
   b. Class Two Quality Standard:
      1) Approved Manufacturer. See Section 01 6200 for definitions of Classes.
         a) Lessco Low Energy Systems Supply Company, Inc., Campbellsport, WI www.lessco-airtight.com.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification Of Conditions:
   1. Confirm dimensions, ratings, and specifications of materials to be installed and coordinate these with site dimensions and with other Sections.

3.2 INSTALLATION

A. Interface With Other Work:
   1. Coordinate with Divisions 22 and 23 for installation of raceway for control of plumbing and HVAC equipment.
   2. Coordinate with Division 27 for installation of raceway for sound system.
   3. Before rough-in, verify locations of boxes with work of other trades to ensure that they are properly located for purpose intended.
      a. Coordinate location of outlet for water coolers with Division 22.
      b. Coordinate location of outlets adjacent to or in millwork with Division 06 before rough-in. Refer conflicts to Architect and locate outlets under his direction.
   4. Install pull wires in raceways installed under this Section where conductors or cables are to be installed under other Divisions.

B. General:
   1. Sound system electrical components furnished by Division 27 and installed under this Section include following items:
      a. Speaker mounting rings.
      b. Speaker enclosures.

C. Conduit And Raceway:
   1. Conceal raceways within ceilings, walls, and floors, except at Contractor's option, conduit may be exposed on walls or ceilings of mechanical equipment areas and above acoustical panel suspension ceiling systems. Install exposed raceway runs parallel to or at right angles to building structure lines.
   2. Seal all raceways penetrating fire rated walls, ceilings and barriers. See Section 07 8400.
   3. Keep raceway runs 6 inches (150 mm) minimum from hot water pipes.
   4. Make no more than four quarter bends, 360 degrees total, in any conduit run between outlet and outlet, fitting and fitting, or outlet and fitting.
      a. Make bends and offsets so conduit is not injured and internal diameter of conduit is not effectively reduced.
      b. Radius of curve shall be at least minimum indicated by NFPA 70.
   5. Cut conduit smooth and square with run and ream to remove rough edges. Cap raceway ends during construction. Clean or replace raceway in which water or foreign matter have accumulated.

6. Install insulated bushings on each end of raceway 1-1/4 inches (32 mm) in diameter and larger, and on all raceways where cables emerge. Install expansion fittings where raceways cross building expansion joints.
7. Run two spare conduits from each new panelboard to ceiling access area or other acceptable accessible area and cap for future use.
8. Bend PVC conduit by hot box bender and, for PVC 2 inches (50 mm) in diameter and larger, expanding plugs. Apply PVC adhesive only by brush.
9. Installation In Framing:
   a. Do not bore holes in joists or beams outside center 1/3 of member depth or within 24 inches (600 mm) of bearing points. Do not bore holes in vertical framing members outside center 1/3 of member width.
   b. Holes shall be one inch (25 mm) diameter maximum.
10. Underground Raceway And Conduit:
    a. Bury underground raceway installed outside building 24 inches (600 mm) deep minimum.
    b. Bury underground conduit in planting areas 24 inches (600 mm) deep minimum.
11. Conduit And Raceway Support:
    a. Securely support raceway with approved straps, clamps, or hangers, spaced as required.
    b. Do not support from mechanical ducts or duct supports without Architect's written approval. Securely mount raceway supports, boxes, and cabinets in an approved manner by:
       1) Expansion shields in concrete or solid masonry.
       2) Toggle bolts on hollow masonry units.
       3) Wood screws on wood.
       4) Metal screws on metal.
12. Prohibited Procedures:
    a. Use of wooden plugs inserted in concrete or masonry units for mounting raceway, supports, boxes, cabinets, or other equipment.
    b. Installation of raceway that has been crushed or deformed.
    c. Use of torches for bending PVC.
    d. Spray applied PVC cement.
    e. Boring holes in truss members.
    f. Notching of structural members.
    g. Supporting raceway from ceiling system support wires.
    h. Nail drive straps or tie wire for supporting raceway.

D. Boxes:
1. Boxes shall be accessible and installed with approved cover.
2. Do not locate device boxes that are on opposite sides of framed walls in the same stud space. In other wall construction, do not install boxes back to back.
3. Locate boxes so pipes, ducts, or other items do not obstruct outlets.
4. Install outlets flush with finished surface and level and plumb.
5. Support switch boxes larger than two-gang with side brackets and steel bar hangers in framed walls.
6. At time of substantial completion, install blank plates on uncovered outlet boxes that are for future use.
7. Install air-vapor barrier boxes.
   a. Follow Manufacturer's installation instructions.
   b. Care should be taken to cut above grade vapor barrier and seal around recessed outlet boxes to minimize air infiltration.
   c. Pull flange of boot inside the plane of vapour barrier and then seal back to the vapour barrier to ensure a continuous, secured, seal.
8. Location:
   a. Install boxes at door locations on latch side of door, unless explicitly shown otherwise on Contract Drawings. Verify door swings shown on electrical drawings with architectural drawings, and report discrepancies to Architect before rough-in. Distance of box from jamb shall be 6 inches (150 mm) from door jamb.
   b. Properly center boxes located in walls with respect to doors, panels, furring, trim and consistent with architectural details. Where two or more outlets occur, space them uniformly and in straight lines with each other, if possible.
   c. Center ceramic tile boxes in tile.

E. Support speaker enclosures and mounting rings from structure or ceiling suspension system.

END OF SECTION

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SECTION 26 0613

ELECTRICAL EQUIPMENT MOUNTING HEIGHT SCHEDULE

PART 1 - GENERAL: Not Used

PART 2 - PRODUCTS: Not Used

PART 3 - EXECUTION

3.1 INSTALLATION

A. Unless otherwise indicated, mount center of outlets or boxes at following heights above finish floor. Refer special conditions to Architect before rough-in and locate outlet under his direction. Refer to Architectural elevations prior to roughen. Electrical drawing outlet locations for reference only and are not to be utilized for scaling purposes.

B. Mounting Heights:

1. HVAC:	
a. Temperature Control Junction Boxes:	As indicated on Drawings.
b. Thermostats not mounted in occupied space:	As indicated on Drawings.
c. Remote Temperature Sensors and thermostats mounted in occupied space:	
1) Wall-Mounted	50 inches (1 270 mm) to top.
d. Indoor Motor Disconnects:	60 inches (1 525 mm).
e. Outdoor Motor Disconnects:	As indicated on Drawings.
f. Motor Controls:	60 inches (1 525 mm).
2. Plumbing:	
a. Electric Water Cooler Outlets:	Mount so outlet and cord are hidden by water cooler and outlet is accessible for resetting for GFCI trip.
3. Electrical:	
a. Distribution Panels:	72 inches (1 830 mm) to top.
b. Receptacles:	18 inches (450 mm).
c. Wall Switches:	42 inches (1 065 mm).
d. Wall-Mounted Exit Lights:	90 inches (2 285 mm).
e. Emergency Lighting Units:	90 inches (2 285 mm).
f. Fire alarm devices as per code.	
4. Communications	
a. Sound Distribution System Components:	As indicated on Drawings.
b. Satellite Distribution System Components:	As indicated on Drawings.
c. TV Distribution System Components:	As indicated on Drawings.
d. Computer and TV:	18 inches (450 mm).
e. Telephone / Data Terminal Boards:	72 inches (1 800 mm) to top.
f. Telephones (wall type):	60 inches (1 500 mm).
g. Telephones (desk type):	18 inches (450 mm).
h. Telephone / Data (desk type):	18 inches (450 mm).
i. Data (desk type):	18 inches (450 mm).

END OF SECTION

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SECTION 26 0924

LIGHTING CONTROL SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install complete lighting control system as described in Contract Documents consisting of the following:
      a. Lighting Control Panel.
      b. Programmable Digital Control Switches.
   2. See Drawings for Lighting Control Diagrams.

B. Related Requirements:
   1. Section 26 0501: 'Common Electrical Requirements'.
   2. Section 26 0523: 'Control-Voltage Electrical Cables'.

1.2 REFERENCES

A. Definitions:
   1. Class A: Equipment has been tested and found to comply with limits for Class A digital device, pursuant to part 15 of FCC Rules. These limits provide reasonable protection against harmful interference when equipment is operated in commercial environment.

B. Reference Standards:
   1. Federal Communications Commission (FCC):
      a. Emission requirements for Class A applications.
   2. Underwriters Laboratories:
      a. UL 916, 'Energy Management Equipment' (2015).

1.3 SUBMITTALS

A. Informational Submittals:
   1. Certifications:
      a. Technician Certification that equipment has been installed, adjusted and tested in accordance with Manufacturer's recommendations.

B. Closeout Submittals:
   1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
      a. Operations and Maintenance Data:
         1) Equipment operation and maintenance manual(s).

1.4 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. All control equipment shall be in compliance with FCC emissions' standards in Part 15 Subpart J for Class A application.
   2. Programmable panelboards shall be UL listed under UL 916 Energy Management Equipment.

B. Qualifications:
   1. Manufacturer Qualifications:
      a. Manufacturer of assembly shall be manufacturer of major components with assembly.

b. Manufacturer of this equipment shall have minimum of five (5) years manufacturing experience.
2. Technician Qualifications:
a. Authorized by Manufacturer and trained.
b. Have thorough knowledge of software, hardware and system programming.

C. Certifications:
1. Provide Technician Certification that equipment has been installed, adjusted and tested in accordance with Manufacturer's recommendations.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery And Acceptance Requirements:
1. Equipment shall be delivered, handled and stored in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Manufacturers:
1. Type One Acceptable Manufacturer: Encillium Refer to Drawings for details.

B. Design Criteria:
1. Lighting Control System shall meet or exceed following capabilities:
a. Capable of switching for specific lighting zone for following:
1) Time-of-day scheduling
2) Daylight savings time adjustments.
3) Light level sensors.

C. Components:
1. Light Control Panel:
a. Enclosure/tub shall be NEMA 1 unless indicated otherwise on Drawings, sized to accommodate required components.
b. Cover shall have hinged and lockable door and be configured for flush mounting of panel.
c. Panel shall include power supply and interior assembly with motherboard and control electronics.
1) Interior construction shall provide isolation between line voltage and low voltage (class 2) wiring.
d. Panel shall be factory assembled and designed for disassembly for mounting enclosure first and reassembly after conduit installation.
e. Panel shall utilize mechanically held latching relays rated for 30A ballast load at 120/277VAC with 10,000A short circuit current rating and shall include contactor for exterior lighting control.
1) Visual LED status and manual override for each relay shall be included.
2) Daylightiing sensors.
f. Panel shall contain network clock/programmer and photocell control module for interface with interior and exterior photocell controls.
1) Network clock shall provide menu driven control for seven (7) day repeating schedules and holiday provisions.
2) Clock shall provide user selectable pre-programmed scenarios for: Scheduled on/off, Manual on/off, Scheduled off, and on/off when used with photocell control module.
g. Panel shall contain automation intelligence card for program, monitor, and control functions and group cards as required for control of groups of relays.
2. Programmable Digital Control Switches:
a. Programmable digital control switches shall be provided with number of control buttons as indicated on Contract Drawings.

1) Each button shall be capable of individual programming without use of computer or other programming device.
2) Each button shall be able to control individual relay or group of relays.
3) Individual buttons shall allow for permanent labeling.

b. Switches shall be illuminated for ease of location in dark.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
1. Install switches flush with wall, straight and level.
2. Permanently label switches as shown on drawing schedule in Contract Drawings.

B. Interface With Other Work:
1. Coordinate with appropriate Sections of Divisions 26.
2. Program system to meet the local energy code.

C. Space Control Requirements:
1. Unless relevant provisions of applicable local Energy codes are more stringent, provide minimum application of lighting controls as follows:
   a. Provide occupancy/vacancy sensors with Manual-ON/OFF functionality in all.
   b. Provide Manual-ON occupancy/vacancy sensors for any enclosed office, conference room, meeting room or classroom. For spaces with multiple occupants, or where line-of-sight may be obscured, provide ceiling-mounted sensors and Manual-ON switches, if necessary.

3.2 FIELD QUALITY CONTROL

A. Field Testing:
1. Manufacturer shall provide Manufacturer's authorized Technician to adequately test supplied equipment and software to ensure system performs as intended including the following:
   a. Test start-up system and confirm proper installation, operation, and adjustment of all system components.
2. Submit Certification in writing that equipment has been installed, adjusted and tested in accordance with Manufacturer's recommendations.

B. Non-Conforming Work: Non-conforming work as covered in the General Conditions applies, but is not limited to following:
1. Correct any work found defective or not complying with Contract Document requirements at no additional cost to the Owner.

3.3 CLOSE-OUT ACTIVITIES

A. Instruction of Owner:
1. Provide Manufacturer's authorized Technician training session for Owner's Representative(s) for demonstrating operation and programming of completed system.
   a. Training program shall include instructions on control system, programming, and other major components. Provide Manufacturer Manual(s) to be submitted to Owner to assist training.
   b. Training program shall include:
      1) System review of all system components and their function.
      2) System review of all management software and its function.
      3) Operator training to develop experience with control applications.
   c. Provide competent instructor for eight (8) hours to train Owner's maintenance personnel in operation and maintenance of Lighting Control systems. Schedule instruction period at time of final inspection.

END OF SECTION

SECTION 26 2417

CIRCUIT-BREAKER PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install circuit-breaker panelboards as described in Contract Documents.

B. Related Requirements:
   1. Section 26 0501: 'Common Electrical Requirements'.
   2. Section 26 4301: 'Surge Protection Devices'.

1.2 REFERENCES

A. Reference Standards:
   1. National Fire Protection Association:
      a. NFPA 70E: 'Standard for Electrical Safety in the Workplace' (2018 or most recent edition adopted by AHJ).
   2. CEC 2018
   3. ABC 2019

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Manufacturers:
   1. Manufacturer Contact List:
      a. Cutler-Hammer Inc, Pittsburgh, PA www.eatonelectric.com.
      b. General Electric Industrial Systems, Charlotte, NC www.geindustrial.com.
      c. Siemens Energy & Automation, Alphrata, GA www.sea.siemens.com.
      d. Square D Co, Palatine, IL www.us.squared.com.

B. Performance:
   1. Capacities:
      a. Panelboard:
         1) Minimum integrated equipment short circuit rating of 22,000 amperes for 120 / 208 Volts.
         2) Minimum integrated equipment short circuit rating of 50,000 amperes for 277 / 280 Volts.
         3) Rated for use as service entrance equipment.
      b. Lighting And Appliance Panelboards:
         1) Minimum integrated equipment short circuit rating of 10,000 amperes for 120 / 208 Volts.
         2) Minimum integrated equipment short circuit rating of 14,000 amperes for 277 / 480 Volts.

C. Material:
   1. Circuit-breaker type.
   2. Galvanized steel cabinets
   3. Bussing and lugs arranged as required.
   4. Multi-pole circuit-breakers shall be common trip.

5. Circuit-breakers shall be molded case thermal magnetic type with inverse time characteristics.
6. Main Panelboard:
   a. Surface-mounted and front accessible.
   b. Enclosures:
      1) Interior of Building:
         a) NEMA / CEMA Type 1.
   c. Minimum dimensions of 32 inches (800 mm) wide by 8 inches (200 mm) deep.
   d. Space designation on Drawings indicates bus hardware and panelboard capacity for future acceptance of one 100 Amp, three-pole circuit-breaker.
   e. See Drawings for maximum allowable size of Main Panel "M" to fit in Electrical 111.
   f. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      1) Type PRL4B by Cutler-Hammer.
      2) Spectra Series by General Electric.
      3) Type P4 by Siemens.
      4) I-Line by Square D.
7. Lighting And Appliance Panelboards:
   a. Plug-on or bolt-on breakers. Multi-pole breakers shall be common trip.
   b. Factory installed or provided circuit number identification for each breaker and space.
   c. Cabinets shall be locking type with no exposed latches or screws when door is closed. Key panels alike and provide minimum of three keys. Provide recessed cabinets with drywall flange.
   d. Minimum dimensions of 20 inches (500 mm) wide by 5-3/4 inches (146 mm) deep.
   e. Space designation on Drawings indicates bus hardware and panelboard capacity for future acceptance of one 20 Amp, single-pole circuit-breaker.
   f. Use equipment from same manufacturer as main panelboard.
   g. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      1) Type PRL1a by Cutler-Hammer.
      2) Type AL or AQ by General Electric.
      3) Type P1 by Siemens.
      4) Type NQOD by Square D.
8. Labels:
   a. All Switchboards shall be labeled with Arc-Flash Hazard Information per NFPA 70E 130.5 including:
      1) Nominal system voltage.
      2) Arc flash boundary.
      3) Available incident energy.
      4) Working distance.
      5) Minimum arc rating of clothing.
      6) Level of PPE.
      7) Complete Arc Flash and coordination study to be included in the distribution manufacturer's cost.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification Of Conditions:
   1. Examine wall framing and verify framing for proper spacing for installation of panelboard(s).
      a. Notify Architect of improper spacing in writing.

3.2 INSTALLATION

A. Label panelboards and each breaker in main panelboard with 1/16 inch (1.6 mm) thick laminated plastic composition material with contrasting color core. Engraved letters shall be 1/4 inch (6 mm) high.

B. Provide typewritten circuit schedules in lighting and distribution panelboards to identify panelboard and load served by each branch breaker.

C. Arrange conductors neatly within panelboards.

3.3 PROTECTION

A. Protect panelboards and interior components from paint, gypsum board compound, dirt, dust, and other foreign matter during construction.

B. Compress air clean out prior to completion.

END OF SECTION

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SECTION 26 2726

WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install wiring devices complete with plates as described in Contract Documents.

B. Related Requirements:
   1. Section 11 6624: 'Basketball Equipment' for motorized basketball backstop.
   2. Section 26 0501: 'Common Electrical Requirements'.
   3. Section 27 1116: 'Communications Cabinets, Racks, Frames, and Enclosures'.
   4. Section 27 1501: 'Communications Horizontal Cabling' for cables for telephone and data systems.
   5. Codes- CEC2018, ABC 2019, CSA,.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Manufacturers:
   1. Manufacturer Contact List:
      a. Cooper Wiring Devices, Peachtree City, GA www.cooperwiringdevices.com.
      b. General Electric Industrial Systems, Charlotte, NC www.geindustrial.com.
      c. Hubbell Building Automation, Austin, TX www.hubbell-automation.com.
      d. Hubbell Inc, Milford, CT www.hubbell-wiring.com or Hubbell Canada Inc, Pickering, ON (800) 263-4622 or (905) 839-4332.
      e. Hunt Control Systems Inc, Fort Collins, CO www.huntdimming.com.
      f. Intermatic Inc, Spring Grove, IL www.intermatic.com.
      g. IR-TEC America, Inc., Brea, CA www.irtec.com/en-ira/.
      h. Leviton Manufacturing Co, Little Neck, NY www.leviton.com or Leviton Manufacturing of Canada Ltd, Pointe-Claire, QB (800) 461-2002 or (514) 954-1840.
      i. Legrand, West Hartford, CT www.legrand.us.com or Vaughan, ON www.legrand.ca.com.
      j. Lutron Electronics Co Inc, Coopersburg, PA www.lutron.com.
      k. Ortronics, New London, CT www.ortronics.com.
      l. Paragon Electric Co Inc, Carol Stream, IL www.icca.invensys.com/paragon or Paragon Electric, Mississauga, ON (800) 951-5526 or (905) 890-5956.
      m. Pass & Seymour, Syracuse, NY www.passandseymour.com or Pass & Seymour Canada Inc, Concord, ON (905) 738-9195.
      n. Philips Lighting Co, Somerset, NJ www.lighting.philips.com/nam or Philips Lighting Canada, Scarborough, ON (416) 292-3000.
      o. Red Dot div of Thomas & Betts, Memphis, TN www.tnbcom.
      p. Schneider Electric North America, Palatine, IL www.schneider-electric.com (847) 397-2600.
      q. Sensorswitch, Wallingford, CT www.sensorswitch.com.
      r. Siemon Company, Watertown, CT www.siemon.com.
      s. Square D Co, Palatine, IL www.squared.com.
      t. Suttle, Hector, MN www.suttleonline.com.
      u. Tork Inc, Mount Vernon, NY www.tork.com.
      v. Watt Stopper Inc, Santa Clara, CA www.wattstopper.com.
   2. Product Options:
      a. Faces shall be nylon where available.
      b. Devices of single type shall be from same Manufacturer.

c. Devices are listed as white. Use white devices on light colored walls, brown on dark colored walls, and black on black walls.

B. Switches:
1. Furnace Disconnect:
a. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
1) 20 AMP, single pole:
a) Cooper: 2221V.
b) Hubbell: HBL1221-I.
c) Pass & Seymour: 20AC1-I.
d) Leviton: 1221-2I.
2. Standard Style:
a. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
1) 20 AMP, single pole:
a) Cooper: 2221V.
b) Hubbell: HBL1221-I.
c) Pass & Seymour: 20AC1-I.
d) Leviton: 1221-2I.
2) Two Pole:
a) Cooper: 2222V.
b) Hubbell: HBL1222-I.
c) Pass & Seymour: 20AC2-I.
d) Leviton: 1222-2I.
3) Three Way:
a) Cooper: 2223V.
b) Hubbell: HBL1223-I.
c) Pass & Seymour: 20AC3-I.
d) Leviton: 1223-2I.
4) Four Way:
a) Cooper: 2224V.
b) Hubbell: HBL1224-I.
c) Pass & Seymour: 20AC4-I.
d) Leviton: 1224-2I.
5) Pilot Switch:
a) Hubbell: HBL1221-PL.
b) Pass & Seymour: 20AC1-RPL.
c) Leviton: 1221-PLR.
6) Lighted Toggle Switch:
a) Single Pole:
(1) Cooper: 2221-LTV.
(2) Hubbell: HBL1221-IL.
(3) Pass & Seymour: 20AC1-ISL.
(4) Leviton: 1221-LHI.
b) Three Way:
(1) Cooper: 2223-LTV.
(2) Hubbell: HBL1223-IL.
(3) Pass & Seymour: 20AC3-ISL.
(4) Leviton: 1223-7LC.
3. Exhaust Fan Timer Switches:
a. Serving Area:
1) 0-60 minute, no hold position.
2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
a) Intermatic: FD60MWC.
b) Paragon: SWPD60M-W.
c) Tork: A560MW.
b. Custodian Room:
1) 24-hour, in-wall, multiple automatic ON-OFF settings.
2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
a) Intermatic: E1020.
b) Tork: 701A.

4. Digital Time/Timer Switch:
   a. As shown in small Storage, Mechanical and Electrical Rooms.
   b. Automatic countdown type:
      1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
         a) Leviton: LTT60-1L.
         b) Hubbell: TD200.
         c) Pass & Seymour: RT1W.
         d) Tork: SSA100.
         e) Watt Stopper: TS-400-W.
5. Dimmer Switches:
   a. Vertical slide control with faceplate.
   b. Preset, ON-OFF switch, 1000VA.
   c. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      1) Hubbell: AS101/AS1I.
      2) Hunt: DAP-10-IV.
      3) Leviton: IPI10-I.
      4) Lutron: N-1003P-IV.
      5) Pass & Seymour: 91180-I.
      6) Phillips: MP1000-I.
      7) Watt Stopper: AD-1103-I.
6. Momentary Switches:
   a. 15 AMP, specification grade.
   b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      1) Cooper: 1895W.
      2) Hubbell: HBL1556W.
      3) Legrand: 1250W.

C. Receptacles:
1. Standard Style:
   a. 15 AMP, specification grade, back and side wired, self grounding, tamper resistant.
   b. Verified by UL to meet Fed Spec WC-596F.
   c. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      1) Cooper: TR5262.
      2) Hubbell: BR20.
      3) Leviton: TBR20.
      4) Pass & Seymour: TR20.
2. Range Receptacle:
   a. Three pole, four wire grounding, 125 / 250 V, NEMA 14-50R, 50 AMP complete with plate.
   b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      1) Cooper: 1258.
      2) Hubbell: HBL9450A.
      3) Leviton: 279.
      4) Pass & Seymour: 3894.
3. Ground Fault Circuit Interrupter (GFCI):
   a. 15 AMP, specification grade.
   b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      1) Cooper: GF15W.
      2) Hubbell: GF5252WA.
      3) Leviton: 8599-W.
      4) Pass & Seymour: 1594-W.
4. Basketball Standard Receptacle:
   a. Three pole, four wire grounding, 125 / 250V, locking type, NEMA L14-20R, 20 AMP, complete with plate.
   b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      1) Cooper: CWL1420R.
      2) Hubbell: HBL2410.
      3) Leviton: 2410.
      4) Pass & Seymour: L1420-R.

D. Plates:

1. Standard Cover Plates:
   a. Office / Occupied Areas:
      1) Nylon or high impact resistant thermoplastic.
      2) Color shall match wiring device.
   b. All Other: Steel.
   c. Ganged switches shall have gang plates.
   d. Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
      1) Cooper.
      2) Hubbell.
      3) Leviton.
      4) Pass & Seymour.
2. Weatherproof In-Use Receptacle Covers:
   a. NEMA 3R rated.
   b. Cast aluminum.
   c. Compatible with GFCI receptacles.
   d. Complete with weather resistant gaskets and stainless steel screws.
   e. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      1) Hubbell: WP26MH, horizontal; WP26M, vertical.
      2) Intermatic: WP1010HMC, horizontal; WP1010MC, vertical.
      3) Red Dot: CKMG, horizontal; CKMGV, vertical.

E. Occupancy Sensors: Encillium Refer to drawings for details. Information provided below relating to other manufacturers for reference only.
   1. Ceiling, ultrasonic type.
      a. Complete with sensor and combined relay / control transformer.
      b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
         1) Encillium Controls:
            a) Sensor: OAC-U-0501-R.
            b) Relay / Transformer: SP20-MV.
         2) IR-TEC America:
            a) Sensor: OS-361DT.
            b) Relay / Transformer: PPU-300.
         3) Leviton:
            a) Sensor: OSC05-RUW.
            b) Relay / Transformer: OPP20-D2.
         4) Sensorswitch:
            a) Sensor: CMPDT9.
            b) Relay / Transformer: MP-20-SP0DM.
         5) Watt Stopper:
            a) Sensor: W-500A.
            b) Relay / Transformer: BZ-150.
      c. Provide manual ON and OFF momentary override switches. Refer to Contract Drawings for number of switches.
   2. Ceiling, passive infrared type.
      a. Complete with sensor and relay / transformer.
      b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
         1) Cooper Controls:
            a) Sensor: OAC-P-1500-R.
            b) Relay / Transformer: SP20-MV.
         2) IR-TEC America:
            a) Sensor: OS-361.
            b) Relay / Transformer: PPU-300.
         3) Leviton:
            a) Sensor: OSC15-RIW.
            b) Relay / Transformer: OPP20-D2.
         4) Sensorswitch:
            a) Sensor: CM10.
            b) Relay / Transformer: MP-20-SP0DM.
         5) Watt Stopper:
            a) Sensor: CI-205.

b) Relay / Transformer: BZ-150.
c)

c. Provide manual ON and OFF momentary override switches. Refer to Contract Drawings for number of switches.

3. Ceiling, dual technology type.
   a. Complete with sensor and relay / transformer.
   b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      1) Cooper Controls:
         a) Sensor: OAC-DT-0501-R.
         b) Relay / Transformer: SP20-MV.
      2) IR-TEC America:
         a) Sensor: OS-361DT.
         b) Relay / Transformer: PPU-300.
      3) Leviton:
         a) Sensor: OSC05-RMW.
         b) Relay / Transformer: OPP20-D2.
      4) Sensorswitch:
         a) Sensor: CMPDT9.
         b) Relay / Transformer: MP-20-SP0DM.
      5) Watt Stopper:
         a) Sensor: DT-305.
         b) Relay / Transformer: BZ-150.
   c. Provide manual ON and OFF momentary override switches. Refer to Contract Drawings for number of switches.
4. Wall switch, passive infrared type.
   a. Features include sensitivity and time delay adjustments.
   b. Manual ON / auto OFF capability.
   c. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      1) Cooper Controls: OSW-P-1001-MV-W.
      2) IR-TEC America: LbS-700NW.
      3) Leviton: ODS10-IDW.
      4) Sensorswitch: WSD-V-WH.
      5) Watt Stopper: PW-100-W.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install devices flush with walls, straight, and solid to box.

B. Label dimmer switch groupings with 1/16 inch (1.6 mm) thick laminated plastic composition material with contrasting color core. Engraved letter shall be 1/4 inch (6 mm) high.

END OF SECTION

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SECTION 26 2816

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install disconnects as described in Contract Documents, except those provided integral with equipment.

B. Related Requirements:
   1. Section 26 0501: 'Common Electrical Requirements'.
   2. CEC 2018
   3. ABC 2019
   4. CSA

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Manufacturers:
   1. Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories.
      a. Disconnects: Same as Manufacturer of Project's main panelboard.
      b. Fuses.
         1) Cooper Bussmann, Ellisville, IL www.cooperbussmann.com.
         2) Edison Fuse, Ellisville, IL (314) 391-3443.
         3) Ferraz Shawmut, Newburyport, MA www.ferrazshawmut.com.
         4) Littelfuse Inc, Des Plaines, IL www.littelfuse.com.

B. Disconnects:
   1. Heavy-duty quick-make, quick-break type, non-fused unless indicated otherwise.
   2. Provide interlock to prevent opening of door when switch is in ON position.
   3. Provide means to lock switch in OFF position with padlock.
   4. Disconnects for motor circuits shall be horsepower rated.
   5. Disconnects For Furnace Units: Provide manual starter with thermal overload relay. Provide overload relay to match motor full load amps.
   6. Enclosures:
      a. Interior: NEMA / CEMA Type 1.
      b. Exterior: NEMA / CEMA Type 3R.
   7. Fuses:
      a. Fuse fused disconnects with dual-element time delay fuses and equip with rejection type fuse holders.
      b. Fuses on Project shall be from single manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Label disconnects to indicate equipment served, such as Condensing Unit CU-1. Use 1/16 inch (1.6 mm) thick laminated plastic composition material with contrasting color core. Engraved letters shall be 1/4 inch (6 mm) high. Attach labels with screws.

B. Install furnace disconnects on furnace at location where it is accessible from front of unit and it does not interfere with unit's operation.

END OF SECTION

SECTION 26 4100

FACILITY LIGHTNING PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install lightning protection system as described in Contract Documents.
   2. See Drawings A121, A306, and E501 for further details.

B. Related Requirements:
   1. Section 10 7430: 'Aluminum Steeple'.
   2. Section 26 0501: 'Common Electrical Requirements'.
   3. Section 26 4301: 'Surge Protective Devices'.

1.2 REFERENCES

A. Reference Standards:
   1. National Fire Protection Association:
      a. NFPA (Fire) 780, 'Standard for the Installation of Lightning Protection Systems' (2014 or latest approved edition).

1.3 SUBMITTALS

A. Action Submittals:
   1. Shop Drawings:
      a. Show layout of system on building, installation details, and items to be used in system.

1.4 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Comply with latest edition of NFPA 780 and other local governing codes.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Type One Acceptable Manufacturers:
   1. Advanced Lightning Technology, Argyle, TX www.altfab.com.
   2. Erico International, Solon, OH www.erico.com.
   3. Harger Lightning And Grounding, Grayslake, IL www.harger.com.
   4. Independent Protection Company (IPC), Goshen, IN www.ipclp.com.
   5. Preferred Lightning Protection, Maryville, MO www.preferredlp.com.
   6. Robbins Lightning Protection Company, Maryville, MO www.robbinslightning.com.
   7. Thompson Lightning Protection, St Paul, MN www.tlpinc.com.
   8. VFC Inc, Woods Cross, UT www.vfcinc.com.
   9. Equal as approved by Architect before bidding. See Section 01 6200.

B. Components:
   1. Lightning protection equipment provided under this Section shall be from same manufacturer.

2. Lightning protection equipment provided for Steeple under this Section:
   a. Class One Quality Standards:
      1) Smooth weave copper cable, minimum 32 strands of 17 gauge: IPC No. 32S.
      2) Bronze ground clamps for 3/4 inch (19 mm) rod: IPC No. 52A.
      3) 3/4 inch (19 mm) by 10 foot (3.0 m) ground rods, copper clad: IPC No. 579.
      4) Bonding Plate:
         a) Aluminum for connection to aluminum steeple / tower elements: IPC No. A238B.
         b) Bronze for connection to steel steeple / tower elements: IPC No. 238B.
         c) Bi-metal bonding plate as supplied by steeple manufacturer.
      5) Pressure Cable Clamp: IPC No. 297A.
      6) Cable Loop Fastener, copper: IPC No. 121A.
      7) Right Angle Through-Roof Connector:
         a) IPC No. 597X, bronze, for use with copper cable in steeple / tower.
         b) IPC No. A597X, aluminum, for use with aluminum cable in steeple / tower.
      8) Inspection / test well: Robbins Lightning, Inc. No. 89C-18.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Interface With Other Work:
   1. Coordinate with steeple fabricator.

B. Ground Rods:
   1. Install ground rods 3 feet (900 mm) minimum away from building or any part of building. Drive each rod until top is a minimum of one foot (300 mm) below finish grade.
   2. Connect cable to ground rods with ground clamps.
   3. Over each ground rod, install inspection / test well with cover flush with finish grade. Coordinate with Landscaping and planter materials.

C. Cable:
   1. Install lightning cable with continuous horizontal or downward course, free from down and up pockets.
   2. Radius of bends shall not be less than 8 inches (200 mm) and never tighter than 90 degree angle.
   3. Install cable supports every 36 inches (900 mm) along run through building using specified cable fasteners.
   4. Bond lightning protection system to building grounding system.

END OF SECTION

SECTION 26 4301

SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install surge protective devices as described in Contract Documents.

B. Related Requirements:
   1. Section 26 0501: 'Common Electrical Requirements'.
   2. Section 26 0526: 'Grounding And Bonding For Electrical Systems'.
   3. Section 26 2417: 'Circuit-Breaker Panelboards'.
   4. Section 26 4100: 'Facility Lightning Protection'.

1.2 REFERENCES

A. Abbreviations And Acronyms:
   1. SPD: Surge Protective Device.

B. Association Publications:
   1. Institute of Electrical and Electronic Engineers:
      a. IEEE C62.41.1-2002, 'Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits'.
      b. IEEE C41.2-2002, 'Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits'.
      c. IEEE C62.45-2002, 'Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits'.
   2. National Electrical Contractors Association:
      a. NECA 1-2015, Standard for Good Workmanship in Electrical Contracting'.

C. Reference Standards:
   1. Military Standard:
      a. MIL-STD-220C, 'Method of Insertion Loss Measurement' (2009).
   2. National Electrical Manufactures Association:
      a. NEMA 250-2014, 'Enclosures for Electrical Equipment (1000 Volts Maximum)'.
      b. NEMA LS-1-1992(R2000), 'Low-Voltage Surge-Protection (LVSP) Devices' (Withdrawn August 19, 2009).
   3. National Fire Protection Association / American National Standards Institute:
      a. NFPA 70-2014 (or most recent edition adopted by AHJ including all applicable amendments and supplements), National Electric Code (NEC).
   4. Underwriters Laboratories:
      a. UL 1449: 'Surge Protective Devices' (4th Edition or current edition including all Revisions).
      b. CSA
      c. CEC2018

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate size and location of over current device compatible with actual surge protective and location to be installed.
   2. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to ordering equipment.

1.4 SUBMITTALS

A. Action Submittals:
   1. Shop Drawings:
      a. Include wiring diagrams showing all factory and field connections with wire and circuit breaker/fuse sizes.

B. Informational Submittals:
   1. Manufacturer Instructions:
      a. Provide Manufacturer's written installation instructions for Surge Protection Devices (SPD).
   2. Manufacturer Reports:
      a. Manufacturer's documentation for compliance with following standards:
         1) UL 1449: 'Surge Protective Devices'.
      b. Test Reports:
         1) Provide test reports from Independent Testing Laboratory verifying COMPLETE SPD will survive published and specified maximum surge current rating:
            a) Test reports will clearly show that all components that make up COMPLETE system were included in these tests (including but not limited to all necessary fuses, thermal disconnects, integral disconnects, and monitoring systems).
            b) Testing shall be performed as described in NEMA LS-1 document.
            c) Less than 10 percent change in protective characteristics from pre to post test.
         2) Provide test data confirming that SPD will survive published and specified repetitive surge current rating (longevity characteristics).
         3) Per requirements of NEC Article 285.6, provide test data demonstrating that SPD is without use of external fusing.
         4) Provide COMPLETE set of test and ratings data per recommendations of NEMA LS-1.
   3. Qualification Statement:
      a. Provide Manufacturer Qualification documentation if requested by Architect.

C. Closeout Submittals:
   1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
      a. Warranty Documentation:
         1) Final, executed copy of Warranty.
      b. Record Documentation:
         1) Record actual connections and locations of surge protective devices.

1.5 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. General:
      a. Conform to requirements of NFPA 70.
      b. Referenced Documentation:
         1) Maintain at project site copy of each referenced document that prescribes execution requirements.
      c. SPD shall:
         1) Bear UL 1449 current edition.
            a) 'Manufactured in accordance with' is not equivalent to UL listing and does not meet intent of this specification.
         2) Performance parameters shall be posted at www.UL.com under Category Code: VZCA. Products or parameters with posing at UL.com shall not be approved.
   2. Qualifications:
      a. Manufacturer Qualifications:
         1) Company specializing in manufacturing products specified in this section with three (3) years minimum documented experience.

1.6 WARRANTY

A. Manufacturer's Warranty:
   1. Provide ten (10) year minimum warranty covering repair or replacement of surge protective devices showing evidence of failure due to defective materials or workmanship.
      a. Exclude surge protective devices from any clause limiting warranty responsibility for acts of nature, including lightning, stated elsewhere.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Manufacturers:
   1. Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories.
      a. Source Limitations: Furnish surge protective devices produced by single manufacture and obtained from single supplier.
      b. Field-Installed, Externally Mounted Surge Protective Devices:
         1) Advanced Protection Technologies, Inc. (APT), Clearfield, FL www.aptspd.com.
         2) Current Technology by Thomas & Betts Power Solutions, Richmond, VA www.tnbpowersolutions.com.
         3) Emerson Network Power, Binghamton, NY www.emersonnetworkpower.com.
         4) GE Industrial Solutions (Division of GE), Plainville, CT www.geindustrial.com.
         5) Atlantic Scientific Corporation, Melbourne FL www.atlanticsceientific.com.
         6) MTL Instruments Group, (Division of Cooper Crouse-Hinds), Great Marlings, Butterfield, Luton, UK www.mtl-inst.com.
         7) Schneider Electric, North American Division, Palatine, IL www.surgelocic.com.

B. Components:
   1. Surge Protective Devices:
      a. Description:
         1) Factory assembled surge protective devices (SPD) for 60 Hz service, listed and classified by UL suitable for purpose specified and indicated; system voltage as indicated on Contract Drawings.
      b. Design Criteria:
         1) Capable of surviving 6,000 ANSI/IEEE C62.41, Category C3 (10kA) impulses without failure or performance degradation of more than ten (10) percent.
         2) Integrally fused to pass requirements of UL 1449 and provide short circuit current rating of 200kAIC:
            a) Each MOV shall be individually matched to + or - volt and individually fused.
            b) LED indicator lights for powe and protection status.
            c) Audible alarm, with silencing switch, to indicate when protection has failed.
            d) One (1) set of dry contacts rated at 5A and 250-V, ac, for remote monitoring of protection status.
      c. Protected Modes:
         1) Wye Systems: L-N, L-G, N-G, L-L.
      d. Voltage Protection Ratings (VPR's) as per UL 1449:
         1) 208Y/120V System Voltage:
            a) Not more than 800 V for L-G, L-G, and N-G modes and 1,200 V for L-L mode.
         2) 480Y/277V System Voltage:
            a) Not more than 1,500 V for L-G, L-G, and N-G modes and 2,000 V for L-L mode.
      e. Maximum Continuous Operating Voltage (MCOV) as per UL 1449:
         1) Not less than one hundred fifteen (115) percent on nominal system voltage.
      f. Enclosure Environment Type as per NEMA 250:
         1) Unless otherwise indicated, as specified for following installation locations:
            a) Indoor clean, dry locations: Type 1.
            b) Outdoor locations: NEMA 4 enclosure.

g. Mounted For Field-Installed, Externally Mounted SPD's: Unless otherwise indicated, as specified for following locations:
   1) Provide surface-mounted SPD where mounted in non-public areas or adjacent to surface-mounted equipment.
   2) Provide flush-mounted SPD where mounted in public areas or adjacent to flush-mounted equipment.

2. Surge Protective Devices For Service Entrance Locations:
   a. General:
      1) Provide field-installed, externally mounted SPD's.
   b. Design Criteria:
      1) List and label as complying with UL 1449, Type 1.
      2) Provide SPD's utilizing field-replaceable modular or non-modular protection circuits.
      3) Surge Current Rating:
         a) Not less than 125 kA per mode/250 kA per phase.
      4) Repetitive Surge Current Capacity: Not less than 5,000 impulses.
      5) Nominal Discharge Current (I-n) as per UL 1449: 20 kA.
      6) Short Circuit Current Rating (SCCR) as per UL:
         a) Not less than available fault current at installed location as indicated on Contract Drawings.
   c. Diagnostics:
      1) Protection Status Monitoring:
         a) Provide indicator lights to report protection for each phase.
      2) Alarm Notification:
         a) Provide indicator light and audible alarm to report alarm condition.
         b) Provide button to manually silence audible alarm.
   d. Provide surge rated integral disconnect switch for SPD's not connected to dedicated circuit breaker or fused switch or not direct bus connected.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification Of Conditions:
   1. Verify field measurements are as shown on Contract Drawings.
   2. Verify service voltage and configuration marked on SPD are consistent with service voltage and configuration at Project location.
   3. Verify electrical equipment is ready to accept connection of SPD and that installed overcurrent device is consistent with requirements of Contract Drawings and Manufacturer's written Instructions.
   4. Verify system grounding and bonding is in accordance with Section 26 0526: 'Grounding And Bonding For Electrical Systems' including bonding of neutral and ground for service entrance and separately derived systems where applicable.
   5. Verify conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. General:
   1. Perform work in neat and workmanlike manner in accordance with Standard Practice Guidelines of NECA 1.

B. Install SPD in accordance with Manufacturer's written instructions.

C. Arrange equipment to provide minimum clearances in accordance with Manufacturer's written Instructions and NFPA 70.

D. Unless indicated otherwise, connect service entrance surge protective device on line side of service disconnect main overcurrent device.

E. Conductors:
   1. Proved conductors with minimum ampacity as indicated on Contract Drawings, as required by NFPA 70, and not less than Manufacturer's recommended minimum conductor size.
   2. Install between SPD and equipment terminations as short and straight as possible, not exceeding Manufacturer's recommended maximum conductor length.
      a. Breaker locations may be reasonably rearranged in order to provide leads as short and straight as possible.
      b. Twist conductors together to reduce inductance.

F. Energizing SPD's:
   1. Do not energize SPD until bonding of neutral and ground for service entrance and separately derived systems is complete in accordance with Section 26 0526: 'Grounding And Bonding For Electrical Systems' where applicable.
   2. Replace SPD's damaged by improper or missing neutral-ground bond.

3.3 FIELD QUALITY CONTROL

A. Field Testing:
   1. Provide factory testing documents.
   2. Verify electrical wiring installation complies with Manufacturer's written installation requirements.
   3. Disconnect SPD prior to performing any high potential testing.
   4. Replace SPD's damaged by performing high potential testing with SPD connected.

END OF SECTION

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SECTION 26 5100

INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install lighting system as described in Contract Documents, complete with lamps.

B. Related Requirements:
   1. Section 26 0501: 'Common Electrical Requirements'.
   2. Section 26 5121: 'Interior Lighting: LED Dimming Drivers'.
   3. Section 09 5116: 'Acoustical Tile Ceilings'.

1.2 REFERENCES

A. Reference Standards:
   1. American National Standards Institute (ANSI):
      a. ANSI C78.377-2017, 'American National Standard for Electric Lamps: Specification for the Chromaticity of Solid State Lighting Products'.
   2. Federal Communications Commission (FCC):
      a. Code of Federal Regulations (CFR):
         1) FCC 47 CFR Part 18, 'Industrial, Scientific, and Medical Equipment'.
   3. Institute of Electrical and. Electronics Engineers (IEEE):
      a. IEEE C62.41.1-2002, 'Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits'
      b. CSA
      c. ABC 2019
      d. CEC2018.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Manufacturers:
   1. Manufacturer Contact List:
      a. Advance Transformer Co, Rosemont, IL www.advancetransformer.com.
      b. Cooper Wiring Devices by Eaton, Peachtree City, GA www.cooperindustries.com.
      c. General Electric Lighting, Hendersonville, NC or General Electric Lighting Canada Inc, Mississauga, ON www.gelighting.com/na.
      d. Howard Lighting Products, Laurel, MS www.howard-ind.com.
      e. Novitas Inc, Peachtree City, GA www.novitas.com.
      f. Osram Sylvania, Danvers, MA www.sylvania.com or Osram Sylvania Ltd, Mississauga, ON (905) 673-6171.
      g. Philips Lighting Co, Somerset, NJ www.lighting.philips.com/nam or Philips Lighting Canada, Scarborough, ON (416) 292-3000.
      h. Universal Lighting Technologies, Nashville, TN www.universalballast.com.
      i. Venture Lighting International, Solon, OH www.venturelighting.com.
      j. Watt Stopper Inc, Santa Clara, CA www.wattstopper.com.
      k. Westinghouse Lighting Corp, Philadelphia, PA www.westinghouselightbulbs.com.

2. Product Options: When several lighting fixtures are specified by name for one use on Drawings, select any one of those specified. Do not mix fixtures from different manufacturers specified for one use.All fixtures will be LED.

B. Materials
   1. Lighting Fixtures:
      a. Type One Acceptable Products:
         1) See Fixture Schedule on Drawings for acceptable manufacturers and models.
         2) Equals as approved by Architect before bidding. See Section 01 6200.
      b. LED Lamps and Fixtures:
         1) Replacement Lamps shall have minimum efficiency of 70 lm / W per LM 79.
         2) Integral LED Lamps shall have minimum efficiency of 90 lm / W per LM 79.
         3) Provide minimum rated life of 50,000 per LM 80 and LM 70 standards.
         4) Color Temperature: 3000k.
         5) Provide full spectrum color index of 65.
   2. Daylight Lighting Switching System:
      a. Complete system enabling control of up to six 277V circuits by daylighting photocell mounted in skylight.
      b. System components include, but are not limited to, following items. Except for photocell, install components in single, locking enclosure:
         1) 20 to 2000 foot candle photocell with necessary mounting hardware.
         2) Control relays or contactors and transformers for up to six circuits
         3) Sensor controller with HIGH, LOW, and DEAD BAND adjustments.
      c. Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
         1) Cooper Lighting.
         2) Watt Stopper.

C. Factory Assembly:
   1. Fixtures shall be fully assembled complete with necessary wiring plaster frames, recessing boxes, hangers, supports, lenses, diffusers, and other accessories essential for complete working installation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Interface With Other Work:
   1. Coordinate with Sections under 09 5000 heading to obtain symmetrical arrangement of fixtures in acoustic tile ceiling as shown on Architectural Reflected Ceiling Plan A151 in Contract.
   2. Coordinate with Sections under 09 9000 heading to ensure that light coves are properly painted before installation of light fixtures.
   3. In mechanical equipment rooms, coordinate locations of light fixtures with equipment locations to provide proper room illumination without obstruction. Suspend fixtures that must be mounted below pipes, ducts, etc, with chains or other Architect approved method.

B. Securely mount fixtures. Support fixtures weighing 50 lbs (23 kg) or more from building framing or structural members.

C. Fasten lay-in fixtures to ceiling suspension system on each side with bolts, screws, rivets, or clips. In addition, connect lay-in fixtures with two (2) No. 12 gauge diagonal wires with three (3) turns each end; two (2) per fixture minimum to building framing or structural members. Connect to opposing corners of fixture. Wires may be slightly slack. Make final conduit connections to fixtures with specified flexible conduit or flexible fixture whips.

D. Where fixtures are shown installed end to end, provide suitable connectors or collars to connect adjoining units to appear as a continuous unit.

E. Where recessed fixtures are to be installed, provide openings, plaster rings, etc, of exact dimensions for such fixtures to be properly installed. Coordinate fixture installation with ceiling type and thickness. Terminate circuits for recessed fixtures in an extension outlet box near fixture and connect with specified flexible conduit. Confirm IC rating requirements and coordinate installations with spray foam schedule.

F. Do not locate LED fixtures in closet or storage areas within 18 inches (450 mm) and light fixtures within 6 inches (150 mm) of shelves.

3.2 ADJUSTMENT

A. Repair scratches or nicks on exposed surfaces of fixtures to match original undamaged conditions.

END OF SECTION

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SECTION 26 5121

INTERIOR LIGHTING: LED Dimming Drivers

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install Interior Lighting LED Dimming Drivers as described in Contract Documents, complete with lamps.

B. Related Requirements:
   1. Section 26 0501: 'Common Electrical Requirements'.
   2. Section 26 0924, 'Lighting Control System'.
   3. Section 26 2726: 'Wiring Devices'.
   4. Section 26 5100: 'Interior Lighting'.

C. Reference Standards:
   1. American National Standards Institute (ANSI) / American National Standard Lighting Group (ANSLG):
      a. ANSI/ANSLG C78.377-2017, 'American National Standard for Electric Lamps: Specification for the Chromaticity of Solid State Lighting Products'.
      b. ANSI/ANSLG C82.11-2017, 'High-Frequency Fluorescent Lamp Ballasts'.
   2. American National Standards Institute (ANSI) / Illuminating Engineering Society (IES):
      a. ANSI/IES RP-16-10, 'Nomenclature and Definitions for Illuminating Engineering'.
   3. Federal Communications Commission (FCC):
      a. Code of Federal Regulations (CFR):
         1) FCC 47 CFR Part 15, 'Class B: Radio Frequency Devices'.
   4. Institute of Electrical and. Electronics Engineers (IEEE) / American National Standards Institute (ANSI):
      a. IEEE/ANSI C62.41.1-2002, 'Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits'.
   5. International Electrotechnical Commission (IEC):
      a. IEC 60929 ED. 4.0 B:2011. 'AC and/or DC Supplied Electronic Control Gear for Tubular Fluorescent Lamps - Performance Requirements'.
      b. IEC 61000-3-2 ED. 5.0 B:2018, 'Electromagnetic Compatibility (EMC) - Part 3-2: Limits for Harmonic Current Emissions (Equipment Input Current <= 16 A per phase)'.
      c. IEC 61347-1 ED. 3.1 B:2017, 'Lamp Controlgear - Part 1: General and Safety Requirements'.
      d. IEC 61347-2-13 ED. 2.1 B:2016, 'Lamp Controlgear - Part 2-13: Particular Requirements for d.c. or a.c. Supplied Electronic Controlgear for LED modules'.
      e. IEC 61547 ED. 2.0 B:2009, 'Equipment for General Lighting Purposes - EMC Immunity Requirements'.
      f. IEC 62384 ED. 1.0 B:2006, 'D.C. or A.C. Supplied Electronic Control Gear for LED Modules - Performance Requirements'.
      g. IEC 62386-101 ED. 2.1 B:2018, 'Digital Addressable Lighting Interface - Part 101: General Requirements - System'.
   6. National Electrical Manufacturers Association (NEMA):
      a. NEMA 410-2015, 'Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts'.
   7. Underwriters Laboratories (UL):
      a. UL 1310: 'Class 2 Power Units' (2018).
   8. Underwriters Laboratories (UL) / Underwriters Laboratories of Canada (ULC):
      a. UL 8750: 'Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products' (2015).
      b. CSA

c. CEC2018
d. ABC2019

1.2 SUBMITTALS

A. Action Submittals:
1. Product Data:
a. Manufacturer's published product data on dimensions, ratings, catalog numbers and identification of products and accessories for products included for project. Include performance data.
2. Shop Drawings:
a. Provide fixture type(s) list for each specific driver.
b. Provide wiring diagrams as needed for special operation or interaction with other system(s).

B. Informational Submittals:
1. Qualification Statements:
a. Manufacturer: Provide experience compliance documentation.
b. Products: Provide compliance documentation with UL / ULC requirements.

C. Closeout Submittals:
1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
a. Warranty Documentation:
1) Final, executed copy of Warranty on drivers.

1.3 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
1. Meet UL / ULC requirements.

B. Qualifications. Requirements of Section 01 4301 applies but not limited to following:
1. Manufacturer:
a. Manufacture with five (5) years experience in manufacture of dimmable electronic lighting drivers.
b. Provide experience documentation.

1.4 FIELD CONDITIONS

A. Ambient Conditions:
1. General:
a. Proceed with installation only when following ambient conditions can be maintained:
1) Install when the temperature is between minus 4 deg F (minus 20 deg C) minimum and 122 deg. F (50 deg. C) maximum and relative humidity is ninety (90) percent, non-condensing.
2) Protect from dust and excess moisture during installation.

1.5 WARRANTY

A. Manufacturer Warranty:
1. Provide five (5) year warranty on drivers to operate driver at or below required driver warranty temperature.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Manufacturers: Refer to Fixture Schedule for exact models and manufacturer information. No alternates accepted.
   1. Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
      a. eldoLED America, San Jose, CA www.eldoled.com.
      b. General Electric Lighting, Hendersonville, NC or General Electric Lighting Canada Inc, Mississauga, ON www.gelighting.com/na.
      c. Howard Lighting Products, Laurel, MS www.howard-ind.com.
      d. OSRAM Sylvania, Danvers, MA or OSRAM Sylvania LTD, Mississauga, Ontario Canada www.Sylvania.com.
      e. Philips Lighting Co, Somerset, NJ www.lighting.philips.com/nam or Philips Lighting Canada, Scarborough, ON (416) 292-3000.

B. LED Dimming Driver:
   1. Description:
      a. LED Dimming Driver:
         1) 4 wire (010V DC Voltage Controlled) Dimming Drivers.
         2) Digital (DALI Low Voltage Controlled) Dimming Drivers.
         3) Integral Diming Driver for replacement lamp.
   2. Design Criteria:
      a. Driver:
         1) Driver must be able to operate for (+/- 10 percent) supply voltage of 120V through 277VAC at 60Hz.
         2) Driver to be UL / ULC recognized under component program and shall be modular for simple field replacement. Drivers that are not UL / ULC recognized or not suited for field replacement will not be used.
         3) Driver shall have ability to provide no light output when analog control signal drops below 0.5 V, or DALI digital signal calls for light to be extinguised and shall consume 0.5 watts or less in this standby. Control deadband between 0.5V and 0.65V shall be included to allow for voltage variation of incoming signal without causing noticeable variation in fixture to fixture output.
      b. Range and Quality:
         1) LED dimming to be equal in range and quality to commercial grade incandescent dimmer:
            a) Quality of dimming to be defined by dimming range, freedom from perceived flicker or visible stroboscopic flicker, smooth and continuous change in level (no visible steps in transitions), natural square law response to control input, and stable when input voltage conditions fluctuate over what is typically experience in commercial environment.
         2) Ten-year expected life while operating at maximum case temperature and 90 percent non-condensing relative humidity.
      c. Inrush Current:
         1) Driver must limit inrush current as followings:
            a) Minimum Requirement: Meet or exceed NEMA 410 driver inrush standard of 430 amps per 10 amps load with maximum of 370 $amps^2$ per second.
            b) Preferred Requirement: Meet or exceed 30mA^2s at 277VAC for up to 50 watts of load and 75A at 240us at 277VAC for 100 watts of load.
      d. Withstand up to 1,000 volt surge without impairment of performance as defined by IEEE/ANSI C62.41.1 Category A.
      e. Light Output:
         1) No visible change in light output with variation of plus/minus 10 percent line voltage input.
      f. Harmonic Distortion:
         1) Total Harmonic Distortion less than 20 percent and meet ANSI/ANSLG C82.11 maximum allowable THD requirements at full output.

2) THD shall at no point in dimming curve allow imbalance current to exceed full output THD.

g. Automatic Adaptation:
   1) Driver must support automatic adaptation, allowing for future luminaire upgrades and enhancements and deliver improved performance.
      a) Adjustment of forward LED voltage, supporting 3V through 55V.
      b) Adjustment of LED current from 200mA to 1.05A at the 100 percent control input point in increments of 1 mA.
      c) Adjustment for operating hours to maintain constant lumens (within 5 percent) over 50,000 hour design life of system, and deliver up to 20 percent energy savings early in life cycle.

h. Light Quality:
   1) Over entire range of available drive currents, driver shall provide step-free, continuous dimming to black from 100 - 1 percent light output and step to 0 percent where indicated. Driver shall respond similarly when raising from 0 percent to 100 percent.
   2) Drivers to track evenly across multiple fixtures at all light levels, and shall have input signal to output light level that allows smooth adjustment over entire dimming range.
   3) Driver and luminaire electronics shall deliver illumination that is free from objectionable flicker as measured by flicker index (ANSI/IES RP-16-10). At all points within dimming range from 100-0.1 percent luminaire shall have:
      a) LED dimming driver shall provide continuous step-free, flicker free dimming similar to incandescent source.
      b) Minimum Requirement: Flicker index shall less that 5 percent at all frequencies below 1000 Hz.
      c) Preferred specification: Flicker index shall be equal to incandescent, less that 1 percent at all frequencies below 1000 Hz.

i. Control Input:
   1) 4-Wire (0-10V DC Voltage Controlled) Dimming Drivers:
      a) Must meet IEC 60929 ED. 4.0 B Annex E for General White Lighting LED drivers.
      b) Connect to devices compatible with 0 to 1 OV Analog Control Protocol, Class 2, capable of sinking 0.6 ma per driver at low end of 0.3V. Limit number of drivers on each 0-1 OV control output based on voltage drop and control capacity.
      c) Control relays or contactors and transformers for up to six circuits
      d) Sensor controller with HIGH, LOW, and DEADBAND adjustments.
   2) Digital (DALI Low Voltage Controlled) Dimming Drivers:
      a) Must meet requirements of IEC 62386-101 ED.1.0 B.
   3) Integral Dimmer Driver for replacement lamps:
      a) LED Driver shall not cause shadows.
      b) LED Driver shall be line voltage controlled and shall be compatible with any universal dimmer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation of driver to meet Manufacturer's prescribed methods and instructions.

B. Meet Ambient Conditions requirements for installation.

C. Driver may be remote mounted up to 300 ft (90 m) depending on power level and wire gauge.

D. 0-10V input shall be protected from line voltage miswire, and immune and output unresponsive to induced AC voltage on control leads.

END OF SECTION

SECTION 26 5200

EMERGENCY LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install emergency battery units as described in Contract Documents.
   2. See Drawings for EM notations.

B. Related Requirements:
   1. Section 26 0501: 'Common Electrical Requirements'.

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Manufacturers: Refer to fixture schedule for model numbers.
   1. Manufacturer Contact List:
      a. Beghelli, Miramar, FL www.beghelliusa.com.
      b. Bodine Emergency Lighting, Collierville, TN www.bodine.com
      c. Dual-Lite, Cheshire, CT www.dual-lite.com.
      d. Iota Engineering Co, Tucson, AZ www.iotaengineering.com
      e. Lightolier, Fall River, MA www.lightolier.com.
      f. Lithonia Lighting, Conyers, GA www.lithonia.com.
      g. McPhilben / Day-Brite Lighting, Tupelo, MS www.mcphilben.com.
      h. Sure-Lites / Cooper Lighting, Elk Grove, IL www.cooperlighting.com.

B. Materials:
   1. Battery Packs:
      a. Design Criteria:
         1) Batteries shall be long life nickel cadmium type.
         2) Complete with charging indicator light and test switch.
         3) Components shall be fully concealed and easily accessible for maintenance or replacement.
         4) Factory installed in lighting fixture, or field installed to same standards.
      b. Class Two Quality Products: See Section 01 4301 for Manufacturer Qualifications and Section 01 6200:
         1) Any Manufacturer that conforms to Contract Documents requirements.
   2. Emergency Lighting Units And Fixtures:
      a. Design Criteria:
         1) Shall operate indicated number of lamps for ninety (90) minutes of emergency operation.
         2) Sealed, maintenance free, lead calcium type battery.
         3) Painted steel housing and complete with power indicator light and test switch.
         4) Lamps to be designed for wet locations and with full vertical and horizontal adjustment of lamps.
      b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
         1) See Contract Drawings for approved fixtures. Coordinate emergency lighting unit and fixture so that systems function as required.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Battery Packs: LED Heads
   1. General:
      a. Wire so unit can be tested with lights on.
      b. Wire so lamps in normal mode are switched off with other lighting in area. Connect unit to unswitched conductor of normal lighting circuit.
   2. Linear Fluorescent Lighting Fixtures:
      a. Install in ballast channel of fixture with charging indicator light and test switch mounted on fixture end, or visible and accessible through lens.

B. Emergency Lighting Units:
   1. Aim lamps to maximize lighting of first 50 feet (15 meters) of egress path.
   2. Wire so lamps are normally off and operate upon loss of normal building power.
   3. Connect units to un-switched conductor of normal lighting circuit.

END OF SECTION

SECTION 26 5600

EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install exterior lighting system as described in Contract Documents.

B. Products Furnished But Not Installed Under This Section:
   1. Anchor bolts.

C. Related Requirements:
   1. Section 03 3111: 'Cast-In-Place Structural Concrete' for bases for light poles and installation of anchor bolts.
   2. Section 26 0501: 'Common Electrical Requirements'.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Manufacturers:
   1. Manufacturer Contact List: Refer to fixture schedule on drawings Alternates not accepted.
      a. Cutler-Hammer Inc, Milwaukee, WI www.cutler-hammer.eaton.com or Cutler-Hammer/Eaton Yale Ltd, Burlington, ON (905) 333-6442.
      b. General Electric Industrial Systems, Charlotte, NC or G E Lighting Canada Inc, Mississauga, ON www.geindustrial.com.
      c. Intermatic Inc, Spring Grove, IL www.intermatic.com.
      d. Paragon Electric Co Inc, Carol Stream, IL www.icca.invensys.com/paragon or Paragon Electric / Maple Chase, Mississauga, ON (800) 951-5526 or (905) 890-5956.
      e. Siemens Energy & Automation, Alphrata, GA www.sea.siemens.com or Siemens Canada, Mississauga, ON (905) 819-8000.
      f. Square D Co, Palatine, IL or Square D / Schneider Electric, Toronto, ON www.squared.com.
      g. Tork Inc, Mount Vernon, NY www.tork.com.

B. Materials:
   1. Exterior Fixtures:
      a. Finish shall be high quality polyester powder coating:
         1) Finish process shall consist of cleaning, electrostatically applying power coat, and thermal curing.
         2) Weather, scratch, UV, and fade resistant.
      b. Color shall be Manufacturer's standard white or black as noted on Fixture schedule and as selected by Architect before bidding.
      c. Type One Acceptable Products:
         1) As indicated on Fixture Schedule. Do not mix fixtures from different manufacturers for one use.
         2) Equals as approved by Architect before bidding. See Section 01 6200.
   2. Parking Area Poles:
      a. Designed for wind loading required for Project location as determined by Architect.
      b. Aluminum hinged base type with matching aluminum anchor bolt cover secured to base.
      c. Include hand hole with cover at pole base.
      d. Finish And Color: Black.
   3. Exterior Lighting Control – coordinate with Lighting Control Panel E302.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Interface With Other Work:
   1. Coordinate location of anchor bolts and conduit in concrete bases so pole will be properly mounted and centered on base.
   2. Install hinged light pole bases so poles can be completely lowered to ground without obstruction out into parking area.

B. Lighting Control – see E302:
   1. Label each component to identify lighting controlled, I.E. 'PARKING LIGHTING' or 'BUILDING LIGHTING.' Label with 1/16 inch (1.5 mm) thick laminated plastic composition material with contrasting color core. Engraved letters shall be 1/4 inch (6 mm) high.

END OF SECTION

DIVISION 27: COMMUNICATIONS

27 1000 STRUCTURED CABLING

27 1116 COMMUNICATIONS CABINETS, RACKS, FRAMES, AND ENCLOSURES
27 1501 COMMUNICATIONS HORIZONTAL CABLING

27 4000 AUDIO-VIDEO COMMUNICATIONS

27 4117 VIDEO SYSTEMS

27 5000 DISTRIBUTED COMMUNICATIONS AND MONITORING SYSTEMS

27 5117 AUDIO SYSTEMS

END OF TABLE OF CONTENTS

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SECTION 27 1116

COMMUNICATIONS CABINETS, RACKS, FRAMES, AND ENCLOSURES

PART 1 - GENERAL

1.1 SUMMARY

A. Selection Includes But Is Not Limited To:
   1. Furnish and install communications cabinets, racks, frames, and enclosures as described in Contract Documents.

B. Related Requirements:
   1. Section 26 0526: 'Grounding And Bonding For Electrical Systems'.
   2. Section 27 1501: 'Communications Horizontal Cabling'.
   3. Section 27 4117: 'Video Systems'.
   4. Section 27 5117: 'Audio Systems'.

C. Products Installed But Not Furnished Under This Section:
   1. Cable Management, Vertical Cable Management, and Horizontal Cable Management.

1.2 REFERENCES

A. Association Publications:
   1. British Standards Institution (BSI):
      a. BS EN 50310:2006, 'Application of Equipotential Bonding and Earthing in Buildings with Information Technology Equipment.
   2. Building Industry Consulting Service International (BISCI:
      a. Information Transport Systems Installation Methods Manual (ITSIMM) (5th Edition).
      b. Telecommunications Distribution Methods Manual (TDMM) (12th Edition).
   3. Institute of Electrical and Electronics Engineers:
      a. IEEE 802.3-2018, *'Standard for Ethernet'*.
      b. IEEE 1100-2005, 'Recommended Practice for Powering and Grounding Electric Equipment'.
   4. Telecommunications Industry Association:
      a. TIA TSB-162, 'Telecommunication Cabling Guidelines for Wireless Access Points' (November 2013).

B. Reference Standards:
   1. International Electrotechnical Commission:
      a. IEC 60603-7:2011, 'Connectors for electronic equipment – Part 7 'Detail specification for 8-way, unshielded, free and fixed connectors'.
   2. International Organization for Standardization / International Electrotechnical Commission:
      a. ISO/IEC 11801 ED.2.0 EN CORR3:2008, 'Information Technology-Generic Cabling for Customer Premises'.
   3. National Fire Protection Association:
      a. NFPA 70, 'Canadian Electrical Code (CEC)' (2017 or most recent edition adopted by AHJ).
   4. CSA Group (Canadian Standards Association):
      a. CSA C22.1-18, 'Canadian Electrical Code, part I (21st edition), safety standard for electrical installations.
   5. Telecommunications Industry Association:
      a. TIA-568.2, 'Balanced Twisted-Pair Telecommunications Cabling and Components Standards' (Revision D, 2018).
      b. TIA-569, 'Telecommunications Pathways And Spaces' (Revision D, 2015).
      c. TIA-606, 'Administration Standard for Telecommunications Infrastructure' (Revision C, 2017).

d. TIA-607, 'Telecommunications Bonding and Grounding (Earthling) for Customer Premises' (Revision C, 2015).
e. TIA-758, 'Customer-Owned Outside Plant Telecommunication Infrastructure Standard' (Revision B, 2012).
f. TIA-942, 'Telecommunications Infrastructure Standard for Data Centers' (Revision B, 2017).
g. TIA-1152, 'Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling' (Revision A 2016).

6. 2019 National Building Code – Alberta Edition.

1.3 SUBMITTALS

A. Action Submittals:
1. Product Data:
a. Provide Manufacturer's documentation and descriptive information on each piece of equipment to be used.

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Manufacturers:
1. Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
a. Atlas Sound, Phoenix, AZ www.atlassound.com.
b. Lowell Manufacturing Co., Pacific, MO www.lowellmfg.com
c. Middle Atlantic Products, Fairfield, NJ www.middleatlantic.com.

PART 3 - EXECUTION

3.1 INSTALLERS

A. Approved Installers:
1. Approved installers in Section 27 5117 are to both furnish and install components of this section. See Section 01 4301. Installer requirements of Section 01 4301 applies.

3.2 INSTALLATION

A. Equipment Cabinet:
1. See Section 27 5117 'Sound System' for installation of Sound Equipment.
2. Coordinate with Electrical and Mechanical trades to ensure adequate room is provided around the equipment racks to allow it to swing open and close properly.

B. Equipment Cabinet:
1. Install vent panels at top and bottom of equipment cabinets and between components where possible for maximum ventilation when equipment locations is not specified in Contract Drawings. Locate amplifiers at top of cabinet. Locate equalizers below amplifiers, separated by several vent panels.
2. Securely fasten equipment plumb and square in place. Utilize all fastening holes in front of cabinet.
3. Securely fasten in place equipment that is not rack mounted, including relays and other small components. Do not use sticky-back tape.
4. Install balancing / isolation transformer when balanced and unbalanced components are connected.
5. Wire XLR-type connections with pin 2 hot, pin 1 shield.

6. Connect powered components to 120 VAC outlets on voltage suppressor power bars. Do not connect to outlets on other components.
7. Identification:
   a. Legibly identify user-operated system controls and system input / output jacks using engraved, permanently attached laminated plastic plates or imprinted Lexan labels. Label equipment and controls within equipment cabinets using similar labels or printed labels from a label maker or laser printer.
   b. Affix label to rack panel inside cabinet listing name and telephone number of installer. Appropriate warranty instructions may be included.

C. Communications Racks, Frames and Enclosures:
1. Racks shall be installed as per Manufacturer's recommendations.
2. Racks shall be securely attached to concrete floor with 3/8 inch (9.5 mm) minimum hardware or as required by local codes.
3. Place racks with 36 inches (900 mm) minimum clearance front and back from walls and 28 inches (710 mm) clear on one side of rack. When mounted in row, maintain 36 inches (900 mm) minimum from wall behind and in front of row of racks and from wall at each end of row.
4. Grounding:
   a. Racks shall be grounded to telecommunications ground bus bar as per Section 26 0526 'Grounding And Bonding For Electrical Systems'.
   b. Racks shall be grounded in accordance with TIA-607.
5. Rack mount screws not used for installing patch panels and other hardware shall be bagged and left with rack upon completion of installation.
6. Mounted termination block fields shall be mounted on Terminal Board in Technology Room provided by Electrical as shown in Contract Documents.
   a. Wall mounted termination block fields shall be installed with lowest edge of Terminal Board.

3.3 FIELD QUALITY CONTROL

A. Non-Conforming Work: Non-conforming work as covered in the General Conditions applies, but is not limited to the following:
1. Correct any work found defective or not complying with Contract Document requirements at no additional cost to Owner.

END OF SECTION

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SECTION 27 1501

COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish, install, and test communications horizontal cabling as described in Contract Documents including following:
      a. Cables and related terminations.
      b. Patch cords and modular connectors.
      c. Surface raceway and outlet poles.
      d. Support and grounding hardware.
      e. UTP Cable.
      f. UTP Patch cords.
      g. UTP Connector Modules.
      h. Installation and testing of Owner Furnished Network Equipment.

B. Related Requirements:
   1. Division 26: Raceways and surface boxes.
   2. Section 07 8400: 'Firestopping' for furnishing and installation of firestopping.
   3. Section 26 0526: 'Grounding And Bonding For Electrical Systems' for installation and termination.
   4. Section 27 1116: 'Communications Cabinet, Racks, Frames, and Enclosures'.
   5. Section 27 4117: 'Video And Satellite Distribution Systems'.
   6. Section 27 5117: 'Audio Systems'.

C. Products Installed But Not Furnished Under This Section:
   1. Owner Furnished Network Equipment as specified on TT (Technology Telecommunication) and TA (Technology Audiovisual) Drawings as shown in Contract Documents including:
      a. Internet Firewall.
      b. ISP Modem.
      c. Network Switch.
      d. Wireless Access Port.

D. Related Requirements:
   1. Section 01 6400: Owner will provide Network Equipment as specified on TT (Technology Telecommunication) and TA (Technology Audiovisual) Drawings as shown in Contract Documents. Contract Documents establishes quality of materials and installation for information of Contractor, Architect, and Owner's Representatives. Design Criteria in PART 2 of this Section identifies Contractor's responsibility for Owner Network Equipment.

1.2 REFERENCES

A. Association Publications:
   1. British Standards Institution (BSI):
      a. BS EN 50310:2006, 'Application of Equipotential Bonding and Earthing in Buildings with Information Technology Equipment'.
   2. Building Industry Consulting Service International (BISCI:
      a. *Information Transport Systems Installation Methods Manual* (ITSIMM) (5th Edition).
      b. *Telecommunications Distribution Methods* Manual (TDMM) (12th Edition).
   3. Institute of Electrical and Electronics Engineers:
      a. IEEE 802.3-2018, *'Standard for Ethernet'*.
      b. IEEE 1100-2005, '*Recommended Practice for Powering and Grounding Electric Equipment*'.
   4. Telecommunications Industry Association:

a. TIA TSB-162, ‘Telecommunication Cabling Guidelines for Wireless Access Points’ (November 2013).

B. Reference Standards:
1. International Electrotechnical Commission:
a. IEC 60603-7:2011, ‘Connectors for electronic equipment – Part 7 ‘Detail specification for 8-way, unshielded, free and fixed connectors'.
2. International Organization for Standardization / International Electrotechnical Commission:
a. ISO/IEC 11801 ED.2.0 EN CORR3:2008, ‘Information Technology-Generic Cabling for Customer Premises'.
3. National Fire Protection Association:
a. NFPA 70, ‘Canadian Electrical Code (CEC)' (2017 or most recent edition adopted by AHJ).
4. Canadian Standards Association:
a. CSA C22.1-18, ‘Canadian Electrical Code, part I (21st Edition), safety standard for electrical installations.
5. Telecommunications Industry Association:
a. TIA-568.2, 'Balanced Twisted-Pair Telecommunications Cabling and Components Standards' (Revision D, 2018).
b. TIA-569, 'Telecommunications Pathways And Spaces' (Revision D, 2015).
c. TIA-606, 'Administration Standard for Telecommunications Infrastructure' (Revision C, 2017).
d. TIA-607, 'Telecommunications Bonding and Grounding (Earthling) for Customer Premises' (Revision C, 2015).
e. TIA-758, ‘Customer-Owned Outside Plant Telecommunication Infrastructure Standard' (Revision B, 2012).
f. TIA-942, 'Telecommunications Infrastructure Standard for Data Centers' (Revision B, 2017).
g. TIA-1152, ‘Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling' (Revision A 2016).
6. Underwriters Laboratories:
a. UL 94: The Standard for Safety of Flammability of Plastic Materials for Parts in Devices and Appliances Testing (March 2013 6th Edition).
1) 94HB, ‘Horizontal Burn Test’.
7. 2019 National Building Code – Alberta Edition.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Coordinate with Project Manager and/or Facility Manager well in advance of Substantial Completion for installation of all Owner Furnished Network Equipment.

1.4 SUBMITTALS

A. Action Submittals:
1. Product Data:
a. Provide Manufacturer’s documentation, installation instructions, and descriptive information on each piece of equipment to be used.
2. Shop Drawings:
a. Provide three (3) copies of labeling system reflecting approved label scheme for cable installation for racks, cables, panels, and outlets.

B. Informational Submittals:
1. Certificates:
a. Provide Installer certificates of qualifications required.
2. Design Data:
a. Identification and labeling:
1) Provide labeling system for cable installation to be approved by Owner.
a) Clearly identify all components of system: racks, cables, panels and outlets.

b) Designate cables origin and destination and unique identifier for cable within facility by room number and port count.
c) Racks and patch panels shall be labeled to identify location within cable system infrastructure.

b. After system installation, provide three (3) full documentation sets to Consulting Engineer/Architect for approval.

3. Tests And Evaluation Reports:
   a. Submit documentation within ten (10) working days of completion of each testing phase. This is inclusive of all test results and record drawings.
   b. Draft drawings may include annotations done by hand. Final copies of all drawings shall be submitted within thirty (30) working days of completion of each testing phase.
   c. At request of Consulting Engineer, provide copies of original test results.
4. Field Quality Control Submittals:
   a. Architect will provide floor plans in paper and electronic formats on which record documentation information can be recorded.
5. Qualification Statements:
   a. Letter from Manufacturer certifying level of training and experience of Installer.

C. Closeout Submittals:
1. Include following information in Operations And Maintenance Manual specified in Section 01 7800:
   a. Operations and Maintenance Data:
      1) Provide operating and maintenance instructions for each item of equipment submitted under Product Data.
   b. Warranty Documentation:
      1) Final, executed copy of Warranty.
   c. Record Documentation:
      1) Manufacturers documentation:
         a) Manufacturer's literature or cut sheet.
      2) Tests and evaluation reports.
      3) As-built Documentation:
         a) Provide record document to include cable routes and outlet locations.
            (1) Sequential number shall identify outlet locations.
            (2) Numbering, icons, and drawing conventions used shall be consistent throughout all documentation.
            (3) Provide labeling system information.

1.5 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
1. System shall meet approval of authority having jurisdiction (AHJ). CEC and Provincial and/or local ordinances and regulations shall govern unless more stringent requirements are specified.
2. Meet all TIA/EIA commercial building wiring standards.
3. Meet Telecommunications Distribution Methods Manual (TDMM) (12th Edition) requirements for installation and testing.
4. All Networks shall be installed per applicable standards and manufacturer's guidelines.
5. Cable assemblies shall be UL / CE, ULC, Listed and CSA Certified. Cables shall be a distinctive green or green/yellow in color, and all jackets shall be UL, VW-1 flame rated.
6. Grounding shall conform to all required Commercial Building Grounding and Bonding Requirements for Telecommunications, Electrical Codes, and Manufacturer’s grounding requirements.

B. Qualifications: Requirements of Section 01 4301 applies, but is not limited to following:
1. Manufacturer Qualifications:
   a. Provide single source for all products of system:
      1) KeyConnect by Belden.
      2) Netkey by Panduit.
      3) System 6 by Siemon.
      4) Uniprise Media 6 by CommScope.

2. Installers Qualifications:
    a. Approved and Certified by Manufacturer (installation and maintenance trained):
        1) Belden Certified System Vendor (CSV).
            a) Belden Certified LDS Partner.
        2) CommScope Certified Business Partner.
            a) CommScope Certified LDS Partner.
        3) Panduit Certified Installer (PCI).
        4) Siemon Certified Installers (CI).
    b. Three (3) year experience with similar projects. Provide documentation.

1.6 WARRANTY

A. Special Warranty:
    1. Cabling System:
        a. Provide warranty for permanent link cabling system to meet Category 6 standard requirements for structured cabling system for twenty (20) years.
    2. Installer Warranty:
        a. Installer guarantees that all work is in accordance with all express and implied requirements of Contract Documents, that all work is of good quality, and further warrants work and material for period of (1) year from date of substantial completion of project, unless longer period of time is specified in Contract. All work not conforming to these requirements, may be considered defective:
            1) If, within one (1) year after substantial completion of work, or within such longer period of time as may be prescribed by law or by terms of any warranty in Contract, any of work is found to be defective or not in accordance with Contract, Installer shall at Installer cost correct it promptly after receipt of written notice from Owner.
            2) Installer’s obligation shall survive termination of Contract.
            3) Owner shall give such notice within reasonable time after discovery of condition.
        b. Installer warrants to Owner that all materials and equipment furnished under this Contract shall be new unless otherwise specified, free from faults and defects and in conformance with Contract Documents:
            1) Contractor shall secure manufacturer’s warranties and deliver copies thereof to Owner upon completion of work.
            2) All such warranties shall commence from date of substantial completion, and will not in any way reduce Installer's responsibilities under his Contract.
            3) Whenever guarantees or warranties are required by specifications for longer period than one year, such longer period shall govern.
        c. Installer will provide twenty (20) year minimum end to end manufacturer warranty.

PART 2 - PRODUCTS

2.1 OWNER-FURNISHED PRODUCTS

A. Category Four Products. See Section 01 6200 for definitions of Categories:
    1. LDS Network Equipment as specified on TT (Technology Telecommunication) and TA (Technology Audiovisual) Drawings as shown in Contract Documents including:
        a. Internet Firewall.
        b. ISP Modem.
        c. Network Switch.
        d. Wireless Access Port.
    2. Coordination:
        a. Coordinate installation of all Owner Furnished Network Equipment including but limited to:
            1) Installation and configure devices in accordance with LDS requirements.
            2) Proper set-up of network equipment.
            3) Owner Furnished internet service to building prior to final installation of AV and Voice Data Equipment.
            4) Testing of network equipment.

2.2 SYSTEMS

A. Manufacturers:
   1. Category Four Approved Manufacturers and Products. See Section 01 6200 for definitions of Categories:
      a. Belden, St. Louis, MO www.belden.com.
      b. Panduit Corporation, Tinley Park IL www.panduit.com.
      c. Systimax Solutions, a CommScope Company, Hickory, NC www.systimax.com.
      d. The Siemon Company, Watertown, CT www.siemon.com.

B. Design Criteria:
   1. Must install single manufacture as complete permanent link.
      a. Category 6 minimum compliance margin on all parameters beyond category 6 and Power Sum ACR out to 250 MHz.
   2. Entire Category 6 system to be provided by single approved Manufacturer throughout.
   3. Install structured cabling system that will be able to support interconnections to active telecommunications equipment for voice and data applications in multi vendor, multi product environment. Structured cabling system should adhere to TIA-568, TIA-606; TIA-607, and TIA-942 standards with respect to pathways, distribution, administration, and grounding of the system.
   4. Each room drop will consist of two drops each consisting of two terminations can be interoperable to accommodate either voice or data applications. Provide convenience phone drops that will consist of single termination that will be installed in proper faceplate for each location's phone.
   5. Install, terminate, test, and guarantee each drop according to customer all applicable standards and customer preferences.
   6. Horizontal cables will be rated Category 6 (250 MHz) in performance and rated to comply with TIA-568 to connector outlets at Work Area. Horizontal cables will home run back to Technology Room (Entrance Facility / Main Cross Connect) and will terminate on individual Category 6 rated jacks to populate modular 48 port angled patch panel on open or flat patch panel inside enclosures. All cables will be patched at cutover as interconnection into floor serving active equipment using RJ45 modular equipment cables rated to Category 6.
   7. Match additions to horizontal raceway to complete system according to TIA-568 where suspension and protection gaps exist.

C. Components – Work Area Subsystem:
   1. Provide connectivity equipment used to connect horizontal cabling subsystem and equipment in work area. Both copper and fiber media shall be supported. Connectivity equipment shall include following options:
      a. Patch (equipment) cords and modular connectors.
      b. Outlets and surface mount boxes.
      c. Surface raceway and outlet poles.
      d. Consolidation point / MUIO.
   2. Patch Cords and Modular Connectors:
      a. Match horizontal cabling medium and rating. Same Manufacturer shall provide modular connectors and patch cords. Total patch cord length at work area is not to exceed 10 feet (3.0 m).
      b. Copper Connectivity:
         1) Network Cabling System:
            a) Provide for Work Area subsystem, including all modular connectors.
            b) Modular connectors shall support of high-speed networks and applications designed for implementation on copper cabling.
            c) Outlets shall utilize fully interchangeable and individual connector modules that mount side-by-side to facilitate quick and easy moves, adds and changes.
         2) Modular Connections:
            a) Data Modules shall be Category 6:
               (1) Eight position modules required in all work areas and shall exceed connector requirements of TIA Category 6 standard.
               (2) Prove termination cap with strain relief on cable jacket, ensure cable twists are maintained to within 1/8 inch (3 mm) and include wiring scheme label. Wiring scheme label shall be available with TIA-568 wiring schemes.
            b) Terminations shall use for TIA-568 wiring scheme.

c) Modules shall terminate 4 pair 23 100-ohm solid unshielded twisted pair cable.
d) Modules shall meet ISO 11801 standard including complying with intermateability standard IEC 60603-7 for backward compatibility.
e) Category 6 modules shall have UL and CSA approval.
f) Modules shall have ETL verified Category 6 performance and ISO 11801 Class E performance in both basic and channel links.
g) Modules shall be universal in design, accepting 2, 3, or 4 pair modular plugs without damage to outer jack contacts.
h) Modules shall be able to be re-terminated minimum of 10 times and be available in 11 standard colors for color-coding purposes.
i) Jack shall snap into all outlets and patch panels.
j) Module shall include black base to signify Category 6 400 MHz performance.

3) Patch Cords:
a) Category 6 patch cords 'shall be factory terminated with modular plugs featuring one-piece, tangle-free latch design and strain-relief boots to support easy moves, adds, and changes.
b) Constructed with Category 6 23-AWG stranded UTP cable.
c) Each patch cord shall be one hundred (100) percent performance tested at factory in channel test to TIA Category 6 standard.
d) Patch cords shall come in standard lengths of 3, 5, 7, 9, 14 and 20 feet (0.90, 1.50, 2.15, 2.75, 4.20 and 6.1 meters) and 6 standard colors of Blue or White.
e) Provide one (1) each 8 feet (2.45 m) patch cord for 50 percent of terminated work station ports.

3. Outlets and Surface Mount Boxes:
a. Outlets and surface mount boxes shall support network system by providing high-density in-wall, surface mount cabling applications.
b. Provide faceplates for flush mount:
1) Outlets faceplates shall be manufactured from high-impact thermoplastic material with UL 94 flammability rating of 94 HB or better.

4. Copper Cable:
a. Design Criteria:
1) Performance exceeds all TIA-568 Category 6 and ISO 11801 for Class E cable requirements.
2) ETL tested and verified for Category 6 component performance.
3) Conductors are twisted in pairs with four pairs contained in flame retardant PVC jacket separated by a spline.
4) Performance tested to 650 MHz.
5) Plenum (CMP) and non-plenum/riser (CMR) flame rated.
6) Maximum installation tension of 25 lbs (110 N).
7) Installation temperature range: 32 deg F (0 deg C) to 140 deg F (60 deg C).
8) Operating temperature range: 14 deg F (minus 10 deg C) to 140 deg F (60 deg C).
9) Cable diameter: Riser – 0.26 inch (6.604 mm) 0.260"; Plenum – 0.25 inch (6.35 mm).
10) Easy payout, reel-in-a-box and descending length markings on cable speed installation.
11) Supports following applications: Ethernet 10BASE-T, 100BASE-T (Fast Ethernet) and 1000BASE-T (Gigabit Ethernet); 1.2Gb/s ATM; Token Ring 4/16; digital video; and broadband/baseband analog video.
12) Color shall be blue.

D. Horizontal Distribution Cabling:
1. General:
a. Horizontal distribution cabling system is portion of telecommunications cabling system that extends from work area telecommunications outlet/connector to horizontal cross-connect in Technology Room (Entrance Facility / Main Cross Connect).
1) Horizontal cabling in office should terminate in Technology Room (Entrance Facility / Main Cross Connect) located on same floor as Work Area being served.
2) Horizontal cabling is installed in star topology (home run).
3) Bridged taps and splices are not permitted as part of copper horizontal cabling.

E. Components – Technology Room (Entrance Facility / Main Cross Connect):
1. General:

a. Connect networking equipment to horizontal and backbone cabling subsystems:
   1) Termination hardware (connectors and patch cords), racks, cable management products and cable routing products.
   2) Cable termination hardware.
b. Terminate each horizontal or backbone cabling run using appropriate connectors or connecting blocks depending upon cable type:
   1) Matching patch cords will be used to perform cross-connect activities or to connect into the networking/voice hardware:
      a) Category 6 Enhanced Unshielded Twisted Pair (UTP).
c. Four-pair Category 6 UTP cabling shall be terminated onto four-pair Category 6 module:
   1) All modules shall be terminated using 568-B wiring scheme.
   2) Eight position module shall exceed connector requirements of TIA Category 6.standard.
   3) Jack termination to 4-pair, 100 ohm solid unshielded twisted pair cable shall be by use of forward motion termination cap and shall not require use of punchdown or insertion tool.

2. Rack, Cabinet, and Cabling Management Enclosure:
   a. Cable Management:
      1) Cable Management System shall be used to provide neat and efficient means for routing and protecting fiber and copper cables and patch cords on telecommunication racks and enclosures.
      2) Provide complete cable management system comprised of vertical and horizontal cable managers to manage cables on both front and rear of rack.
      3) System shall protect network investment by maintaining system performance, controlling cable bend radius and providing cable strain relief.
   b. Vertical Cable Management:
      1) General:
         a) Vertical cable managers include components that aid in routing, managing and organizing cable to and from equipment.
         b) Panels shall protect network equipment by controlling cable bend radius and providing cable strain relief.
      2) Provide panels with universal design mounting to 19 inches (480 mm) rack and constructed of steel bases with PVC duct attached.
      3) Covers shall be able to hinge from either side yet still be easily removed to allow for quick moves, adds, and changes.
   c. Horizontal Cable Management:
      1) General:
         a) Horizontal cable managers include components that aid in routing managing and organizing cable to and from equipment.
         b) Panels shall protect network equipment by controlling cable bend radius and providing cable strain relief.
      2) Provide panels with universal design mounting to 19 inches (480 mm) rack and constructed of steel bases with PVC duct attached.
      3) Duct fingers shall include retaining tabs to retain cables in place during cover removal.
      4) Covers shall be able to hinge from either side yet still be easily removed to allow for quick moves, adds, and changes.
3. Patch Cords:
   a. Provide patch cords between modular patch panels configured as cross-connect or between patch panel and networking hardware when patch is used as interconnect. Provide one (1) each 3 feet (0.90 m) patch cord for each terminated patch panel port.
   b. Provide patch cords as indicated on Drawings and Specifications as shown in Contract Documents. Ensure all devices are fully connected to network equipment.
   c. Provide additional patch cords with appropriate length to connect all Owner provided internet enabled appliances (IEA) as specified on TT (Technology Telecommunication) and TA (Technology Audiovisual) Drawings as shown in Contract Documents.
   d. Patch cords shall be factory terminated with modular plugs featuring one-piece, tangle-free latch design and black strain-relief boots to support easy moves, adds and changes.
   e. Construct patch cords with Category 6 24-AWG stranded UTP cable.
   f. Patch cords shall be one hundred (100) percent performance tested at factory in channel test to Category 6 standard.
4. Patch Panels:

a. Four-pair Category 6 UTP cabling shall be terminated onto four-pair-punch-down style connecting hardware mounted to rear of integral patch panels and routed to Category 6 modules on front face of patch panel.
b. Patch panels shall be universal for TIA-568 wiring configurations.
c. Patch panels shall have removable 6-port design that allows 6-port module to be removed without disrupting other ports.
d. Integral cable tie mounts shall be included in panel for cable management on back of panel.
e. Port and panels shall be easy to identify with write-on areas and optional label holder for color-coded labels.
f. Rack mountable patch panels shall mount to standard 19 inches (480 mm) rack.

5. Grounding and Bonding:
   a. Provide Telecommunications Bonding Backbone:
      1) Ground all telecommunications cable shields, equipment, racks, cabinets, raceways, and other associated hardware that has potential to act as current carrying conductor.
      2) Install telecommunication Bonding Backbone independent of building's electrical and building ground.
      3) Designed in accordance with recommendations contained in TIA-607 Telecommunications Bonding and Grounding Standard.
   b. All wires used for telecommunications grounding purposes shall be identified with green insulation:
      1) Non-insulated wires shall be identified at each termination point with wrap of green tape.
      2) All cables and bus bars shall be identified and labeled as required.
6. Firestopping: Furnish and install firestopping as per Section 07 8400.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
   1. Install communications system in accordance with Manufacturer's written instructions, and complying with applicable portions of CEC 'Standard of Installation'.

B. Work Area Outlets:
   1. Cables shall be coiled in in-wall or surface-mount boxes if adequate space is present to house cable coil without exceeding Manufacturers bend radius.
      a. No more than 12 inches (300 mm) of UTP slack shall be stored in in-wall box, modular furniture raceway, or insulated walls.
      b. Excess slack shall be loosely configured and stored in ceiling above each drop location when there is not enough space present in outlet box to store slack cable.
   2. Cables shall be dressed and terminated in accordance with TIA-568, Manufacturer's recommendations, and best industry practices.
   3. Cables shall be bundled using Velcro straps at least 0.25 inch (6.35 mm) wide. Use of plastic wire ties or zip ties is not allowed on project.
   4. Pair untwist at termination shall not exceed 0.125 inch (3.175 mm).
   5. Bend radius of cable in termination area shall not be less than 4 times outside diameter of cable.
   6. Cable jacket shall be maintained to within one inch (25 mm) of termination point.
   7. Data / voice jacks, unless otherwise noted in Contract Documents, shall be located on each faceplate.
   8. Horizontal Cabling:
      a. Data jacks in horizontally oriented faceplates shall occupy rightmost position(s).
      b. Voice jacks shall occupy the top position(s) on the faceplate. Voice jacks in horizontally oriented faceplates shall occupy the left-most position(s).

C. Horizontal Cross Connect:
   1. Cables shall be dressed and terminated in accordance with TIA-568, Manufacturer's recommendations, and best industry practices.
   2. Pair untwist at termination shall not exceed 0.125 inch (3.175 mm).

a. Bend radius of cable in termination area shall not be less than 4 times outside diameter of cable.

3. Cables shall be neatly bundled and dressed to their respective panels or blocks.
   a. Each panel or block shall be fed by individual bundle separated and dressed back to point of cable entrance into rack or frame.
   b. Cables shall be bundled using Velcro straps at least 0.25 inch (6.35 mm) wide. Use of plastic wire ties or zip ties is not allowed on project.
4. Cable jacket shall be maintained as close as possible to termination point.
5. Each cable shall be clearly labeled on cable jacket behind patch panel at location that can be viewed without removing bundle support ties.
   a. Cables labeled within bundle, where label is obscured from view shall not be acceptable.
6. Horizontal Cabling:
   a. A pull cord (nylon; 1/8 inch (3 mm) minimum) shall be co-installed with all cable installed in any conduit.
   b. Cable raceways shall not be filled greater than required by TIA-569 maximum fill for particular raceway type.
   c. Cables shall be installed in continuous lengths from origin to destination (no splices) except for transition points, or consolidation points.
   d. Where transition points or consolidation points are allowed, they shall be located in accessible locations and housed in enclosure intended and suitable for purpose.
   e. Cable's minimum bend radius and maximum pulling tension shall not be exceeded.
   f. If J-hook or trapeze system is used to support cable bundles, all horizontal cables shall be supported at 48 inch (1 200 mm) to 60 inches (1 500 mm) maximum intervals. At no point shall cable(s) rest on acoustic ceiling grids or panels.
   g. Horizontal distribution cables shall be bundled in groups of no more than 25 cables. Cable bundle quantities in excess of 25 cables may cause deformation of bottom cables within bundle and degrade cable performance.
   h. Cables shall be bundled using Velcro straps at least 0.25 inch (6.35 mm) wide. Use of plastic wire ties or zip ties is not allowed on project.
   i. Cable shall be installed above fire-sprinkler systems and shall not be attached to system or any ancillary equipment or hardware. Cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.
   j. Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, install appropriate carriers to support cabling.
   k. Cables shall be identified by self-adhesive label and meet requirements of TIA-606. Cable label shall be applied to cable behind faceplate on section of cable that can be accessed by removing cover plate.
   l. Unshielded twisted pair cable shall be installed so that there are no bends smaller than four times the cable outside diameter at any point in run and at termination field.
   m. Pulling tension on 4-pair UTP cables shall not exceed 25 lbf (111 N) for a four-pair UTP cable.

D. Vertical Outlet Pole And Surface Raceway:
   1. Horizontal Cabling:
      a. General:
         1) Vertical outlet poles and Surface Raceway refers to surface raceway system used for branch circuit wiring and/or data network, voice, video and other low-voltage cabling. Surface raceway shall be used in solid wall applications or for applications where moves, additions and changes are very typical to workflow.
      b. Raceway system shall consist of raceway, appropriate fittings and accessories to complete installation per electrical Contract Documents. Non-metallic surface raceway is to be utilized in dry interior locations only as covered in Article 352, part B of the CEC, as adopted by the NFPA and as approved by the ANSI.

E. Copper Termination Hardware:
   1. Cables shall be dressed and terminated in accordance with TIA-568, Manufacturer's recommendations, and best industry practices.
   2. Pair untwist at termination shall not exceed 0.125 inch (3.175 mm).
      a. Bend radius of cable in termination area shall not be less than 4 times outside diameter of cable.

3. Cables shall be neatly bundled and dressed to their respective panels or blocks.
   a. Each panel or block shall be fed by individual bundle separated and dressed back to point of cable entrance into rack or frame.
   b. Cables shall be bundled using Velcro straps at least 0.25 inch (6.35 mm) wide. Use of plastic wire ties or zip ties is not allowed on project.
4. Cable jacket shall be maintained as close as possible to termination point.
5. Each cable shall be clearly labeled on cable jacket behind patch panel at location that can be viewed without removing bundle Velcro support straps.
   a. Cables labeled within bundle, where label is obscured from view shall not be acceptable.

F. Grounding System:
1. Where required, Telecommunications Bonding Backbone shall be designed and/or approved by qualified Installer.
2. Follow requirements of TIA-607.

G. Identification and Labeling:
1. Apply machine generated approved labeling for racks, cables, panels and outlets:
   a. Designate cables origin and destination and unique identifier for cable by room name and/or number and port count.
   b. Racks and patch panels shall be labeled to identify location within cable system infrastructure.
2. Place labeling within view at termination point on each end.
3. Outlet, patch panel and wiring block labels shall be installed on, or in, space provided on device.
4. See Contract Drawings for labeling scheme.
5. Conform to IP addressing assignments as listed in Attachment 'FACILITIES ZONE IP ADDRESS ASSIGNEMENT TABLE'.

   a. See Attachment 'FACILITIES ZONE IP ADDRESS ASSIGNEMENT TABLE' for 'IP Address Assignments.

3.2 FIELD QUALITY CONTROL

A. Field Tests:
1. Provide testing upon completion of installation.
   a. General:
      1) Testing to be in accordance with TIA standards and Manufacturer's system warranty guidelines and best industry practice.
         a) If any of these are in conflict, discrepancies shall be brought to attention of Architect/Consulting Engineer for clarification and resolution.
   b. Cables and termination hardware:
      1) Test complete system for defects in installation.
      2) Verify cabling system performance under installed conditions according to requirements of TIA-568:
         a) All pairs of each installed cable shall be verified prior to system acceptance.
         b) Any defect in cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure one hundred (100) percent useable conductors in all cables installed.
   c. Copper channel testing:
      1) All twisted-pair copper cable links shall be tested for compliance to requirements of TIA-568 for appropriate Category of cabling installed.
      2) Backbone multimode fiber cabling shall be tested at both 850 nm and 1300 nm.
   d. UTP Cables and Links testing:
      1) UTP cabling channel must be tested at swept frequencies up to 250 MHz for internal channel performance parameters as defined in IEEE 802.3 and TIA-568. Certifications shall include following parameters for each pair of each cable installed:
         a) Wire map (pin to pin connectivity).
         b) Length (in feet or millimeters).
         c) Near End Crosstalk (NEXT).

d) Far End Crosstalk (FEXT).
e) ELFEXT.
f) Attenuation/Crosstalk Ration (ACR).
g) Return Loss.
h) Propagation Delay.
i) Delay Skew.
j) Test equipment shall provide electronic and printed record of these tests.

2) Test each pair of cable for opens, shorts, grounds, and pair reversal.
a) Correct short or grounded and reversed pairs.
b) Examine open and shorted pairs to determine if problem is caused by improper termination.
c) If termination is proper, tag bad pairs at both ends and note on termination sheets.
d) If horizontal cable contains bad conductors, remove and replace cable.

e. Testing Equipment:
1) Comply with requirements of TIA-568.
a) Appropriate level III tester shall be used to verify Category 6 cabling systems.
2) UTP Cables and Links test equipment:
a) Category Four Approved Testing Equipment. See Section 01 6200 for definitions of Categories:
(1) Fluke Networks DTX-1800 with firmware version 2.04 or later.
(a) Test lead to be P/N DTX-PLA001 or PLA002 universal permanent link interface adapter.
(2) Agilent Wirescope Pro N2640A with firmware version 2.1.9 or later.
(a) Test lead to be P/N N2644A-101 universal CAT6A link smart probes.

f. Re-Testing:
1) Consulting Engineer may request ten (10) percent random field re-test to be conducted on cable system, at no additional cost to Owner, to verify documented findings.
a) Tests shall be repeat of those defined above.
b) If findings contradict documentation submitted, additional testing can be requested to extent determined necessary by Consulting Engineer, including one hundred (100) percent re-test at no additional cost to Owner.

g. Tests And Evaluation Reports:
1) Printouts generated for each cable by wire test instrument shall be submitted as part of documentation package. Installer may furnish this information in electronic form.
a) Media shall contain electronic equivalent of test results as defined by the Section along with software necessary to view and evaluate test reports.
2) Submit documentation within ten (10) working days of completion of each testing phase. This is inclusive of all test results and record drawings.
3) Draft drawings may include annotations done by hand. Final copies of all drawings shall be submitted within thirty (30) working days of completion of each testing phase.
4) If requested by Consulting Engineer, provide copies of original test results.

h. Test Documentation:
1) Provide electronic format documentation within three (3) weeks after completion of project.
2) Documentation shall be clearly marked on outside front cover with following:
a) "Project Test Documentation".
b) Project name.
c) Date of completion (month and year).
3) Test results shall include following:
a) Record of test frequencies.
b) Cable type.
c) Conductor pair and cable (or outlet) I.D.
d) Measurement direction.
e) Reference setup.
f) Crew member name(s).
g) Test equipment name, manufacturer, model number, serial number, software version.
h) Last calibration date:
(1) Unless Manufacturer specifies more frequent calibration cycle, annual calibration cycle is required on all test equipment used on project.

(2) Document shall detail test method used and specific settings of equipment during test as well as software version being used in field test equipment.

B. Non-Conforming Work: Non-conforming work as covered in General Conditions applies, but is not limited to following:
1. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced at no additional cost to Owner.
2. Any defect in cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure one hundred (100) percent useable conductors in all cables installed at no additional cost to Owner.
3. Correct deviation and repeat applicable testing at no additional cost to Owner.
4. Correct any work found defective or not complying with Association Publications and TDMM requirements at no additional cost to Owner.
   a. Document all problems found and corrective action taken.
   b. Include both failed and passed test data.

END OF SECTION

ATTACHMENTS

Facilities Zone IP Address Assignments

Installers connecting any equipment to the Facilities Zone shall conform to the IP addressing assignments listed in the Table below.

- For each device listed, the Device must be statically assigned the IP Address that is given by adding the specified offset in the table to the Facility Zone Gateway address.
- IP addresses should follow standard IPv4 Octet form.
- The respective Device installer is responsible for setup of the device.
- Structured Cabling Installer shall post a copy of this list near the Firewall, with the Gateway address filled in.

FACILITIES ZONE IP ADDRESS ASSIGNEMENT TABLE	
Facility Zone Gateway Address	10.____.____.____
Device Name	Gateway Offset
Fire Alarm	1
Security System	2
Condenser Theft Detection System	3
Access Control	4
Lighting Controller	5
Webstat Thermostat	6
Irrigation	7
Solar Panel Charge Controller	8
DSP1	9
DSP2	10
Surge Suppressor 1	11
Surge Suppressor 2	12
Contrio 1 - Chapel (MA)	13
Contrio 2 - Rack (KP)	14
Contrio 3 - Relief Society (SV8)	15
Contrio 4 - Children's Room (SV8)	16
Contrio 5 - Priesthood/ Multi-Purpose (SV8)	17
Power Amp (1)	18
Satellite Receiver #1	19
Satellite Receiver #2	20
Open	21
Open	22
Open	23
Open	24

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SECTION 27 4117

VIDEO SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install complete and operational video and satellite system as described in Contract Documents including:
      a. Satellite dish, LNB, receiver, line amplifiers, video and audio processors, video switchers, cable, connectors and ancillary equipment necessary to successful reception and distribution of video and audio signal from selected reception device (satellite and/or video stream).
      b. Installation and testing of Owner Furnished Network Streaming Equipment.
   2. Assist Audiovisual Consultant with final inspection of system and provide necessary test equipment. Correct problems found at time of final inspection of system.

B. Related Requirements:
   1. Division 26: 'Electrical':
      a. Power to equipment location.
   2. Section 26 0533: 'Raceway And Boxes For Electrical Systems' for raceway and boxes for video wiring.
   3. Section 27 1116: ‘Communications Cabinet, Racks, Frames, and Enclosures’.
   4. Section 27 5117: ‘Audio Systems’.
   5. Instructions to Owner by Audiovisual Consultant.
   6. Audiovisual Consultant will perform final inspection and instruct local leaders in operation of system.

C. Products Installed But Not Furnished Under This Section:
   1. Owner Furnished Network Streaming Equipment as specified on TA (Technology Audiovisual) Drawings as shown in Contract Documents including:
      a. Webcast Communicator or Webcast Capable Device.

D. Related Requirements:
   1. Section 01 6400: Owner will Furnish Network Streaming Equipment as specified on TA (Technology Audiovisual) Drawings as shown in Contract Documents. Contract Documents establishes quality of materials and installation for information of Contractor, Architect, and Owner's Representatives. Design Criteria in PART 2 of this Section identifies Contractor’s responsibility for Owner Network Equipment.

1.2 REFERENCES

A. Association Publications:
   1. Building Industry Consulting Service International (BISCI:
      a. *Information Transport Systems Installation Methods Manual* (ITSIMM) (5th Edition).
      b. *Telecommunications Distribution Methods Manual* (TDMM) (12th Edition).
   2. InfoComm International Association:
      a. *Audiovisual Best Practices: The Design & Integration Process for the AV and Construction Industries*.
      b. *AV Design Reference Manual* (1st Edition, 2006).
      c. *Basics of Audio and Visual Systems Design* (2003).
   3. Institute of Electrical and Electronics Engineers:
      a. IEEE 1100-2005, '*Recommended Practice for Powering and Grounding Electric Equipment*'.

B. Reference Standards:

1. American National Standards Institute/InfoComm International Association:
   a. ANSI/INFOCOMM 2M:2010, ‘Standard Guide for Audiovisual Systems Design and Coordination Processes'.
   b. ANSI/INFOCOMM 3M:2011, ‘Projected Image System Contrast Ration'.
   c. ANSI/INFOCOMM 4:2012, ‘Audiovisual Systems Energy Management'.
2. ASTM International:
   a. ASTM A53/A53M-18, ‘Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless’.
3. Telecommunications Industry Association:
   a. TIA-568.2, 'Balanced Twisted-Pair Telecommunications Cabling and Components Standards' (Revision D, 2018).
   b. TIA-569, 'Telecommunications Pathways And Spaces' (Revision D, 2015).
   c. TIA-606, 'Administration Standard for Telecommunications Infrastructure' (Revision C, 2017).
   d. TIA-607, 'Telecommunications Bonding and Grounding (Earthling) for Customer Premises' (Revision C, 2015).
   e. TIA-758, ‘Customer-Owned Outside Plant Telecommunication Infrastructure Standard' (Revision B, 2012).
4. 2019 National Building Code – Alberta Edition

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate with Owner’s Representative (Project Manager and/or Facility Manager) well in advance of Substantial Completion for installation of all Owner Furnished Network Streaming Equipment.
   2. Coordinate final inspection schedule of both audio and video systems before Audiovisual Consultant's final inspection.

B. Schedule:
   1. After completion of video system installation of this section, Installer to perform Field Testing before Audiovisual Consultant Final Inspection of audio system.
   2. Notify Audiovisual Consultant two (2) weeks minimum before Field Inspection specified in Field Quality Control in Part 3 of this specification.

1.4 SUBMITTALS

A. Informational Submittals:
   1. Manufacturer Reports:
      a. Itemized list of equipment to be supplied.
   2. Special Procedure Submittals:
      a. Provide itemized list of equipment to be supplied.
      b. Provide proposed labeling for system components.
   3. Qualification Statement:
      a. Installer:
         1) Provide Qualification documentation as requested by Engineer/Architect including:
            a) List of Projects requested.
            b) List of certified technician(s) with dates of training courses completed.

B. Closeout Submittals:
   1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
      a. Operations and Maintenance Data:
         1) Include following items supplied by Audiovisual Consultant at time of final inspection:
            a) System operation and maintenance instructions.
            b) List of equipment provided, including portable equipment, showing make, model, and serial number.

2) Leave clear plastic sheet protector in rear of equipment cabinet with system drawings and documentation.
3) Set-up files and settings for video equipment.

b. Warranty Documentation:
1) Final, executed copy of Warranty.

c. Record Documentation:
1) Manufacturers documentation:
a) Equipment manufacturer's manuals and warranty information.

d. Software:
1) Video System Software:
a) Set-up files and settings for video equipment.

1.5 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
1. System shall be installed in accordance with applicable standards, requirements, and recommendations of 2019 National Building Code – Alberta Edition, Canadian Electrical Code - CEC, and all local authorities having jurisdiction.

B. Qualifications:
1. Installer. Requirements of Section 01 4301 applies, but not limited to following:
a. Approved Installers:
1) Installers are to furnish and install components of video system and meet qualification requirements.
2) Approval subject to agreement process for Pre-Approval Installers.
b. Same Approved Installer shall furnish and install Section 27 5117 'Audio Systems'.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery And Acceptance Requirements:
1. Materials shall be delivered in original, unopened packages with labels intact.

B. Storage And Handling Requirements:
1. Provide secure location protected from weather in cool, dry location, out of direct sunlight in compliance with Manufacturer's instructions and recommendations.
2. Keep materials free from dirt and foreign matter.

1.7 WARRANTY

A. Special Warranty:
1. Provide complete warranty repair or replacement for one (1) year at no cost to Owner, except in case of obvious abuse.
2. If failure causes Chapel or Cultural Center audio system to be inoperative or unusable for its intended purpose, Installer, when notified of problem before Wednesday, shall repair system so it will be operational and usable by following Sunday. If defective components cannot be repaired in time, furnish and install temporary loaner equipment as required.
3. Honor component warranties for term established by Manufacturer, if greater than one (1) year.

PART 2 - PRODUCTS

2.1 OWNER-FURNISHED PRODUCTS

A. Category Four Products. See Section 01 6200 for definitions of Categories:

1. Network Streaming Equipment as specified on TA (Technology Audiovisual) Drawings as shown in Contract Documents including:
   a. Projectors.
   b. Video Monitors.
2. Coordination:
   a. Coordinate installation of all Owner Furnished Network Streaming Equipment including but not limited to:
      1) Installation and configure devices in accordance with LDS requirements.
      2) Proper set-up of Network Streaming Equipment.
      3) Testing of Network Streaming Equipment.

2.2 SYSTEM

A. Design Criteria:
   1. Video distribution system refers but is not limited to following components:
      a. Satellite dish, LNB, receiver, line amplifiers, video and audio processors, video switchers, cable, connectors and ancillary equipment necessary to successful reception and distribution of video and audio signal from the selected reception device (satellite and/or video stream).
      b. Owner Furnished Network Streaming Equipment.
   2. Intent of this specification is that receiving system will receive broadcasts from network streaming device and/or satellite currently in use by Church and provide video, audio, and video signal distributed properly throughout system.
   3. System shall be fully function and complete video distribution system using equipment and materials of types, sizes, rating, and performances as indicated in Contract Drawings and following requirements:
      a. Equipment and materials shall comply with manufactures' standard design and construction in accordance with published product data and in compliance with referenced standards.
      b. Equipment and materials are to be integrated with components and connections functions at optimum performance.
      c. Setup shall be optimized for display resolutions matching owner furnished display devices.

B. Manufacturers Contact List:
   1. Category Four Approved Components as shown on Contract Drawings from following manufacturers. See Section 01 6200 for definitions of Categories:
      a. Anderson Manufacturing, Idaho Falls, ID (800) 635-6106 or (208) 523-6460.
      b. Atlas Sound, Ennis, TX www.atlassound.com.
      c. Belden Wire & Cable Co, Richmond, IN www.belden.com.
      d. Blonder Tongue Laboratories Inc, Old Bridge, NJ www.blondertongue.com.
      e. California Amplifier, Camarillo, CA www.calamp.com.
      f. Chatsworth, Westlake Village, CA www.chatsworth.com.
      g. CommScope Inc., Hickory NC www.commscope.com.
      h. EFI Electronics, Salt Lake City, UT www.efinet.com.
      i. EMTECH Electronics Inc, Lindon, UT www.emtechelectronics.com.
      j. Extron, Anaheim, CA, www.extron.com.
      k. HellermannTyton, Milwaukee, WI www.hellermann.tyton.com.
      l. Holland Electronics, Ventura CA www.hollandelectronics.com.
      m. Hubbell Inc, Orange, CT www.hubbell-wiring.com.
      n. Leviton Manufacturing Co, Little Neck, NY www.leviton.com.
      o. Norsat, Richmond, BC www.norsat.com.
      p. Pelco, Clovis, CA www.pelco.com.
      q. Pico Macom Inc, Lakeview Terrace, CA www.picomacom.com.
      r. Prodelin Corp, Conover, NC www.prodelin.com.
      s. PSP Products Inc, West Valley City, UT www.pspproducts.com.
      t. Radio Design Labs, Carpenteria, CA www.rdlnet.com.
      u. Ramko Research Inc, Rancho Cordova, CA (800) 678-1357 or (916) 635-3600.
      v. Sony, New York, NY http://pro.sony.com.
      w. Surgex, Knightdale, NC www.surgex.com.
      x. RMS Electronics Inc, Secaucus, NJ (800) 223-8312 or (201) 288-8833.
      y. Switchcraft, Chicago, IL www.switchcraft.com.

z. TII Network Technologies, Edgewood, NY www.tiinetworktechnologies.com.
aa. Times Fiber Communications, Wallingford, CT www.timesfiber.com.
bb. TV One, Erlanger, KY www.tvone.com.
cc. Vicon Industries Inc, Hauppage, NY www.vicon-cctv.com.
dd. Wegener Communications, Duluth, GA www.wegener.com.
ee. West Penn Wire Corp, Washington, PA www.westpenn-cdt.com.

C. Materials:
1. Video Components as specified on TA (Technology Audiovisual) Drawings as shown in Contract Documents.

PART 3 - EXECUTION

3.1 INSTALLERS

A. Approved Installers:
1. Category Four Approved Installers. See Section 01 6200 for definitions of Categories:
a. Qualifications:
1) Meet qualification requirements as specified in Quality Assurance in Part 1 of this specification.
b. Allstar Show Industries: 10331 176th Street, Edmonton, AB, 780 486 4000. Contact Wayne Rabidoux – wayner@allstar-show.com.
c. ATP Systems: 210A, 12A Street North, Lethbridge, AB, 587 787 1330. Contact Alberto Bonini – Alberto.bonini@atpsystemsav.com.

3.2 EXAMINATION

A. Verification Of Conditions:
1. Verify compliance with following items before beginning work of this Section:
a. Assure that antenna clears every obstacle and has clear line-of-sight to United States domestic-arc satellites. If there are obstructions, report to Architect before proceeding.
b. No cables spliced.
c. Specified cables and equipment cabinets are properly installed.
2. Verify all site conditions are in compliance with requirements for proper installation and function of video system work.

3.3 INSTALLATION

A. Owner Furnished Equipment:
1. Network Streaming Equipment:
a. Install and setup Owner Furnished Network Streaming Equipment.
2. Extended Display Identification Data (EDID):
a. Set all specified EDID capable devices for Owner Furnished Display Device resolutions and sync signals including installation and setup.

B. General:
1. Install system in accordance with NFPA 70 'Canadian Electrical Code', NFPA 72 'National Fire Alarm and Signaling', and other applicable codes. Install equipment in accordance with manufacturer's written instructions.

C. Equipment Cabinet:
1. File smooth exposed rough edges after cutting and drilling. Do not allow sharp screws to protrude from cabinet.

2. Install vent panels at top and bottom of equipment cabinets. In addition, install vent panels above and below satellite receiver and between other components, where possible, for maximum ventilation.
3. Securely fasten equipment plumb and square in place. Utilize all fastening holes in front of cabinet.
4. Securely fasten in place equipment that is not rack mounted, including relays and other small components. Do not use sticky-back tape.
5. Install balancing / isolation transformer when balanced and unbalanced components are connected.
6. Wire XLR-type connections with pin 2 hot, pin 1 shield.
7. Connect powered components to 120 VAC outlets on voltage suppressor power bars. Do not connect to outlets on other components.
8. Identification:
   a. Legibly identify user-operated system controls and system input/output jacks using engraved, permanently attached laminated plastic plates or imprinted Lexan labels. Label equipment and controls within equipment cabinets using similar labels or printed labels from a label maker or laser printer.
   b. Affix label to rack panel in cabinet listing name and telephone number of installer. Appropriate warranty instructions may be included.

D. Cables, Wires, And Connectors:
   1. Cables:
      a. Cable and wire shall be new and unspliced.
      b. Splicing:
         1) Splicing of cables and conductors is expressly prohibited in any location other than equipment racks.
         2) Splicing of control and speaker level conductors shall be accomplished via punch block or terminal strip connections only.
      c. Additional cable length shall be provided at all connector locations. Duplex box, junction box, and floor box locations shall be installed with sufficient cable length behind cover plates to permit wiring maintenance and connector replacement in the future.
      d. When cable runs utilize vertical cable raceways located within walls, acoustic integrity of walls shall be maintained:
         1) Cables that pass through cover plates of junction boxes and raceways, through slab-to-slab walls, and through conduit lines shall be properly gasketted and sealed. Acoustic material shall be restored or replaced.
      e. Separation between system cables and other services shall be maximized to prevent and/or minimize potential for electro-magnetic interference (EMI):
         1) Provide at least 12 inches (305 mm) separation from electrical lines whenever feasible.
         2) Where separation is unavoidable, distribution cables shall cross other services at right angles whenever practical to minimize EMI.
      f. Do not install signal cables on top of light fixtures, ceiling speakers, video projector lifts, projection screens, HVAC controls or sensing devices, fire safety and sprinkler system detection technology, or any other technology or mechanical equipment.
      g. Do not lay cables directly on top of T-bar grid ceiling tiles:
         1) Support cables installed outside of conduit at 4 feet (1.20 m) maximum intervals from building structure.
         2) Do not utilize support wires from other trades or systems.
      h. Install system cables shall not block access to other equipment or services, across removable service panels and/or in any other manner to prohibit routine maintenance of HVAC systems, fire safety equipment and building mechanical control systems.
      i. Inter-rack cabling:
         1) Inter-rack cabling shall be neatly laced, dressed, strain relieved and adequately supported.
         2) Inter-rack cables shall be grouped according to signals being carried to reduce signal contamination. Separate groups shall be formed for following:
            a) Power.
            b) Control.
            c) Video.
            d) Audio cables carrying signals less than -20 dBM.

e) Audio cables carrying signals between -20 dBM and +20 dBM.
f) Audio cables carrying signals over +20 dBM.

j. Power cables, control cables, and high level cables shall be run on left side of equipment racks as viewed from rear. All other cables shall be run on right side of all equipment racks as viewed from rear.
k. Cables must be cut to electrical length, shall be cut to length dictated by cable run.
l. Terminal blocks, boards, strips or connectors, shall be furnished by installer for all cables which interface with racks, cabinets, consoles, or equipment modules. Affix terminal blocks, boards, strips or connectors to equipment racks using screws only. Double sided tape will not be accepted.
m. Shields for audio cables shall be grounded at input end only of various equipment items on system to prevent potential for ground loops.

2. Wiring and Cabling:
   a. Comply with industry standard circuit polarity and loudspeaker wiring polarity. No cables shall be terminated with polarity reversal between connectors at either end.
   b. System wire, after being cut and stripped, shall have wire strands twisted back to their original lay and be terminated by approved soldered or mechanical means. No bare wire ends shall be accepted.
   c. Do not place any wires and cables for this system in any conduit, raceway, wire way or cable tray that is used for mechanical systems of building.
   d. Route all cable and wiring within equipment racks, cabinets and millwork according to function, separating wires of different signal levels (microphone, line level, amplifier output, AC, control, etc.) by as much distance as possible. Neatly arrange, harness and bundle all cable with velcro straps.
   e. After completion of wiring and cable installation, all trough and box covers shall be notched out and grommetted for clearance of various cable bundles, (i.e., separate audio, video, and control). Panel covers shall be screwed back in place and all gaskets shall be restored or replaced.
3. Connectors:
   a. Provide connectors of type and quality as detailed in Contract Drawings and/or as required to meet minimum bandwidth requirements of equipment to which connectors are terminated. Overall quantity of connectors shall not be limited by quantities indicated in Contract Drawings and shall be provided as required.
   b. No connectors shall be installed in non-accessible locations or used for splicing cables. Connectors shall be new.
   c. Connectors shall incorporate strain relief mechanisms which firmly grip the jacket of connected cables.
   d. Connectors shall be properly polarized to prevent improper seating.
   e. Connectors shall provide appropriate electrical characteristics for circuitry to which they are attached.
   f. Exposed conductors inside of equipment racks shall be dressed with heavy duty neoprene heat-shrink tubing.
   g. Heat-shrink type tubing shall be used to insulate and dress ends of all wire and cables including separate tube for ground or drain wire.
   h. Solder connections shall be made with rosin-core solder. Temperature controlled soldering irons rated at least 60 watts shall be used for all soldering work. No soldering guns, gas or butane, or temperature unregulated irons shall be used on job site.
   i. Mechanical connections shall be made with approved crimp lugs of correct size and type for connection. Wire nuts shall not be permitted except inside speaker enclosures. Each connector shall be attached with proper size controlled-duty-cycle ratcheting crimp tool approved by manufacturer.
   j. Conventional non-ratcheting type crimping tools are unacceptable, and shall not be used on job site. Presence of such tools on job site shall constitute evidence of mechanical connections made with unauthorized tools and shall provide sufficient grounds for rejection of all mechanical connections in system, and will be considered non-conforming work.

E. Mounting And Securing Equipment:
   1. Equipment shall be firmly secured in place unless requirements of portability dictate otherwise.
   2. Fastenings and supports shall be adequate to support their loads with safety factor of at least three (3) times weight of equipment being installed.

3. Any structural mounting that is not able to meet this requirement due to specific nature of equipment, manufacturer's requirements or limitations of facility, shall not be installed without prior approval of Engineer.
4. Install all boxes, equipment, hardware, and other materials plumb, level, and square.

F. Millwork:
1. Install technology equipment and support equipment in podium, and other loose supplied millwork in neat and cosmetically dressed out manner.
2. Saw cuts, holes and recesses into laminates and woodwork shall be straight.
3. Radius and circular cuts shall be consistent, and all uneven surfaces shall be corrected. This shall include use of moldings, grommets, bushings, laminates, and wood products as required to dress out installation of equipment.
4. Verify installation of equipment and panels in technology racks and podiums are completed by using matching screws, hardware and grommets.

G. Technology:
1. Provide sufficient ventilation for adequate cooling of equipment.
2. Install vent rack panels in unused spaces. Install vent panels at top and bottom and above each power amplifier.
3. Securely fasten equipment plumb and square in place. Where equipment is installed in rack cabinets, utilize all fastening holes and cove open spaces with perforated panels.
4. Securely fasten relays and small components. Do not use sticky-back tape for fasteners.
5. Install balancing transformer on each unbalanced input or output that connects to devices outside equipment cabinet, or that connects to balanced input or output within equipment cabinet.
6. Connect powered components to 120 VAC outlets on transient voltage surge suppressors. Do not connect to outlets on other components.
7. Leave sufficient service loops to uniform length on cables to allow operation of system with chassis outside cabinet.
8. Equipment shall be held firmly in place with proper types of mounting hardware as recommended and/or supplied by manufacturer:
   a. Mounting hardware provided with equipment shall be used when practical. This shall include, but not be limited to, front and rear rack rails, angle brackets and rack mount kits.
   b. Equipment shall be installed so as to provide reasonable safety to operator.

3.4 SYSTEM SETUP

A. Digital Video System Setup:
1. . Pulpit HDMI and VGA Input (DTP T UWP 332D):
   a. Set Transmitter to Auto Switch between inputs, by shorting Contact Pins 1 and 2 to ground.

B. Rack Mounted DTP Receiver (DTP HDMI 330 RX):
1. Connect HDMI and Analog audio outputs to respective inputs on DTP switcher.

C. Video Switcher ‘VS’ Audio Setup:
1. Inputs:
   a. Video Input 2 must be set to Analog.
   b. Video Input 3 must be set to Multi-Ch Auto, system will automatically switch between analog and digital audio inputs when Input 3 is selected.
   c. Video Input 4 must be set to Multi-Ch Auto, system will automatically switch between analog and digital audio inputs when Input 4 is selected.
   d. Video Input 5 must be set for LPCM-2Ch Auto.
   e. Mic/Line Inputs 1 and 2 shall be muted.
2. Outputs:
   a. Input 1 and 6 must be set with preset which mutes analog audio outputs to Chapel when either input 1 or 6 is selected.
   b. All other inputs must be set up to unmute analog outputs.
   c. Input 5 must be configured to pass Left Program on Left Channel, Right Program on Right Channel.

d. Variable analog output should be setup to pass ‘No Program’.
e. Digital Outputs must be setup for ‘Stereo Program’.

D. Video Switcher ‘VS’ Video Setup:
1. Input Configuration:
a. All inputs shall be labeled in software according to inputs connected to them.
b. Input 1’s selected signal type shall match Camera’s Native Signal Output. IF no camera is installed, Signal type shall be set to composite.
c. Input 2’s signal type shall be set to RGB.
d. Aspect Ratio for Inputs 2 and 5 shall be set to follow, all others shall be set to fill.
e. All Inputs shall be set to auto image, auto memory, HDCP authorized, and Film Detect.
2. Output Configuration:
a. Set output Configuration to 1920x1200 @ 60 Hz.
b. Set Output Format for Auto for each output group.
c. Set Transitions to ‘CUT’.
3. General Settings:
a. Screen Saver shall be set to Blue with OSD Bug.
b. Select display color when sending HDCP content on non-compliant device to Green.
c. Set front Panel Lock out to Mode 2, allowing only input selection and volume controls.
d. Set HDCP mode to Follow Input.

3.5 FIELD QUALITY CONTROL

A. Field Tests:
1. Installer Testing:
a. Upon completion of installation and before inspection by Audiovisual Consultant, test functions verifying following. Make necessary corrections:
1) System is free from hum, noise, ghosting, loose parts and poor construction or soldering.
2) Video signals shall be clear, sharp, noise-free picture with good chroma and undistorted, noise free audio.
3) Audio to sound system is undistorted and noise free.
b. Complete documentation required by Audiovisual Consultant and submit to consultant within five (5) days of Substantial Completion.

B. Field Inspections:
1. Audiovisual Consultant Inspection:
a. Coordinate final inspection schedule with Audiovisual Consultant two (2) weeks minimum before Consultant's final inspection.
b. Have copy of Installer redlined documents sent to Audiovisual Consultant two (2) weeks minimum to before field inspection.
c. Provide following test equipment in good working order:
1) Digitally generated video test signal generator:
a) Generator shall provide minimum of but not be limited to industry standard test signals including color bar patterns, grey scale, alternating pixel, cross hatch and H-pattern.
b) Generator shall provide resolutions compatible with all specified video equipment.
c) Generator shall provide resolutions up to 1920 x 1200.
2) Digital Volt-Ohmmeter.
3) Necessary chargers, cable, test leads, adapters and other accessories for test equipment.
d. Ensure Owner Furnished Display Devices such as projectors and video monitors are available and on site at time of inspections.
e. Correct minor items so Audiovisual Consultant may certify satisfactory completion without return trip.

C. Non-Conforming Work:
1. Correct any work found defective or not complying with contract document requirements at no additional cost to the Owner.

D. Manufacturer Services:
   1. Provide services of factory authorized service representative to supervise field assembly and connection of components and pretesting, testing, and adjustment of system.

3.6 CLEANING

A. Waste Management:
   1. All work areas are to be kept clean, clear and free of debris at all times.
   2. Disposal of rubbish, debris, and packaging materials to Contractor provided Dumpster.

END OF SECTION

SECTION 27 5117

AUDIO SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install complete and operational sound system as described in Contract Documents including:
      a. Complete systems for amplifying sound signals from microphones and media source equipment and distributing them to loudspeakers at various locations.
   2. Assist Audiovisual Consultant with final inspection and equalization of system and provide necessary test equipment for audio system and partition noise isolation tests if applicable. Correct problems found at time of final inspection of system.

B. Related Requirements:
   1. Division 26 'Electrical':
      a. Raceway, boxes, and installation of speaker enclosures and mounting rings furnished by Division 27.
      b. Power to equipment location and power relay wiring if applicable.
   2. Section 27 1116: 'Communications Cabinet, Racks, Frames, and Enclosures'.
   3. Section 27 1501: 'Communications Horizontal Cabling'.
   4. Section 27 4117: 'Video Systems'.
   5. Audiovisual Consultant will perform final inspection, system balance, equalization, and instruct local leaders in operation of system.

C. Products Installed But Not Furnished Under This Section:
   1. Webcast Communicator or Webcast Capable Device.

D. Related Requirements:
   1. Section 01 6400: Owner will furnish Webcast Communicator or Webcast Capable Device such as personal computer or laptop. This Section establishes quality of materials and installation for information of Contractor, Architect, and Owner's Representatives.

1.2 REFERENCES

A. Association Publications:
   1. Building Industry Consulting Service International (BISCI):
      a. *Information Transport Systems Installation Methods Manual* (ITSIMM) (5th Edition).
      b. *Telecommunications Distribution Methods Manual* (TDMM) (12th Edition).
   2. InfoComm International Association:
      a. *Audiovisual Best Practices: The Design & Integration Process for the AV and Construction Industries*.
      b. *AV Design Reference Manual* (1st Edition, 2006).
      c. *Basics of Audio and Visual Systems Design* (2003).
   3. Institute of Electrical and Electronics Engineers:
      a. IEEE 1100-2005, '*Recommended Practice for Powering and Grounding Electric Equipment*'.

B. Reference Standards:
   1. American National Standards Institute/InfoComm International Association:
      a. ANSI/INFOCOMM 1M:2009, 'Audio Coverage Uniformity in Enclosed Listener Areas'.
      b. ANSI/INFOCOMM 2M:2010, 'Standard Guide for Audiovisual Systems Design and Coordination Processes'.
      c. ANSI/INFOCOMM 4:2012, 'Audiovisual Systems Energy Management'.
   2. National Fire Protection Association:

a. NFPA 70, ‘Canadian Electrical Code (CEC)' (2017 or most recent edition adopted by AHJ).
b. NFPA 72, ‘National Fire Alarm and Signaling Code’ (2019 or most recent edition adopted by AHJ).

3. Telecommunications Industry Association:
   a. TIA-568.2, 'Balanced Twisted-Pair Telecommunications Cabling and Components Standards' (Revision D, 2018).
   b. TIA-569, 'Telecommunications Pathways And Spaces' (Revision D, 2015).
   c. TIA-606, 'Administration Standard for Telecommunications Infrastructure' (Revision C, 2017).
   d. TIA-607, 'Telecommunications Bonding and Grounding (Earthling) for Customer Premises' (Revision C, 2015).
   e. TIA-758, ‘Customer-Owned Outside Plant Telecommunication Infrastructure Standard' (Revision B, 2012).
4. Underwriters Laboratories (UL):
   a. UL 486A-486B, 'Wire Connectors' (3rd Edition April 2018).
5. 2019 National Building Code – Alberta Edition.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate final inspection schedule of both audio and video systems before Audiovisual Consultant's final inspection.

B. Schedule:
   1. After completion of audio system installation of this section, Installer to perform Field Testing before Audiovisual Consultant Final Inspection of audio system.
   2. Notify Audiovisual Consultant two (2) weeks minimum before Audiovisual Consultant's final inspection as specified in Field Quality Control in Part 3 of this specification.

1.4 SUBMITTALS

A. Informational Submittals:
   1. Special Procedure Submittals:
      a. Provide itemized list of equipment to be supplied.
      b. Provide proposed labeling for system components.
   2. Qualification Statement:
      a. Installer:
         1) Provide Qualification documentation as requested by Engineer/Architect including:
            a) List of Projects requested.
            b) List of certified technician(s) with dates of training courses completed.

B. Closeout Submittals:
   1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
      a. Operations and Maintenance Data:
         1) Equipment Manufacture’s manual:
            a) Audio system operation and maintenance instructions.
            b) List of equipment provided, including portable equipment, showing make, model, and serial number.
      b. Warranty Documentation:
         1) Include copy of final, executed warranty.
      c. Record Documentation:
         1) Software and Programming: Copies of all manufacturers’ software used for programming various components and functions of the system shall be furnished to the Owner:
            a) Original audio processor program files, source codes and compiled codes used for system control, audio setup and any other computerized functions of system including screen layout generation, configuration and layouts and any other related computer files shall also be furnished to Owner.

b) In each and every case, all programming, code generation, configuration files, layout files and any other software and/or code written and generated of setup and operation of this system are property of Owner of system and not of Audiovisual Consultant, Contractor or Integrator.

1.5 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. System shall be installed in accordance with applicable standards, requirements, and recommendations of 2019 National Building Code – Alberta Edition, Canadian Electrical Code – CEC, and all local authorities having jurisdiction.

B. Qualifications:
   1. Installer. Requirements of Section 01 4301 applies, but not limited to following:
      a. Approved Installers:
         1) Installers are to furnish and install components of audio system and meet qualification requirements.
         2) Approval subject to agreement process for Pre-Approval Installers.
      b. Same Approved Installer shall furnish and install components of Section 27 1116 'Communications Cabinets, Racks, Frames and Enclosures' and Section 27 4117 'Video Systems'.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery And Acceptance Requirements:
   1. Materials shall be delivered in original, unopened packages with labels intact.

B. Storage And Handling Requirements:
   1. Provide secure location protected from weather in cool, dry location, out of direct sunlight in compliance with Manufacturer’s instructions and recommendations.
   2. Keep materials free from dirt and foreign matter.

1.7 WARRANTY

A. Special Warranty:
   1. Provide complete warranty repair or replacement for one (1) year at no cost to Owner, except in case of obvious abuse.
   2. If failure causes Chapel or Cultural Center audio system to be inoperative or unusable for its intended purpose, Installer, when notified of problem before Wednesday, shall repair system so it will be operational and usable by following Sunday. If defective components cannot be repaired in time, furnish and install temporary loaner equipment as required.
   3. Honor component warranties for term established by Manufacturer, if greater than one (1) year.

PART 2 - PRODUCTS

2.1 OWNER-FURNISHED PRODUCTS

A. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
   1. Webcast Communicator or Webcast Capable Device.

2.2 SYSTEM

A. Manufacturers Contact List:

1. Category Four components as shown on Drawings from following Manufacturers. See Section 01 6200 for definition of Categories.
   a. Atlas Sound, Phoenix, AZ www.atlassound.com.
   b. Audio-Technica US Inc, Stow, OH www.audio-technica.com.
   c. Belden Wire & Cable Co, Richmond, IN www.belden.com.
   d. BSS Audio, Sandy, UT www.bssaudio.com.
   e. Chatsworth, Westlake Village, CA www.chatsworth.com.
   f. Community Professional Loudspeakers, Chester, PA www.communitypro.com.
   g. COMTEK Inc, Salt Lake City, UT www.comtek.com.
   h. Conquest Sound Co, Tinley Park, IL www.conquestsound.com.
   i. Crown Audio Inc, Elkhart, IN www.crownaudio.com.
   j. Countryman, Menlo Park, CA www.countryman.com.
   k. EIKI International, Laguna Nigel, CA www.eiki.com.
   l. Electro-Voice Inc, Burnsville, MN www.electro-voice.com.
   m. Emtech Electronics Inc, Orem, UT www.emtechelectronics.com.
   n. Extron, Anaheim, CA www.extron.com.
   o. HellermannTyton, Milwaukee, WI www.hellermann.tyton.com.
   p. Hubbell Inc, Orange, CT www.hubbell-wiring.com.
   q. IVIE Technologies Inc, Lehi, UT www.ivie.com.
   r. JBL Professional, Northridge, CA www.jblpro.com.
   s. König & Meyer, Wertheim, Germany www.k-m.de/en.
   t. Leviton Manufacturing Co, Little Neck, NY www.leviton.com.
   u. Liberty AV Solutions, Colorado Springs, CO www.libertycable.com.
   v. Lowell Manufacturing Co, Pacific, MO www.lowellmfg.com.
   w. Middle Atlantic Products, Fairfield, NJ www.middleatlantic.com.
   x. Neutrik USA Inc, Lakewood, NJ (732) 901-9488. www.neutrikusa.com.
   y. Newark Electronics, Sola and Triad, Chicago, IL www.newark.com.
   z. QSC Audio Products, Costa Mesa, CA www.qscaudio.com.
   aa. Radio Design Labs, Carpenteria, CA www.rdlnet.com.
   bb. Rane Corp, Mukilteo, WA www.rane.com.
   cc. Shure Brothers, Evanston, IL www.shure.com.
   dd. SoundTech, Mundelein, IL www.soundtech.com.
   ee. Soundtube Entertainment, Park City, UT www.soundtube.com.
   ff. Surgex, Knightdale, NC www.surgex.com.
   gg. Switchcraft, Chicago, IL www.switchcraft.com.
   hh. TOA Electronics, South San Francisco, CA www.toaelectronics.com.
   ii. TV One, Erlanger, KY www.tvone.com.
   jj. Whirlwind Music Distributors, Inc., Rochester, NY www.whirlwindusa.com.
   kk. Wireworks Corp, Hillside, NJ www.wireworks.com.

B. Performance:
   1. Capabilities:
      a. Installations with audio DSP shall meet following performance parameters:
         1) From 100 Hz to 2 kHz, flat within plus or minus 2 dB.
         2) Above 2 kHz, slope down along an approximate 3 dB per octave slope to 8 kHz.
      b. No noise, hum, RFI pickup or distortion shall be audible under normal operating conditions.
      c. Audio systems shall reproduce program material at level of 80 to 85 dBA without audible distortion.
      d. All input levels shall be pre-set so system may be operated without going into feedback under normal conditions.
      e. Seat-to-seat variations in the 4kHz octave band shall not exceed plus or minus 2 dB in the Chapel or Cultural Center.
      f. Sound masking system:
         1) Sound masking system shall provide adequate speech privacy in Corridor when set between 42 dBA and 46 dBA at ear-height under speaker so conversation in Office at slightly raised voice levels cannot be understood in Corridor.

C. System Requirements:
   1. General:

a. Provide complete and fully functional audio systems using materials and equipment of types, sizes, ratings, and performances as indicated in equipment list in accompanying drawings:
   1) Use materials and equipment that comply with referenced standards and manufacturers' standard design and construction in accordance with published product information.
   2) Coordinate features of materials and equipment so they form integrated system with components and interconnections matched for optimum performance of specified functions.

2. Provide all wire, cable, and connectors as required to complete installation of all systems as designed and specified.

D. Equipment And Materials:
1. General:
   a. Provide equipment selected from equipment list on drawings, or as substituted following proscribed substitution process, using all solid state components fully rated for continuous duty at ratings indicated or specified.
   b. Select equipment for normal operation on input power supplied at 105 130 V, 60 Hz.

PART 3 - EXECUTION

3.1 INSTALLERS

A. Approved Installers:
1. Category Four Approved Installers. See Section 01 6200 for definitions of Categories:
   a. Qualifications:
      1) Meet qualification requirements as specified in Quality Assurance in Part 1 of this specification.
   a. Allstar Show Industries: 10331 176th Street, Edmonton, AB, 780 486 4000. Contact Wayne Rabidoux – wayner@allstar-show.com.
   b. ATP Systems: 210A, 12A Street North, Lethbridge, AB, 587 787 1330. Contact Alberto Bonini – Alberto.bonini@atpsystemsav.com.

3.2 EXAMINATION

A. Verification Of Conditions:
1. Verify compliance with following items before beginning work of this Section:
   a. No cables spliced.
   b. Isolated ground run back to electrical panel from all equipment cabinets.
   c. Specified conduit, cables, speaker enclosures and equipment cabinets are properly installed.
   d. Location and angle of speaker cabinets.
2. Ensure that no solid structural or decorative member impedes sound propagation from speakers and that no member with cross section greater than 3/4 inch (19 mm) is placed in front of speakers.
3. Verify installation of fiberglass insulation in field-fabricated speaker enclosures.

3.3 INSTALLATION

A. General:
1. Install system in accordance with NFPA 70 'Canadian Electrical Code', NFPA 72 'National Fire Alarm and Signaling', and other applicable codes. Install equipment in accordance with manufacturer's written instructions.

B. Mounting And Securing Equipment:
1. Equipment shall be firmly secured in place unless requirements of portability dictate otherwise.
2. Fastenings and supports shall be adequate to support their loads with safety factor of at least three (3) times weight of equipment being installed.

3. Any structural mounting that is not able to meet this requirement due to specific nature of equipment, manufacturer's requirements or limitations of facility, shall not be installed without prior approval of Engineer.
4. Install all boxes, equipment, hardware, and other materials plumb, level, and square.

C. Millwork:
1. Install technology equipment and support equipment in millwork in neat and cosmetically dressed out manner.
2. Install technology equipment and support equipment in podium and other loose supplied millwork in neat and cosmetically dressed out manner.
3. Saw cuts, holes and recesses into laminates and woodwork shall be straight.
4. Radius and circular cuts shall be consistent, and all uneven surfaces shall be corrected. This shall include use of moldings, grommets, bushings, laminates, and wood products as required to dress out installation of equipment.
5. Install equipment and panels in technology racks and podiums using matching screws, hardware and grommets.

D. Speakers:
1. Maintain uniform polarity in speakers and wiring.
2. Employ no positive stop in rotation of speaker volume controls. Controls shall be capable of continuous rotations in either direction.
3. Mount transformers with screws securely to speaker brackets or enclosures. Adjust torsion springs as necessary to securely support speaker assembly.
4. Neatly mount speaker grilles, panels, connector plates, control panels, etc., tight, plumb, and square unless indicated otherwise on drawings.
5. Provide brackets, screws, adapters, springs, rack mounting kits, etc, recommended by manufacturer for correct assembly and installation of speaker assemblies and electronic components.
6. Line factory-fabricated speaker back boxes with one inch (25 mm) minimum fiberglass if not done by Back box Manufacturer.
7. Speaker Back Boxes shall be secured to structure using 12 ga (2.7 mm) minimum seismic safety cables.

E. Technology:
1. Provide sufficient ventilation for adequate cooling of equipment.
2. Install vent rack panels in unused spaces. Install vent panels at top and bottom and above each power amplifier.
3. Securely fasten equipment plumb and square in place. Where equipment is installed in rack cabinets, utilize all fastening holes and cove open spaces with perforated panels.
4. Securely fasten relays and small components. Do not use sticky-back tape for fasteners.
5. Install balancing transformer on each unbalanced input or output that connects to devices outside equipment cabinet, or that connects to balanced input or output within equipment cabinet.
6. Connect powered components to 120 VAC outlets on transient voltage surge suppressors. Do not connect to outlets on other components.
7. Leave sufficient service loops to uniform length on cables to allow operation of system with chassis outside cabinet.
8. Equipment shall be held firmly in place with proper types of mounting hardware as recommended and/or supplied by manufacturer:
    a. Mounting hardware provided with equipment shall be used when practical. This shall include, but not be limited to, front and rear rack rails, angle brackets and rack mount kits.
    b. Equipment shall be installed so as to provide reasonable safety to operator.

F. Cables, Wires, And Connectors:
1. Cables:
    a. Cable and wire shall be new and unspliced.
    b. Splicing:
        1) Splicing of cables and conductors is expressly prohibited in any location other than equipment racks.
        2) Splicing of control and speaker level conductors shall be accomplished via punch block or terminal strip connections only.

c. Additional cable length shall be provided at all connector locations. Duplex box, junction box, and floor box locations shall be installed with sufficient cable length behind cover plates to permit wiring maintenance and connector replacement in the future.
d. When cable runs utilize vertical cable raceways located within walls, acoustic integrity of walls shall be maintained:
    1) Cables that pass-through cover plates of junction boxes and raceways, through slab-to-slab walls, and through conduit lines shall be properly gasketted and sealed. Acoustic material shall be restored or replaced.
e. Separation between system cables and other services shall be maximized to prevent and/or minimize potential for electro-magnetic interference (EMI):
    1) Provide at least 12 inches (305 mm) separation from electrical lines whenever feasible.
    2) Where separation is unavoidable, distribution cables shall cross other services at right angles whenever practical to minimize EMI.
f. Do not install signal cables on top of light fixtures, ceiling speakers, projection screens, HVAC controls or sensing devices, fire safety and sprinkler system detection technology, or any other technology or mechanical equipment.
g. Do not lay cables directly on top of T-bar grid ceiling tiles:
    1) Support cables installed outside of conduit at 4 feet (1.20 m) maximum intervals from building structure.
    2) Do not utilize support wires from other trades or systems.
h. Install system cables shall not block access to other equipment or services, across removable service panels and/or in any other manner to prohibit routine maintenance of HVAC systems, fire safety equipment and building mechanical control systems.
i. Inter-rack cabling:
    1) Inter-rack cabling shall be neatly laced, dressed, strain relieved and adequately supported.
    2) Inter-rack cables shall be grouped according to signals being carried to reduce signal contamination. Separate groups shall be formed for following:
        a) Power.
        b) Control.
        c) Video.
        d) Audio cables carrying signals less than -20 dBM.
        e) Audio cables carrying signals between -20 dBM and +20 dBM.
        f) Audio cables carrying signals over +20 dBM.
j. Power cables, control cables, and high-level cables shall be run on left side of equipment racks as viewed from rear. All other cables shall be run on right side of all equipment racks as viewed from rear.
k. Cables, except video cables which must be cut to electrical length, shall be cut to length dictated by cable run.
l. Terminal blocks, boards, strips or connectors, shall be furnished by installer for all cables which interface with racks, cabinets, consoles, or equipment modules. Affix terminal blocks, boards, strips or connectors to equipment racks using screws only. Double sided tape will not be accepted.
m. Shields for audio cables shall be grounded at input end only of various equipment items on system to prevent potential for ground loops.
n. Shields for microphone cables shall be grounded at both ends to allow Phantom Power to pass.

2. Wiring and Cabling:
    a. Comply with industry standard circuit polarity and loudspeaker wiring polarity. No cables shall be terminated with polarity reversal between connectors at either end.
    b. System wire, after being cut and stripped, shall have wire strands twisted back to their original lay and be terminated by approved soldered or mechanical means. No bare wire ends shall be accepted.
    c. Do not place any wires and cables for this system in any conduit, raceway, wire way or cable tray that is used for mechanical systems of building.
    d. Route all cable and wiring within equipment racks, cabinets and millwork according to function, separating wires of different signal levels (microphone, line level, amplifier output, AV, control, etc.) by as much distance as possible. Neatly arrange, harness and bundle all cable with velcro straps.

e. After completion of wiring and cable installation, all trough and box covers shall be notched out and grommetted for clearance of various cable bundles, (i.e., separate audio, video, and control). Panel covers shall be screwed back in place and all gaskets shall be restored or replaced.

3. Connectors:
   a. Provide connectors of type and quality as detailed in Contract Drawings and/or as required to meet minimum bandwidth requirements of equipment to which connectors are terminated. Overall quantity of connectors shall not be limited by quantities indicated in Contract Drawings and shall be provided as required.
   b. No connectors shall be installed in non-accessible locations or used for splicing cables. Connectors shall be new.
   c. Connectors shall incorporate strain relief mechanisms which firmly grip the jacket of connected cables.
   d. Connectors shall be properly polarized to prevent improper seating.
   e. Connectors shall provide appropriate electrical characteristics for circuitry to which they are attached.
   f. Exposed conductors inside of equipment racks shall be dressed with heavy duty neoprene heat-shrink tubing.
   g. Heat-shrink type tubing shall be used to insulate and dress ends of all wire and cables including separate tube for ground or drain wire.
   h. Solder connections shall be made with rosin-core solder. Temperature controlled soldering irons rated at least 60 watts shall be used for all soldering work. No soldering guns, gas or butane, or temperature unregulated irons shall be used on job site.
   i. Mechanical connections shall be made with approved crimp lugs of correct size and type for connection. Wire nuts shall not be permitted except inside speaker enclosures. Each connector shall be attached with proper size controlled-duty-cycle ratcheting crimp tool approved by manufacturer.
   j. Conventional non-ratcheting type crimping tools are unacceptable, and shall not be used on job site. Presence of such tools on job site shall constitute evidence of mechanical connections made with unauthorized tools and shall provide sufficient grounds for rejection of all mechanical connections in system, and will be considered non-conforming work.

G. Equipment Cabinet:
1. Install vent panels at top and bottom of equipment cabinets and between components where possible for maximum ventilation. Locate amplifiers at top of cabinet. Locate equalizers below amplifiers, separated by several vent panels.
2. Securely fasten equipment plumb and square in place. Utilize all fastening holes in front of cabinet.
3. Securely fasten in place equipment that is not rack mounted, including relays and other small components. Do not use sticky-back tape.
4. Install balancing / isolation transformer when balanced and unbalanced components are connected.
5. Wire XLR-type connections with pin 2 hot, pin 1 shield.
6. Connect powered components to 120 VAC outlets on voltage suppressor power bars. Do not connect to outlets on other components.
7. Identification:
   a. Legibly identify user-operated system controls and system input / output jacks using engraved, permanently attached laminated plastic plates or imprinted Lexan labels. Label equipment and controls within equipment cabinets using similar labels or printed labels from a label maker or laser printer.
   b. Affix label to rack panel inside cabinet listing name and telephone number of installer. Appropriate warranty instructions may be included.

H. Identification And Labeling:
1. Cables, regardless of length, shall be identified with machine-printed wrap-around labeling system at both ends:
   a. These labels shall be self-laminating to ensure durability.
   b. Label format used shall be equal, or better than, system detailed.
2. There shall be no unmarked cables any place in system.

3. Marking codes used on cables shall correspond to codes provided with submittals, and/or written documentation of 'Record Drawings'.
4. Connectors, controls, equipment components, terminal blocks and equipment racks are to be permanently labeled in format approved during submittal process.
5. Equipment labels are to be permanently engraved in metal. Alternative method shall be approved during submittal process only.
6. Clearly and permanently label all jacks, controls, connections, and so forth. Embossed or printed label tape shall not be used and is considered unacceptable for this system. Attach labels with double stick tape as required.
7. Labeling shall be completed prior to acceptance of final system.

I. Grounding:
1. Provide equipment grounding connections for audio system as indicated. Tighten connections to comply with tightening torques specified in UL Standard 486A-486B to assure permanent and effective grounds.
2. Ground equipment, conductor, and cable shields to eliminate shock hazard and to eliminate ground loops, common mode returns, noise pickup, cross talk, and other impairments. Provide 5 ohm ground at main equipment location. Measure, record, and report ground resistance.
3. Provide grounding conductor with green insulation between as indicated on Contract Drawings. Comply with IEEE and TIA standards.

J. Pulpit:
1. Install pulpit microphone pre-amplifier to be accessible below lectern. Do not alter factory supplied microphone cable and connectors.
2. Install pulpit microphone so tip of microphone head is 2 inches (50 mm) inside edge of lectern when microphone is tilted down to maximum extent.

K. Loose Millwork Devices:
1. Install required devices into loose supplied millwork lecturns, podiums, etc…as indicated on millwork drawings – see A413.

3.4 FIELD QUALITY CONTROL

A. Field Tests:
1. Installer Testing:
a. After completion of installation but before inspection by Audiovisual Consultant, perform following:
1) Conduct system tests and make necessary corrections for proper system operation including, but not limited to, following:
a) Output level uniformity.
b) Polarity.
c) Shock, strain excited hum, and oscillation.
d) Clipping, hum, noise, and RFI in all system configurations.
e) Speaker line impedances.
f) Loose parts and poor workmanship or soldering.
2) Sweep speaker systems with high-level sine wave or 1/3 octave pink noise source. Correct causes of buzzes or rattles related to speakers or enclosures. Notify Contractor and Audiovisual Consultant of external causes of buzzes or rattles.
3) Rough Balance: Balance system well enough that it can be used for meetings before final inspection.
b. Complete documentation required by Audiovisual Consultant and submit to consultant within five (5) days of Substantial Completion.

B. Field Inspections:
1. Audiovisual Consultant Inspection And Equalization:
a. Coordinate final inspection schedule with Audiovisual Consultant two (2) weeks minimum before Consultant's final inspection.
b. Have copy of Installer redlined documents sent to Audiovisual Consultant two (2) weeks minimum to before field inspection.

c. Have loose equipment (microphones, cables, etc.) available at time of inspection.
d. Assist Audiovisual Consultant in final inspection of completed system.
e. Assist Audiovisual Consultant in noise isolation testing of folding partitions and office doors.
f. Provide following test equipment in good working order:
    1) Laptop computer:
        a) Operating System: Microsoft Window 7.
        b) Processor: 2 GHz Dual-Core Intel Processor or faster (or compatible).
        c) RAM: 2 GB or greater.
        d) Video: Graphics processor with 128 M dedicated video RAM, minimum 1024x768 display or better.
        e) Sound Hardware: Audio Hardware with OS compatible ASIO, Wav/WDB drivers, sample rate of up to 192kHz and bit-resolutions of up to 32. Bit,or better.
    2) 1/3 octave real-time audio spectrum analyzer with SPL meter, and precision microphone.
    3) Digitally generated random pink noise generator, 20Hz-20KHz, minimum two (2) hour repetition rate or ten (10) minutes minimum of equivalent signal recorded on compact disc.
    4) Direct reading audio impedance meter, minimum three (3) frequencies, and ten (10) percent accuracy.
    5) Digital Volt-Ohmmeter.
    6) Audio oscillator, variable frequency, 20Hz-20KHz.
    7) MP3 player with pre-recorded speech and music program material.
    8) Necessary chargers, cables, test leads, adapters, and other accessories for test equipment.
    9) Tools and spare parts for making adjustments and corrections to system.
    10) CAT-5 / RJ-45 continuity tester similar to Ideal 62-200 or Amprobe DCT-300.
g. Correct minor items so Audiovisual Consultant may certify satisfactory completion during his visit.

C. Non-Conforming Work:
    1. Correct any work found defective or not complying with contract document requirements at no additional cost to the Owner.

D. Manufacturer Services:
    1. Provide services of factory authorized service representative to supervise field assembly and connection of components and pretesting, testing, and adjustment of system.

3.5 CLEANING

A. Waste Management:
    1. All work areas are to be kept clean, clear and free of debris at all times.
    2. Disposal of rubbish, debris, and packaging materials to Contractor provided Dumpster.

END OF SECTION

ATTACHMENTS

MEETINGHOUSE SOUND SYSTEM FUNCTIONALITY

Each of the sound system(s) should function as indicated

SOUND MASKING SYSTEM

Sound masking speakers located in outside of offices, should be tapped at 1W, and be calibrated to produce 44-46 dBA SPL when measured at 5'10" AFF. Masking speakers located in offices, shall be tapped at ½ W. SPL is determined by calibration of public area sound masking speakers.

CHAPEL SYSTEM

'CP' shall be equipped with pulpit Up/Down buttons, Room Volume step up/down buttons, LED's to provide user feedback of relative volume level. Power On/Off button, and power LED. Each time the system is turned on, the system will shall:

- restore the system to its default settings, and,
- illuminate the middle sound level LED, which corresponds to the defaults sound level.
- Trigger the Chapel amplifier relay, wait 3 to 5 seconds, for the amplifier to power up, then unmute the DSP output to the chapel amplifier.
- While the amplifier is powering up, the power LED should flash, indicating that the system is not fully ready.
- After the system is fully ready, the LED should remain on.
- Pulpit Up/Down control
- When the system is activated, the pulpit up/down control shall trigger relays in the pulpit height motor causing it to move up or down within the limits determined by the pulpit manufacturer
- shall not cause an audible pop to be heard over the sound system
- Relays installed by the AV contractor shall not be audible in the vicinity of the pulpit, when being operated.

Volume Level Control

- The volume level control shall allow the user to control the relative volume level of the room within a 10dB range. Steps up from the default level shall be made in 2dB steps. Steps down from the default level shall be made in 3dB steps. Where the manufactures products do not allow steps of different levels, the increasing, and decreasing steps shall be of equal magnitude. The LEDs on the CP shall each correspond to a step location, and shall illuminate to indicate the selected relative sound level.

In systems where a VM is installed in the chapel, the VM should:

- As closely as possible mirror the KP in the video Rack, both audio levels and selections should be mirrored.
- Control the volume of the selected auxiliary audio feed, without affecting the volume of the microphones, or the auxiliary input on the side of the pulpit.
- The selected audio from the VM should be routed to the CP, to be included with the room mix.
- The VM, should not function unless the CP is already on.
- If a user attempts to active the VM when the CP is off, the system should initiate the startup sequence for the system, then activate the VM.

- When the sound system is turned off, the last selected VM configuration should be retained in memory for 4hrs. After 4hrs, the VM selection should revert to none, and the volume level should be set to ∞.
- No microphones inputs should be muted when an Aux source is selected on the VM

Default Configuration

- The defaults sound level for the system is -4 dB below the feedback level.
- The number of open microphones (NOM) shall be 3.
- The pulpit, and sacrament microphones shall be set to always open.
- Auxiliary feeds from both the video system, and the audio system shall not be included in the NOM calculation.

CULTURAL HALL SYSTEM

The cultural hall system consists of multiple sections. From the available sections, the section closest to the chapel shall be equipped with a 'CC' or main controller, and shall be referred to as the main section. The next largest available section shall be equipped with a 'CC2' or secondary controller, and shall be referred to as the secondary. Each section shall be electronically separated, or combined via an Infrared sensor, which shall be mounted such that it reliably detects weather the operable partition doors physically separating the sections are open or closed.

The Cultural hall 'CC' device shall consist of power and manual control buttons. 3 rotary knobs, along with one each XLR, RCA, and stereo mini input jacks housed in a protective metal wall box. The power button, shall be capable of turning the cultural hall sound system on in all attached sections, and shall default to auto mode. When in auto mode, the sound level in the cultural hall shall be determined by the level determined by the consultant as part of the EO. When in manual mode, volume knobs shall allow users to adjust the volume of individual microphone or line level inputs.

The cultural hall 'CC2' device shall be consist of a 4-button controller with volume control mounted in a protective metal wall box. The 4 buttons shall be labeled from top to bottom as Off and local mic. In meetinghouses, equipped with a satellite system, the reaming buttons shall be labeled with the second and third most common languages used in the meetinghouse. Where no languages are used, the buttons shall be left blank.

Room Combining

- Cultural hall sections and the chapel shall be combinable, by opening the folding partition doors, and triggering the IR sensors. Combinable sections are assigned a priority, when a lower priority section is combined with a higher priority section, controls in the lower priority section shall be disabled, and the sound mix from the higher priority section shall be routed to the lower priority section. When controls are disabled, LEDs shall flash, indicating that the controls are not available. Sound originating in the Cultural Hall section shall never be routed to the Chapel speakers.

ASSISTIVE LISTENING SYSTEM (ALS)

The assistive listening system, uses RF frequencies to broadcast an audio feed to compatible receivers. When the chapel sound system is on, the system broadcasts the chapel sound. If the cultural hall system is on, and the chapel is not, the system will broadcast the sound form the cultural hall.

INDEPENDENT ROOM SYSTEMS

Rooms with independent systems, are equipped to include one or more microphone jacks and a wall controller. The wall controller shall be capable of selecting the sound source to be heard over the local sound system. In meetinghouses without a satellite system, the controller shall select between the local feed, and the perimeter feed. In meetinghouse which include a satellite system, the controller shall also be able to select between the available satellite languages. The controller shall list the satellite language name as sat, followed by the language names, such as "Sat English".

The wall controller shall also be equipped with a volume control knob, capable of adjusting the volume between mute, and odB. The odB level shall correspond to the maximum volume level set at EO which does not produce feedback when the local microphone is used.

PERIMITER ROOM SYSTEMS, AND THE PERIMITER FEED

The perimeter room systems shall include a speaker and volume control knob, in each meetinghouse foyer area, serving area, as well as other selected rooms. These systems shall be connected to the perimeter feed.

When active, the perimeter feed shall transmit sound to the connected systems and rooms. Connected systems shall include independent room systems, Assistive Listening Systems, and Foyer systems, the perimeter feed shall default to the chapel sound whenever the chapel system is on. If the cultural hall system is on, when the chapel system is off, the perimeter feed shall transmit the cultural hall system. When both systems are off, the perimeter feed shall transmit no sound signals.

WEBCAST AUDIO

Stake Centers shall be equipped with XLR inputs and outputs for the purpose of allowing users to alter the default webcast audio feed. The AV rack shall include connections for 2 Choir microphones, an Organ Output, a Chapel Mix output, and a Webcast Input. The chapel organ sound shall be routed from the chapel organ to the chapel organ output. The sound heard through the overflow speakers in the chapel shall be routed to the Chapel Mix Output. The Choir Microphone outputs shall be cabled directly to the Choir microphone inputs on the rostrum.

The system shall include a webcast output connected directly from the DSP processor to the Webcast device. By Default, the system shall route the Chapel Mix to webcast device. If signal is detected on the Webcast In, the system shall automatically route that signal to the webcast device instead of the default chapel mix. Users shall be able to connect a manual mixer to the provided connections on CP1, and automatically route a custom mix to the webcast device.

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DIVISION 28: ELECTRONIC SAFETY AND SECURITY

28 3000 ELECTRONIC DETECTION AND ALARM

28 3101 FIRE DETECTION AND ALARM SYSTEM

END OF TABLE OF CONTENTS

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SECTION 28 3101

FIRE DETECTION AND ALARM SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install fire alarm and detection system as described in Contract Documents.
   2. Furnish and install raceway, cable and conductors, boxes, and miscellaneous items necessary for complete system.

B. Products Furnished But Not Installed Under This Section:
   1. Door Plates for door hold / release devices.

C. Related Requirements:
   1. Division 21: Furnishing and installing of water flow switches, valve tamper switches, and low temperature sensors.
   2. Division 26: Quality of and installation standards for wiring, raceway, conduit, and boxes.

1.2 REFERENCES

A. Reference Standards:
   1. National Fire Protection Association:
      a. NFPA 72, 'National Fire Alarm and Signaling Code' (2019 or most recent edition adopted by AHJ).
   2. Underwriters Laboratories:
      a. UL 268, 'Smoke Detectors for Fire Alarm Systems'.
      b. UL 464, 'Audible Signal Appliances'.
      c. UL 521, 'Heat Detectors for Fire Protective Signaling Systems'.
      d. UL 864, 'Control Units and Accessories for Fire Alarm Systems'.
      e. UL 1480, 'Speakers for Fire Alarm, Emergency, and Commercial and Professional'.
      f. UL 1481, 'Power Supplies for Fire-Protective Signaling Systems'.
      g. UL 1971, 'Standard for Signaling Devices for the Hearing Impaired'.
   3. Underwriters Laboratories of Canada:
      a. CAN/ULC-S524-14, 'Standard for the Installation of Fire Alarm Systems'.
      b. ABC 2019
      c. CEC 2018

1.3 SUBMITTALS

A. Action Submittals:
   1. Shop Drawings:
      a. Prepared by authorized factory representative and including:
         1) Single line diagram of actual system. Typical riser diagrams are not acceptable.
         2) Complete wiring diagrams.
         3) Manufacturer's original catalog data and descriptive information on each piece of equipment to be used.

B. Informational Submittals:
   1. Certificates:
      a. Certificate of completion, from Manufacturer's Representative, in accordance with NFPA 72 requirements.
   2. Qualification Statement:

a. Installer:
1) Provide NICET Certification documentation.

C. Closeout Submittals:
1. Include following information in Operations And Maintenance Manual specified in Section 01 7800:
a. Operations and Maintenance Data:
1) Provide operating and maintenance instructions for each item of equipment submitted under Product Data.
2) Provide instruction manual from Manufacturer that explains what is to be done in event of various indications.
b. Record Documentation:
1) Include copy of approved shop drawings.

1.4 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
1. System shall meet approval of authority having jurisdiction (AHJ). NEC and local ordinances and regulations shall govern unless more stringent requirements are specified.
2. Equipment, devices, and cable shall be UL or Factory Mutual listed for use in fire alarm systems.

B. Qualifications:
1. Installer:
a. Project Forman or Person in Charge at all times to be NICET Level III Certified for work performed by this Section.
b. Provide Certificate documentation before installation.

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Manufacturers:
1. Type One Acceptable Manufacturers:
2. Symplex
3. Notifier
a. Bosch Security Systems, Fairport, NY www.boschsecurity.us.
b. Fire-Lite Alarms, Northford, CT www.firelite.com.
c. Mircom / Summit Systems Technologies, Cheektowaga (Buffalo), NY, Vaughan (Toronto), Ontario www.mircom.com / www.summit-st.net.
d. Potter Electric Signal Company, St. Louis, MO www.pottersignal.com.
e. Silent Knight Security Systems, Northford CT www.silentknight.com.
f. Equal as approved by Architect before bidding. See Section 01 6200.

B. Performance:
1. Design Criteria:
a. Automatic fire alarm system consisting of control panel, power supplies, alarm initiating devices, notification appliances, and off-site communicating devices. System shall be non-coded and addressable, and monitored for integrity of conductors.
b. Class A loop type initiating device circuits and Class A loop type notification appliance circuits.
c. Equipment and accessories furnished under this Specification shall be standard products of single manufacturer, or include written statement by Control Panel Manufacturer confirming compatibility of components and inclusion of these components under system warranty.

C. Operation:
1. Operation Sequences:

a. Operation of manual station or automatic activation of any smoke detector, heat detector, or sprinkler flow device shall:
   1) Cause system notification appliances to operate.
   2) Indicate zone in alarm on control panel.
   3) Initiate off-site alarm notification system.
b. System shall return to normal when operated device is returned to normal and control panel is manually reset, except alarms may be silenced as specified below.
c. Alarm may be silenced by switch in control panel.
   1) Ring Back Feature: When silenced, this shall not prevent the resounding of subsequent alarms if another zone should alarm.
d. When alarms are silenced, zone indicating red LEDs on control panel and remote annunciator shall remain indicated until operated device is returned to normal and control panel is manually reset.
e. Green pilot LED, or other visual annunciation, shall normally be on indicating that system is receiving normal power. In addition, failure of normal power shall be annunciated.
f. Trouble alarm and annunciation, operating together, shall signal trouble condition. Following conditions shall signal trouble condition:
   1) Failure of normal power.
   2) Opens or short circuits on indicating circuits.
   3) Disarrangements in system wiring.
   4) Control panel circuit board removal.
   5) Ground faults.
   6) Trouble silencing switch shall silence trouble alarm, but visual annunciation shall remain on until system is restored to normal. As ring-back feature, trouble alarm shall resound as reminder to return silencing switch to normal position.
g. Supervisory LED, separate from trouble LED, and alarm, operating together, shall signal operation of supervisory device, such as control valve tamper or low temperature sensors. Alarm silence switch shall operate in same manner as trouble alarm.

D. Components:
1. Control Panel:
   a. Listed under UL Standard 864.Fully addressable single stage.
   b. Solid-state design with flush or semi-flush mounting.
   c. Control functions shall be behind locked door with annunciating devices visible through door. Single key shall operate all keyed functions in system. Provide three keys.
   d. Each zone shall be electrically supervised in accordance with wiring style specified.
   e. Provide integral surge protection.
   f. Make provisions for connection to off-site alarm notification system including all required programming. Provide separate dry contacts for alarm and supervisory/trouble alarms.
   g. Power Supply:
      1) Provide indication of normal power supply.
      2) Loss of normal power shall activate trouble alarm.
      3) Meet requirements of and size in accordance with UL Standard 1481 and NFPA 72.
      4) Include standby batteries, charger, and automatic transfer equipment.
   h. Visual Annunciation:
      1) Separate indication on each zone for alarm, trouble, or supervisory conditions.
      2) Visual indication shall be by LED lights or other easily identifiable method.
      3) On zoned system, permanently custom label zones by zone name, not number.
      4) Fault or trouble condition on any zone shall not affect any other zone.
   i. Audible Horn Alarm Annunciation:
      1) Provide separate and distinct alarm signals for alarm and trouble conditions.
      2) Alarm signal shall also operate strobe lights, if specified.
      3) Provide alarm silence switches at control panel.
      4) Trouble alarm shall be horn integral to control panel.
      5) Supervisory alarm may be same audible alarm as trouble alarm, but with separate visual annunciation.
      6) Exterior strobe for fire departments direction.
2. Off-Site Alarm Notification System:
   a. Provide two (2) telephone lines to fire alarm control panel.

b. Install, program and connect cellular communication device furnished by Owner. Coordinate with Owner at least four (4) weeks in advance for equipment delivery.
c. Provide dialer system equipment and programming compatible with Owner selected monitoring service (refer to alarm.ldschurch.org for details).
d. Owner will arrange for monitoring connection contract.
e. Communicator device shall transmit all zone identification, device identification alarm identification, and all other signals available at panel to Owner's Central Station using standard contact ID codes.
f. Phone Dialer device shall be of same manufacturer as Fire Alarm Panel or shall be supplied, approved and tested by Fire Alarm Panel Manufacturer.

3. Alarm Initiating Devices:
   a. Smoke Detectors:
      1) Photoelectric type.
      2) Listed under UL Standard 268.
      3) Provide visual indication of alarm on unit.
   b. Heat Detectors:
      1) Non-settable 135 deg F (57 deg C) fixed temperature.
      2) Provide visible indication that device has operated.
      3) Listed under UL Standard 521.
   c. Low Building Temperature Device:
      1) Set for contact closure at 35 deg F (2 deg C).
      2) Type Two Acceptable Products;
         a) Honeywell T631A1006.
         b) Equal as approved by Architect before installation. See Section 01 6200.
   d. Manual Fire Alarm Boxes:
      1) Non-coded and double-action requiring two actions to initiate alarm. Breakable glass type is not approved.
      2) Box shall mechanically latch when actuated and require key to reset. Key shall match control panel door lock.
4. Notification Appliances:
   a. Color: White.
   b. Combination Horn / Strobe:
      1) Wall mounted flush or semi-flush.
      2) Non-coded audible output of 90 dB minimum at 10 feet (3 meters).
      3) Integrally mounted flashing light unit with block letters 'FIRE.' Minimum light intensity of 15 candela and flash rate between one and three Hertz.
      4) Listed under UL Standard 464 and UL Standard 1971.
5. Door Hold / Release Devices:
   a. Electronically operated magnetic devices that hold doors open until released by main control panel.
   b. 120 V, 60 Hz operations.
   c. Semi-flush mounting of electromagnet w/ thru bolts.
   d. Provide surface mounting or extension shoe where door hardware configuration dictates.
   e. Stainless steel armature.
   f. Type One Acceptable Products:
      1) Simplex: 2088-9608 / surface mounted extension.
      2) Edwards: 1505-N5 / 1508-N5.
      3) Equal as approved by Architect before bidding. See Section 01 6000.
   g. Provide relay to release units electronically operated devices at fire alarm condition. Use hold open model to fit specific application to hold door as close to wall as possible without conflict with door hardware.
6. Accessory Devices:
   a. Notification Appliance Protective Devices: Provide wire guard covers for appliances installed in Cultural Center.
7. Cables And Wiring:
   a. Comply with NEC Article 760.
   b. Jacket and insulation color shall be red.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fire alarm and detection systems as indicated, in accordance with Equipment Manufacturer's written instructions, and complying with applicable portions of NEC, NFPA, and NECA's 'Standard of Installation'.
   1. Mounting Heights: Heights as per Can ULC standards , CEC 2018 and ABC 2019. Below for reference only.
      a. Unless otherwise indicated, mount center of outlets or boxes at following heights above finish floor:
         1) Control Panel: 72 inches (1 800 mm) to top.
         2) Wall-Mounted Horn / Strobe: 80 inches (2 1032 mm). 6 inches (150 mm) below ceiling, whenever ceiling is below 80 inches (2 1032 mm).
         3) Wall-Mounted Strobe: 80 inches (2 1032 mm). 6 inches (150 mm) below ceiling, whenever ceiling is below 80 inches (2 1032 mm).
         4) Manual pull stations: 48 inches (1 200 mm).
         5) Remote annunciator panel: 60 inches (1 500 mm).
   2. Locate fire alarm manual stations 24 inches (600 mm) minimum away from any light switch.

B. Identification:
   1. Label zone indicators on control unit indicating location and type of initiating device, i.e., CORRIDOR SMOKE, VALVE TAMPER, LOW TEMPERATURE, etc. Labels shall be engraved plastic laminate, or other permanent labeling system as supplied by Control Unit Manufacturer.
   2. Post copy of wire identification list inside fire alarm panel door or other area accessible to fire alarm service personnel.
   3. Print location of circuit disconnecting means inside panel.

C. Conductors:
   1. Install conductors in conduit per NEC requirements.
   2. Fire alarm system conductors from different zones may be combined in common conduit. Make certain that raceway size and wire quantity, size, and type is suitable for equipment supplied and is within NEC standards. Label pull and junction boxes 'FIRE ALARM.'
   3. Install conductors and make connections to water flow switches, valve tamper switches, and low temperature sensors.
   4. Loop wires through each device on zone for proper supervision. Tee-taps not permitted.
   5. Minimum conductor size shall be 14 AWG unless otherwise specified.

D. Do not install ceiling mounted detectors within 36 inches (900 mm) of air discharge grilles. Do not install manual fire alarm boxes within 24 inches (610 mm) of light switches. Coordinate with other trades as required.

E. Contractor to allow $2800.00 in bid for MPP engineering witness test. If an Alternative Engineer is utilized the contractor shall carry 80% of the amount identified for MP&P to review the alternative engineers documentation prior to C2 release.

3.2 FIELD QUALITY CONTROL

A. Field Tests:
   1. Provide factory-trained representative to perform complete system testing in presence of Owner's representative and local fire department personnel upon completion of installation.
      a. Test each initiating and annunciating device for proper operation, except fixed temperature heat detectors.
      b. Test operation of trouble annunciation on each circuit.
      c. Perform complete testing of control panel functions including off-site monitoring.

B. Testing and Verification:

1. Arrange to have and pay for components and system operation verification by supplier.
2. Arrange to have and pay for components and system operation verification by professional engineer registered in the Province of Alberta.
3. Submit verification certificate signed and sealed by the Professional Engineer registered in the Province of Alberta for submission to the AHJ.

3.3 CLOSEOUT ACTIVITIES

A. Instruction Of Owner:
   1. Instruct Owner's Representative in proper operation and maintenance procedures.

3.4 PROTECTION

A. Provide dust protection for installed smoke detectors until finish work is completed and building is ready for occupancy.

B. Protect conductors from cuts, abrasion and other damage during construction.

END OF SECTION

DIVISION 31: EARTHWORK

31 0500 COMMON WORK RESULTS FOR EARTHWORK

31 0501 COMMON EARTHWORK REQUIREMENTS

31 1000 SITE CLEARING

31 1123 AGGREGATE BASE
31 1413 TOPSOIL STRIPPING AND STOCKPILING

31 2000 EARTH MOVING

31 2213 ROUGH GRADING
31 2214 PROOF ROLLING
31 2216 FINE GRADING
31 2316 EXCAVATION
31 2323 FILL
31 2500 EROSION AND SEDIMENTATION CONTROLS

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SECTION 31 0501

COMMON EARTHWORK REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited to:
   1. General procedures and requirements for earthwork.

B. Related Requirements:
   1. Section 01 1200: 'Multiple Contract Summary' for multiple contracts.
   2. Pre-Installation conferences held jointly with Section 31 0501 as described in Administrative Requirements on Part 1 of this specification section:
   3. Section 32 9001: 'Common Planting Requirements':
      a. Pre-installation conference held jointly with other landscape related sections.

1.2 REFERENCES

A. Definitions:
   1. Aggregate Base: Layer of granular material immediately below concrete and asphalt paving or miscellaneous site concrete (sidewalks, curbs, etc) and below interior concrete slabs on grade.
   2. Base: See aggregate base.
   3. Building Grading: sloping of grounds immediately adjacent to building. Proper grading causes water to flow away from a structure. Grading can be accomplished either with machinery or by hand.
   4. Compacted Fill: Placement of soils on building site placed and compacted per Contract Documents. Used to replace soils removed during excavation or to fill in low spot on building site.
   5. Excavation: Removal of soil from project site or cavity formed by cutting, digging or scooping on project site.
   6. Fine Grading (FG): Preparation of subgrade preceding placement of surfacing materials (aggregate base, asphalt or concrete paving, and topsoil) for contour of building site required. Fine Grading is conducted to ensure that earth forms and surfaces have been properly shaped and subgrade has been brought to correct elevations. It is performed after rough grading and placement of compacted fill but before placement of aggregate base or topsoil.
   7. Finish Grading: Completed surface elevation of landscaping areas for seeding, sodding, and planting on building site.
   8. Natural Grade: Undisturbed natural surface of ground.
   9. Rough Grading (RG): Grading, leveling, moving, removal and placement of existing or imported soil to its generally required location and elevation. Cut and fill is part of rough grading.
   10. Subgrade (definition varies depending upon stage of construction and context of work being performed):
      a. Prepared natural soils on which fill, aggregate base, or topsoil is placed.
         or
      b. Prepared soils immediately beneath paving or topsoil.
   11. Topsoil Placement and Grading: Topsoil placement and finish grading work required to prepare site for installation of landscaping.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:
   1. Participate in MANDATORY pre-installation conference for common earthwork sections:
      a. Schedule conference after completion of site clearing but before beginning grading work.
      b. Participate in pre-installation conference held jointly with following sections:

1) Section 03 3111: 'Cast-In-Place Structural Concrete'.
2) Section 31 1123: ‘Aggregate Base’.
3) Section 31 1413: ‘Topsoil Stripping and Stockpiling’.
4) Section 31 2213: 'Rough Grading'.
5) Section 31 2216: 'Fine Grading'.
6) Section 31 2316: ‘Excavation’.
7) Section 31 2323: ‘Fill’.
8) Section 32 1216: ‘Asphalt Paving’.
9) Division 33: Utilities.

c. In addition to agenda items specified in Section 01 3100, review following:
1) Review Geotechnical Evaluation Report.
2) Review common earthwork schedule.
3) Review protection requirements.
4) Review cleaning requirements.
5) Review safety issues.
6) Review field tests and inspections requirements.

d. In addition to agenda items specified above, review following. These are items that will occur before pre-installation conference for landscape sections:
1) Review topsoil stripping and stockpiling requirements.
2) Review landscape grading requirements.
3) Review landscape finish grade tolerance requirements.
4) Review landscape and plant tolerances.
5) Review surface preparation of landscape and planting areas.
6) Review additional agenda items as specified in related sections listed above.

2. Participate in pre-installation conference for landscape sections as specified in Section 32 9001:
a. Schedule pre-installation conference after completion of Fine Grading specified in Section 31 2216, but one (1) week minimum before beginning landscape work and held jointly with following sections:
1) Section 32 8423: ‘Underground Sprinklers’.
2) Section 32 9120: ‘Topsoil And Placement’.
3) Section 32 9122: ‘Topsoil Grading’.
4) Section 32 9223: ‘Sodding’.
5) Section 32 9300: ‘Plants’.

b. In addition to agenda items specified in Section 01 3100 and Section 32 9001, review following that these items have been installed correctly:
1) Review topsoil placement requirements.
2) Review topsoil surface preparation requirements.
3) Review topsoil depth requirements.
4) Review landscape finish grade tolerance requirements.
5) Review surface preparation of landscape and planting areas.

B. Sequencing:
1. General Earthwork:
a. Excavation.
b. Rough Grading.
c. Fill.
d. Fine Grading.
e. Aggregate Base or Topsoil Grading.

1.4 QUALITY ASSURANCE

A. Testing And Inspection:
1. Owner is responsible for Quality Assurance. Quality assurance performed by Owner will be used to validate Quality Control performed by Contractor.
a. Owner will employ testing agencies to perform testing and inspection as specified in Field Quality Control in Part 3 of this specification:
1) Owner’s employment of an independent Testing Agency does not relieve Contractor of Contractor’s obligation to perform the Work in strict accordance with requirements of Contract Documents and perform contractor testing and inspection.

2) See Section 01 1200: 'Multiple Contract Summary'.
2. Contractor is responsible for Quality Control (QC) Testing.

PART 2 - PRODUCTS: Not Used

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification Of Conditions:
1. Forty-eight (48) hours minimum before performing any work on site, contact Alberta First Call and any private locates as necessary to arrange for utility location services.
2. Perform minor, investigative excavations to verify location of various existing underground facilities at sufficient locations to assure that no conflict with the proposed work exists and sufficient clearance is available to avoid damage to existing facilities.
3. Perform investigative excavating ten (10) days minimum in advance of performing any excavation or underground work.
4. Upon discovery of conflicts or problems with existing facilities, notify Architect by phone or fax within twenty-four (24) hours. Follow telephone or fax notification with letter and diagrams indicating conflict or problem and sufficient measurements and details to evaluate problem.

3.2 PREPARATION

A. Protection:
1. Spillage:
a. Avoid spillage by covering and securing loads when hauling on or adjacent to public streets or highways.
b. Remove spillage and sweep, wash, or otherwise clean project, streets, and highways.
2. Dust Control:
a. Take precautions necessary to prevent dust nuisance, both on-site and adjacent to public and private properties.
b. Correct or repair damage caused by dust.
3. Existing Plants And Features:
a. Do not damage tops, trunks, and roots of existing trees and shrubs along boulevards that are intended to remain.
b. Do not use heavy equipment within branch spread.
c. Interfering branches may be removed only with permission of Architect.
d. Do not damage other plants and features that are to remain.

3.3 REPAIR / RESTORATION

A. Adjust existing covers, boxes, and vaults to grade.

B. Replace broken or damaged covers, boxes, and vaults.

C. Independently confirm size, location, and number of covers, boxes, and vaults that require adjustment.

3.4 FIELD QUALITY CONTROL

A. Field Tests And Inspections:
1. Civil and structural field tests, laboratory testing, and inspections are provided by Owner's independent Testing Agency as specified in Section 01 4523 'Testing And Inspection Services':

a. Quality Control is sole responsibility of Contractor. Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform The Work or Contractors own Testing and Inspection services.

2. Testing and inspection of earthwork operations is required.
3. Field Tests and Laboratory Tests:
   a. Owner reserves right to require additional testing to re-affirm suitability of completed work including compacted soils that have been exposed to adverse weather conditions.
4. Field Inspections:
   a. Notify Architect forty-eight (48) hours before performing excavation or fill work.
   b. If weather, scheduling, or any other circumstance has interrupted work, notify Architect twenty-four (24) hours minimum before intended resumption of grading or compacting.

B. Non-Conforming Work:
   1. If specified protection precautions are not taken or corrections and repairs not made promptly, Owner may take such steps as may be deemed necessary and deduct costs of such from monies due to Contractor. Such action or lack of action on Owner's part does not relieve Contractor from responsibility for proper protection of The Work.

END OF SECTION

SECTION 31 1123

AGGREGATE BASE

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install the following as described in Contract Documents:
      a. Aggregate Base:
         1) Interior concrete slabs-on-grade.
         2) Miscellaneous exterior concrete (sidewalks, curb, gutter, edgers, and equipment pads).
         3) Asphalt paving.

B. Related Requirements:
   1. Section 01 1200: ‘Multiple Contract Summary’ for multiple contracts.
   2. Section 01 4523: ‘Testing and Inspecting Services’ for testing and inspection, and testing laboratory services for materials, products, and construction methods.
   3. Section 03 3111: 'Cast-In-Place Structural Concrete'.
   4. Section 31 0501: ‘Common Earthwork Requirements’:
      a. General procedures and requirements for earthwork.
      b. Pre-installation conference held jointly with other common earthwork related sections.
   5. Section 31 2213: ‘Rough Grading’.
   6. Section 31 2216: 'Fine Grading' for subgrade procedures.
   7. Section 31 2323: 'Fill' for compaction procedures and tolerances.
   8. Section 32 1216: 'Asphalt Paving.

C. Products Installed But Not Furnished Under This Section:
   1. Vapor Retarder:
      a. Interior slabs on grade:
         1) Under-slab vapor retarder and seam tape.

D. Related Requirements:
   1. Section 07 2616: 'Below-Grade Vapor Retarders' for:
      a. Furnishing of vapor retarder and seam tape.

1.2 REFERENCES

A. Definitions:
   1. Aggregate (Asphalt Paving):
      a. Aggregate: A hard inert mineral material, such as gravel, crushed rock, slag, or sand.
      b. Coarse Aggregate: Aggregate retained on No. 8 (2.36 mm) sieve.
      c. Dense-Graded Aggregate: Aggregate that is graded from maximum size down through filler with object of obtaining an asphalt mix with controlled void content and high stability.
      d. Fine Aggregate: Aggregate passing No. 8 (2.36 mm) sieve.
      e. Reclaimed Asphalt Pavement (RAP): Existing asphalt mixture that has been pulverized, usually by milling, and is used like an aggregate in recycling of asphalt pavements.

B. Reference Standards:
   1. ASTM International:
      a. ASTM C131/C131M-14, 'Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine’.
      b. ASTM D1556/D1556M-15, ‘Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method’.

c. ASTM D1557-12, ‘Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3))’.
d. ASTM D1883-16, 'Standard Test Method for California Bearing Ratio (CBR) of Laboratory-Compacted Soils.
e. ASTM D2167-15, ‘Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method’.
f. ASTM D2419-14, ‘Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate’.
g. ASTM D4318-17, ‘Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils'.
h. ASTM D6938-17, 'Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)’.
i. ASTM E1643-18a, 'Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs’.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conferences:
1. Participate in MANADORY pre-installation conference as specified in Section 31 0501.
2. In addition to agenda items specified in Section 01 3100 and Section 31 0501, review following:
a. Review requirements and frequency of testing and inspections.
b. Review aggregate base installation requirements.
c. Review vapor retarder installation requirements.
d. Review proposed miscellaneous exterior concrete schedule.
e. Review proposed asphalt paving schedule.
f. Review Section 01 4523 for Testing and Inspection administrative requirements and responsibilities and Field Quality Control tests and inspections required of this section.
1) Review frequency of testing and inspections.

B. Sequencing:
1. Compaction as described in Section 31 2216 'Fine Grading'.
2. Exterior Footings and Foundations are installed.
3. Vapor Retarder below interior concrete slabs on grade:
a. Install below-grade vapor retarder on top of aggregate base.
b. See detail A/A305.
4. Aggregate Base:
a. Install aggregate base at location shown in Contract Drawings.
5. Concrete Slab is installed.

C. Scheduling:
1. Interior slab-on-grade concrete:
a. Notify Architect twenty-four (24) hours minimum before installation of concrete to allow inspection of vapor retarder installation.
b. Notify Testing Agency and Architect twenty-four (24) hours minimum before installation of interior concrete slabs to allow inspection of aggregate base.
c. Allow special inspector to review all sub grades and excavations to determine if building pad has been prepared in accordance with geotechnical report prior to placing any aggregate base.
2. Miscellaneous exterior concrete:
a. Notify Testing Agency and Architect twenty-four (24) hours minimum before placing concrete for exterior site work concrete (sidewalks, curbs, gutters, etc.), footings, foundation walls, and building slabs to allow inspection of aggregate base.
3. Asphalt Paving:
a. Notify Testing Agency and Architect twenty-four (24) hours minimum before placing aggregate base to allow inspection of aggregate base.

1.4 SUBMITTALS

A. Closeout Submittals:
1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
a. Record Documentation:
1) Testing and Inspection Reports:
a) Testing Agency Testing and Inspecting Reports of aggregate base.

1.5 QUALITY ASSURANCE

A. Testing And Inspection:
1. Owner will provide Testing and Inspection for aggregate base:
a. Owner is responsible for Quality Assurance. Quality assurance performed by Owner will be used to validate Quality Control performed by Contractor.
b. Owner will employ testing agencies to perform testing and inspection for aggregate base as specified in Field Quality Control in Part 3 of this specification.
1) Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform the Work in strict accordance with requirements of Contract Documents and perform contractor testing and inspection.
2) See Section 01 1200: 'Multiple Contract Summary'.
2. Contractor is responsible for Quality Control (QC) Testing.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery And Acceptance Requirements:
1. Materials shall be delivered in original, unopened packages with labels intact.

1.7 FIELD CONDITIONS

A. Ambient Conditions:
1. Do not perform work during unfavorable conditions as specified below:
a. Aggregate Base:
1) Presence of free surface water.
2) Over-saturated sub base materials.
b. Vapor Retarder:
1) Unacceptable conditions for installation include presence of high winds which would tear or damage vapor retarder.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aggregate Base:
1. Under Interior Slab-On-Grade Concrete:
a. New Aggregate Base:
1) Gravel: 3/4 inch 18mm minimum to one inch 25 mm maximum well-graded, clean gravel or crushed rock.
2) Base type gravel or crushed rock, graded by weight as follows (three-quarter to one-inch clean gap-graded gravel):
a) Road Base type gravel or crushed stone (slag not allowed), graded as follows:

(1) Sieve		Percent of Weight Passing
(a) 1 inch	(25.4 mm)	100
(b) 3/4 inch	(19.0 mm)	90 - 80
(c) 1/2 inch	(12.7 mm)	20 - 40

(d)	3/8 inch	(9.5 mm)	5 - 10
(e)	No. 4	(4.750 mm)	0 - 12

2. Under Miscellaneous Exterior Concrete:
   a. New Aggregate Base:
      1) Road Base type gravel or crushed stone, graded as follows:

a) Sieve			Percent of Weight Passing
(1)	1 inch	(25.4 mm)	100
(2)	3/4 inch	(19.0 mm)	85 - 100
(3)	No. 4	(4.750 mm)	45 - 60
(4)	No. 10	(2.000 mm)	30 - 50
(5)	No. 200	(0.05 mm)	5 - 10 (non-plastic)

3. Under Asphalt paving:
   a. New Aggregate Base:
      1) Road Base type gravel or crushed stone, graded as follows:

a) Sieve			Percent of Weight Passing
(1)	1 inch	(25.4 mm)	100
(2)	3/4 inch	(19.0 mm)	85 - 100
(3)	No. 4	(4.750 mm)	45 - 60
(4)	No. 10	(2.000 mm)	30 - 50
(5)	No. 200	(0.05 mm)	5 - 10 (non-plastic)

PART 3 - EXECUTION

3.1 PREPARATION

A. Stockpiles:
   1. Provide area for each stockpile of adequate size, reasonably uniform in cross-section, well drained, and cleared of foreign materials.
   2. Locate piles so that there is no contamination by foreign material and no intermingling of aggregates from adjacent piles. Do not use steel-tracked equipment on stockpiles.
   3. Do not store aggregates from different sources, geological classifications, or of different gradings in stockpiles near each other unless bulkhead is placed between different materials.
   4. Do not use washed aggregates sooner than twenty-four (24) hours after washing or until surplus water has drained out and material has uniform moisture content.
   5. Do not stockpile higher than 15 feet (4.57 m). Cover or otherwise protect stockpiles for use in HMA to prevent buildup of moisture.

B. Surface Preparation (Miscellaneous Exterior Concrete):
   1. Subgrade:
      a. Finish grade to grades required by Contract Documents.
      b. Compact subgrade as specified in Section 31 2323.

C. Surface Preparation (Asphalt Paving):
   1. Subgrade:
      a. Finish grade parking surface area to grades required by Contract Documents.
      b. Aggregate base and paving must be placed before any moisture or seasonal changes occur to subgrade that would cause compaction tests previously performed to be erroneous. Recompact and retest subgrade soils that have been left exposed to weather.

D. Surface Preparation (Interior Slab-On-Grade Concrete):
   1. Vapor Retarder:
      a. Install vapor retarder in accordance with ASTM E1643 except where Contract Documents indicate otherwise and following instructions:
         1) Install vapor retarder over aggregate base over compacted subgrade so entire area under slab is covered.
         2) Install vapor retarder in accordance with ASTM E1643 at interior stem walls.
         3) Lap joints 6 inches (150 mm) minimum and seal with specified seam tape.

4) Lap vapor retarder up vertical concrete interface 4 inches (100mm) minimum and seal with specified seam tape.
5) Seal vapor retarder around pipes, conduits, and other utility items that penetrate vapor retarder using factory-fabricated boot installed as recommended by Manufacturer.
6) Except for punctures required for reinforcing and anchor bolts at top of stem walls, seal tears and punctures.

3.2 INSTALLATION

A. Aggregate Base:
1. General:
a. Do not place aggregate base material when subgrade is frozen or unstable.
b. Spread aggregate base material with equipment except in limited or restricted areas where use of hand spreading is allowed.
c. Spread aggregate base material in manner that does not break down material and eliminates segregation, ruts, and ridges.
d. Correct damage to aggregate base caused by construction activities and maintain corrected aggregate base until subsequent course is placed.
e. Do not allow traffic on aggregate base.
f. Remove all standing storm water.
2. Under interior concrete slab-on-grade aggregate base:
a. Place 4 inches (100 mm) minimum of aggregate base under vapor retarder, level, and compact with vibratory plate compactor over 12 inches (305mm) of pit run – see detail A/A305.
3. Under miscellaneous exterior concrete aggregate base:
a. Place 8 inches (200 mm) minimum of aggregate base, level, and compact as specified in Section 31 2323.
b. See details G102, G103, and G104 for typical structures.
4. Asphalt paving aggregate base:
a. 6 inches (152mm) thick minimum after compaction in accordance with Contract Drawings.
b. 12 inches (305mm) thick minimum pit run after compaction in accordance with Contract Drawings.
c. See detail A/G102.
d. If roller is smaller than 8 ton (7260 kg), lay aggregate base and compact in two courses.
e. Compact as specified in Section 31 2323.
f. Priming: Prime aggregate base with application of 0.2 to 0.5 gallons (2 to 5 liters) of asphalt cement primer per square yard (meter) if pavement will be laid more than three days after compaction of aggregate base, or if precipitation is anticipated between completion of compaction of aggregate base and laying of asphalt paving.
g. Recompact unprimed aggregate base if it receives precipitation before pavement is laid.
h. Remove or repair improperly prepared areas as directed by Architect.

B. Tolerances:
1. Asphalt Paving Areas:
a. Aggregate base:
1) 6 inches (152mm) high.
2) Measure using string line from curb to curb, gutter, flat drainage structure, or grade break.
3) Finished base course shall be true to line and grade within plus or minus 1/4 inch in 10 feet (6 mm in 3 meters).
4) Maximum variation from required grades shall be 1/10 of one foot (28 mm).
b. Pit Run base:
1) 12 inches (305mm) high.
2) Measure using string line from curb to curb, gutter, flat drainage structure, or grade break.
3) Finished base course shall be true to line and grade within plus or minus 1/4 inch in 10 feet (6 mm in 3 meters).
4) Maximum variation from required grades shall be 1/10 of one foot (28 mm).

3.3 FIELD QUALITY CONTROL

A. Field Tests And Inspections:
   1. Civil and structural field tests, laboratory testing, and inspections are provided by Owner's independent Testing Agency as specified in Section 01 4523 'Testing And Inspection Services':
      a. Quality Control is sole responsibility of Contractor.
         1) Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform testing and inspection as part of his Quality Control:
            a) Testing and inspections, if performed by Contractor, will be responsibility of Contractor to be performed by an independent entity.
   2. Aggregate Base:
      a. Interior slab-on-grade concrete areas:
         1) Testing Agency shall provide testing and inspection for interior aggregate base.
         2) Number of tests may vary at discretion of Architect.
         3) Testing Agency will test compaction of base in place according to ASTM D1556/D1556M, ASTM D2167, and ASTM D6938, as applicable. Tests will be performed at following frequency:
            a) Building Slab Areas: One test for every 2,500 sq. ft. (232 sq. m) or less of building slab area but no fewer than three tests.
      b. Miscellaneous exterior concrete areas:
         1) Testing Agency shall provide testing and inspection for exterior aggregate base.
         2) Number of tests may vary at discretion of Architect.
         3) Testing Agency will test compaction of base in place according to ASTM D1556/D1556M, ASTM D2167, and ASTM D6938, as applicable. Tests will be performed at following frequency:
            a) Sitework Areas: One test for every 10,000 sq. ft. (930 sq. m) or less of exterior pads area but no fewer than three tests.
      c. Asphalt paving area:
         1) Testing Agency shall provide testing and inspection for exterior aggregate base.
         2) Number of tests may vary at discretion of Architect.
         3) Testing Agency will test compaction of base in place according to ASTM D1556/D1556M, ASTM D2167, and ASTM D6938, as applicable. Tests will be performed at following frequency:
         4) Sitework Areas: One test for every 10,000 sq. ft. (930 sq. m) or less of paving area but no fewer than three tests.
   3. Contractor to provide Quality Control (QC) Testing.

3.4 PROTECTION

A. Interior Slab-On-Grade Concrete:
   1. Vapor Retarder:
      a. Do not allow water onto vapor retarder or aggregate base before placing concrete.
      b. Protect membrane from possible punctures caused by reinforcing bar supports before placing concrete.

END OF SECTION

SECTION 31 1413

TOPSOIL STRIPPING AND STOCKPILING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Strip any organic top layer and remove from site. There is no re-usable topsoil on site. Contractor to provide imported topsoil for use on project site.
   2. Strip top 12 inches (305mm) of clay fill from site as described in Contract Documents. Contractor may use this clay fill material as needed for fill in landscaped areas.

B. Related Requirements:
   1. Section 31 0501: 'Common Earthwork Requirements':
      a. General procedures and requirements for earthwork.
      b. Pre-installation conference held jointly with other common earthwork related sections.
      c. Pre-installation conference held jointly with other landscape related sections.
   2. Section 31 2213: 'Rough Grading'.
   3. Section 31 2316: 'Excavation'.
   4. Section 32 9001: 'Common Planting Requirements'.
   5. Section 32 9120: 'Topsoil And Placement' for topsoil evaluation and placement required for topsoil grading.
   6. Section 32 9122: 'Topsoil Grading' for preparation of topsoil and addition of amendments prior to landscaping.

1.2 REFERENCES

A. Definitions:
   1. Existing topsoil: Defined as total amount of soil stripped and stored for reuse, less vegetation layer stripped and disposed of as specified in Paragraphs below.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:
   1. Participate in pre-installation conferences as specified in Section 31 0501.

PART 2 - PRODUCTS: Not Used

PART 3 - EXECUTION

3.1 PERFORMANCE

A. Strip any organic top layer and remove from site. There is no re-usable topsoil on site. Contractor to provide imported topsoil for use on project.

B. Strip top 12 inches (305mm) of clay fill from site as described in Contract Documents. Contractor may use this clay fill material as needed for fill in landscaped areas.

END OF SECTION

SECTION 31 2213

ROUGH GRADING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Perform rough grading work required to prepare site for construction as described in Contract Documents.
   2. Refer to Section 31 2323 “Fill” for specific details, scarification, moisture conditioning, and compaction requirements.

B. Related Requirements:
   1. Section 01 3100: ‘Project Management and Coordination’ for pre-installation conference.
   2. Section 03 3053: Miscellaneous Exterior Cast-In-Place Concrete.
   3. Section 31 0501: ‘Common Earthwork Requirements’ for:
      a. General procedures and requirements for earthwork.
      b. Pre-installation conference held jointly with other common earthwork related sections.
   4. Section 31 1123: ‘Aggregate Base’ for aggregate base requirements.
   5. Section 31 1413: ‘Topsoil Stripping And Stockpiling’ for stripping existing topsoil.
   6. Section 31 2216: ‘Fine Grading’ for grading of subgrade below aggregate base and topsoil.
   7. Section 31 2316: ‘Excavation’.
   8. Section 31 2323: ‘Fill’ for compaction procedures and tolerances for base.
   9. Section 32 1216: ‘Asphalt Paving’.
   10. Section 32 9122: ‘Topsoil Grading’ for preparation of topsoil and addition of amendments prior to landscaping.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:
   1. Participate in MANDATORY pre-installation conference as specified in Section 31 0501:
   2. In addition to agenda items specified in Section 01 3100 and Section 31 0501, review following:
      a. Identify benchmark to be used in establishing grades and review Contract Document requirements for grades, fill materials, and topsoil.
      b. Examine site to pre-plan procedures for making cuts, placing fills, and other necessary work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials used for fill shall be as specified for backfill in Section 31 2323 'Fill'.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification Of Conditions:
   1. Verify elevations of rough grading are correct before compacted fill, fine grading, aggregate base or landscape grading are placed.

3.2 PREPARATION

A. Protection Of In-Place Conditions:
   1. When existing grade around existing plants to remain is higher than new finish grade, perform regrading by hand.
   2. Do not expose or damage shrub or tree roots.

3.3 PERFORMANCE

A. Subgrade (Natural Soils):
   1. Subgrade beneath compacted fill or aggregate base under asphalt or concrete paving shall be constructed smooth and even.

B. Special Techniques:
   1. Compact fills as specified in Section 31 2323 'Fill'.
   2. If soft spots, water, or other unusual and unforeseen conditions affecting grading requirements are encountered, stop work and notify Architect.

C. Tolerances:
   1. Maximum variation from required grades shall be 1/10 of one foot (28 mm).

END OF SECTION

SECTION 31 2214

PROOF ROLLING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Proof roll areas designated for asphaltic pavement and under interior concrete floor slab as described in Contract Documents, following Rough Grading and prior to fill, and again after placement of pit run sub-base.
   2. Refer to 31 2323 “Fill” for proof roll schedule and requirements.

B. Related Sections:
   1. Section 31 0501 : Common Earthwork Requirements.

1.2 QUALITY ASSURANCE

A. Pre-Installation Meeting:
   1. Participate in pre-installation meeting specified in Section 31 2213.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Use heavy 15 to 60 tonne (17 to 66 tons) rubber tired roller having four wheels abreast on independent axles with high contact wheel pressure (inflation pressure) Ranging from 550 kPa (80 psi) to 1030 kPa (150 psi).

B. Heavily loaded truck may be used in lieu of equipment specified above if truck is loaded to minimum 10 tonnes (11 tons) per axle and minimum tire pressure of 550 kPa (80 psi).

PART 3 - EXECUTION

3.1 PREPARATION

A. Proof roll in presence of Consultant and appointed soils engineer at ground speed of 4 kilometer per hour 06 or 65 meters per minute

B. Provide two complete coverages with proof rolling equipment in one direction and second series of two coverages made at right angle to first series:
   1. One coverage means every point of proof rolled surface has been subjected to tire pressure of loaded wheel.
   2. Less rigorous procedures may be acceptable under certain conditions subject to approval of Consultant.

END OF SECTION

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SECTION 31 2216

FINE GRADING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Perform fine grading of subgrade work required to prepare site for paving finish grading and for placement of topsoil as described in Contract Documents.
   2. Refer to Section 31 2323 “Fill” for sub grade preparation requirements.
   3. Asphalt Paving:
      a. Prepare natural soil subgrade as described in Section 31 2213 ‘Rough Grading’ or prepare fill subgrade as described in this specification section for asphalt paving.

B. Related Requirements:
   1. Section 01 1200: ‘Multiple Contract Summary’ for multiple contracts.
   2. Section 01 4523: ‘Testing and Inspecting Services’ for testing and inspection, and testing laboratory services for materials, products, and construction methods.
   3. Section 31 0501: ‘Common Earthwork Requirements’ for:
      a. General procedures and requirements for earthwork.
      b. Pre-installation conference held jointly with other common earthwork related sections.
   4. Section 31 1123: ‘Aggregate Base’ for aggregate base requirements.
   5. Section 31 1413: ‘Topsoil Stripping And Stockpiling’ for stripping existing topsoil.
   6. Section 31 2213: ‘Rough Grading’ for grading and preparation of natural soil subgrades below fill and aggregate base materials.
   7. Section 31 2316: ‘Excavation’.
   8. Section 31 2323: ‘Fill’ for compaction procedures and tolerances for base.
   9. Section 32 1216: ‘Asphalt Paving’ for finish grading for asphalt paving.
   10. Section 32 9001: 'Common Planting Requirements'.
      a. Pre-installation conference held jointly with other common planting related sections.
   11. Section 32 9120: ‘Topsoil And Placement’ for topsoil evaluation and placement required for topsoil grading.
   12. Section 32 9122: ‘Topsoil Grading’ for preparation of topsoil and addition of amendments prior to landscaping.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:
   1. Participate in MANDATORY pre-installation conference as specified in Section 31 0501 and Section 32 9001.
   2. In addition to agenda items specified in Section 01 3100 and Section 31 0501, review following:
      a. Review backfill requirements.
      b. Review geotechnical report.
      c. Review Section 01 4523 for Testing and Inspection administrative requirements and responsibilities and Field Quality Control tests and inspections required of this section.
         1) Review requirements and frequency of testing and inspections.

B. Scheduling:
   1. Notify Testing Agency and Architect twenty-four (24) hours minimum before installation of fill / engineered fill to allow inspection.
   2. Allow special inspector to review all subgrades and excavations to determine if site has been prepared in accordance with geotechnical report prior to placing any fill, aggregate base or concrete.

3. Allow inspection and testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after inspections and test results for previously compacted work comply with requirements.

1.3 SUBMITTALS

A. Closeout Submittals:
   1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
      a. Record Documentation:
         1) Testing and Inspection Reports:
            a) Testing Agency Testing and Inspecting Reports of fill / engineered fill.

1.4 QUALITY ASSURANCE

A. Testing And Inspection:
   1. Owner is responsible for Quality Assurance. Quality assurance performed by Owner will be used to validate Quality Control performed by Contractor.
   2. Owner will provide Testing and Inspection for fill / engineering fill:
      a. Owner will employ testing agencies to perform testing and inspection for fill / engineering fill as specified in Field Quality Control in Part 3 of this specification.
         1) Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform the Work in strict accordance with requirements of Contract Documents and perform contractor testing and inspection.
         2) See Section 01 1200: 'Multiple Contract Summary'.
   3. Contractor is responsible for Quality Control (QC) Testing.

PART 2 - PRODUCTS: Not Used

PART 3 - EXECUTION

3.1 PREPARATION

A. Protection Of In-Place Conditions: Protect utilities and site elements from damage.

B. Surface Preparation:
   1. Landscaping and Planting Areas:
      a. Before grading, dig out weeds from planting areas by their roots and remove from site. Remove rocks and foreign matter such as building rubble, wire, cans, sticks, concrete, etc.
      b. Remove imported paving base material present in planting areas down to natural subgrade or other material acceptable to Architect.
   2. Asphalt Paving:
      a. Survey and stake parking surfaces to show grading required by Contract Documents.
      b. Subgrade (material immediately below aggregate base):
         1) Compact subgrade as specified in Section 31 2323 (fill).
         2) Fine grade parking surface area to grades required by Contract Documents.
         3) Subgrade to be constructed smooth and even.

3.2 PERFORMANCE

A. Interface With Other Work: Do not commence work of this Section until grading tolerances specified in Section 31 2213 are met.

B. General:

1. Do not expose or damage existing shrub or tree roots.

C. Tolerances:
   1. Site Tolerances:
      a. Subgrade (material immediately below aggregate base):
         1) Refer to New Grading Plan SD102 for imported engineered clay fill.
         2) Provide imported engineered clay fill over existing clay till to entire site as required to set new design grades.
         3) Measure using string line from curb to curb, gutter, flat drainage structure, or grade break.
      b. Maximum variation from required grades shall be 1/10 of one foot (28 mm).
   2. Aggregate Base (Asphalt Paving) Tolerances:
      a. Aggregate base shall be 6 inches (150 mm) thick minimum after compaction, except where shown thicker on Drawings.
      b. Pit Run base shall be 12 inches (305mm) thick minimum after compaction, see detail A/G102.
      c. Measure using string line from curb to curb, gutter, flat drainage structure, or grade break.
   3. Aggregate Base (Under Concrete Slab) Tolerances:
      a. Aggregate base shall be 4 inches (100 mm) thick minimum after compaction, except where shown thicker on Drawings.
      b. Pit Run base shall be 12 inches (305mm) thick minimum after compaction, see detail A/A305.
   4. Landscaping and Planting Tolerances:
      a. Maximum variation from required grades shall be 1/10 of one foot (28 mm).
      b. To allow for final finish grades as specified in Section 32 9121 of planting areas, fine grade elevations before placing topsoil and mulch are:
         1) Sod Areas: 8 inches (200 mm) below top of walk or curb.
         2) Planter Areas: 16 inches (400 mm) below top of walk or curb.
   5. Slope grade uniform away from building as detailed on New Grading Plan SD102.

3.3 FIELD QUALITY CONTROL

A. Field Tests And Inspections:
   1. Civil and structural field tests, laboratory testing, and inspections are provided by Owner's independent Testing Agency as specified in Section 01 4523 'Testing And Inspection Services':
      a. Quality Control is sole responsibility of Contractor:
         1) Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform testing and inspection as part of his Quality Control:
            a) Testing and inspections, if performed by Contractor, will be responsibility of Contractor to be performed by an independent entity.
   2. Site Preparation:
      a. Prior to placement of fill / engineered fill, inspector shall determine that site has been prepared in accordance with geotechnical report.
      b. Footing subgrade: At footing subgrades, Certified Inspector is to verify that soils conform to geotechnical report.
   3. Fill / Engineered Fill:
      a. Testing Agency shall provide testing and inspection for fine grading.
      b. Number of tests may vary at discretion of Architect.
      c. Testing Agency is to provide one (1) moisture-maximum density relationship test for each type of fill material.

END OF SECTION

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SECTION 31 2316

EXCAVATION

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Perform Project excavating and trenching as described in Contract Documents, except as specified below.
   2. Procedure and quality for excavating and trenching performed on Project under other Sections unless specifically specified otherwise.
   3. Refer to Section 31 2323 “Fill” for specific details, scarification, moisture conditioning, and compaction requirements.

B. Related Requirements:
   1. Section 31 0501: ‘Common Earthwork Requirements’ for:
      a. General procedures and requirements for earthwork.
      b. Pre-installation conference held jointly with other common earthwork related sections.
   2. Section 31 1123: ‘Aggregate Base’.
   3. Section 31 1413: ‘Topsoil Stripping and Stockpiling’.
   4. Section 31 2213: ‘Rough Grading’ for rough grading and preparation of natural soil subgrades below fill and aggregate base materials.
   5. Section 31 2216: ‘Fine Grading’ for grading of subgrade below aggregate base and topsoil.
   6. Section 31 2323: ‘Fill’ for compaction procedures and tolerances for base.
   7. Performance of excavating inside and outside of building required for electrical and mechanical work is responsibility of respective Section doing work unless arranged differently by Contractor.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:
   1. Participate in MANDATORY pre-installation conference as specified in Section 31 0501:
   2. In addition to agenda items specified in Section 01 3100 and Section 31 0501, review following:
      a. Review protection of existing utilities requirements.

PART 2 - PRODUCTS: Not Used

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification Of Conditions:
   1. Carefully examine site and available information to determine type soil to be encountered.
   2. Discuss problems with Architect before proceeding with work.

3.2 PREPARATION

A. Protection of Existing Utilities:
   1. Protect existing utilities identified in Contract Documents during excavation.
   2. If existing utility lines not identified in Contract Documents are encountered, contact Architect before proceeding.

3.3 PERFORMANCE

A. Interface With Other Work:
   1. Section 31 2213: 'Rough Grading' for rough grading and preparation of natural soil subgrades below fill and aggregate base materials.
   2. Section 31 2216: 'Fine Grading' for grading of subgrade below aggregate base and topsoil.

B. Excavation:
   1. Building Footings And Foundations:
      a. Excavate as necessary to properly place and form concrete footings and foundations.
      b. Bottom of footings to bear on native clay till – see details.
      c. Under Building:
         1) See detail A/A305.
      d. Excavation Carried Deeper Than Required:
         1) Under Footings: Fill with concrete specified for footings.
         2) Under Slabs: Use specified compacted backfill material.
   2. Pavement And Miscellaneous Cast-In-Place Concrete:
      a. Excavate as necessary for proper placement and forming of concrete site elements and pavement structure. Remove vegetation and deleterious material and remove from site.
      b. Backfill over-excavated areas with compacted base material specified in Section 31 1123.
      c. Remove and replace exposed material that becomes soft or unstable.
      d. See detail A/G102 and details G102, G103, and G104.
   3. Utility Trenches:
      a. Unless otherwise indicated, excavation shall be open cut. Short sections of trench may be tunneled if pipe or duct can be safely and properly installed and backfill can be properly tamped in tunnel sections and if approved by Architect.
      b. Excavate to proper alignment, depth, and grade. Excavate to sufficient width to allow adequate space for proper installation and inspection of utility piping.
      c. If trenches are excavated deeper than required, backfill until trench bottom is proper depth with properly compacted native material.
      d. Pipe 4 Inches (100 mm) In Diameter Or Larger:
         1) Grade bottom of trenches to provide uniform bearing and support for each section of pipe on undisturbed soil at every point along its length.
         2) Except where rock is encountered, take care not to excavate below depths indicated.
            a) Where rock excavations are required, excavate rock with minimum over-depth of 4 inches (100 mm) below required trench depths.
            b) Backfill over-depths in rock excavation and unauthorized over-depths with loose, granular, moist earth, thoroughly compacted.
         3) Whenever wet or unstable soil incapable of properly supporting pipe, as determined by Architect, occurs in bottom of trench, remove soil to depth required and backfill trench to proper grade with coarse sand, fine gravel, or other suitable material acceptable to Architect.
      e. See Mechanical Site Plan SD201.
   4. If unusual excavating conditions are encountered, stop work and notify Architect.

3.4 CLEANING / REPAIR / RESTORATION

A. Repair damage to other portions of the Work resulting from work of this Section at no additional cost to Owner. On new work, arrange for damage to be repaired by original installer.

B. Debris and material not necessary for Project are property of Contractor and are to be removed before completion of Project. However, if material necessary for Project is hauled away, replace with specified fill / backfill material.

END OF SECTION

SECTION 31 2323

FILL

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Perform Project backfilling and compacting as described in Contract Documents, except as specified below.
   2. Procedure and quality for backfilling and compacting performed on Project under other Sections unless specifically specified otherwise.

B. Related Requirements:
   1. Section 01 1200: 'Multiple Contract Summary' for multiple contracts.
   2. Section 01 4523: 'Testing and Inspecting Services' for testing and inspection, and testing laboratory services for materials, products, and construction methods.
   3. Section 31 0501: 'Common Earthwork Requirements' for:
      a. General procedures and requirements for earthwork.
      b. Pre-installation conference held jointly with other common earthwork related sections.
   4. Section 31 1123: 'Aggregate Base' for aggregate base requirements.
   5. Section 31 1413: 'Topsoil Stripping And Stockpiling' for stripping existing topsoil.
   6. Section 31 2213: 'Rough Grading' for grading and preparation of natural soil subgrades below fill and aggregate base materials.
   7. Section 31 2216: 'Fine Grading' for grading of subgrade below aggregate base and topsoil.
   8. Section 31 2316: 'Excavation'.
   9. Section 32 9120: 'Topsoil And Placement' for topsoil evaluation and placement required for topsoil grading.
   10. Section 32 9122: 'Topsoil Grading' for preparation of topsoil and addition of amendments prior to landscaping.
   11. Division 32: Compaction of subgrade under walks and paving.
   12. Division 33: Utilities.
   13. Performance of backfilling and compacting inside and outside of building required for electrical and mechanical work is responsibility of respective Section doing work unless arranged differently by Contractor.

1.2 REFERENCES

A. Reference Standards:
   1. ASTM International (Following are specifically referenced for fill and aggregate base testing):
      a. ASTM D698-12, 'Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft3 (600 kN-m/m3))'.
      b. ASTM D1556/D1556M-15, 'Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method'.
      c. ASTM D1557-12, 'Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3))'.
      d. ASTM D2167-15, 'Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method'.
      e. ASTM D2487-11, 'Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)'.
      f. ASTM D6938-15, 'Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)'.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conferences:
   1. Participate in MANDATORY pre-installation conference as specified in Section 31 0501.
   2. In addition to agenda items specified in Section 01 3100 and Section 31 0501, review following:
      a. Review backfill requirements.
      b. Review Section 01 4523 for Testing and Inspection administrative requirements and responsibilities and Field Quality Control tests and inspections required of this section.
         1) Review requirements and frequency of testing and inspections.

B. Sequencing:
   1. Do not backfill against bituminous dampproofing to exterior foundation walls for twenty-four (24) hours after application of dampproofing.
   2. Before backfilling, show utility and service lines being covered on record set of Drawings. Do not backfill until utilities involved have been tested and approved by Architect and until instructed by Architect.
   3. Do not backfill against foundation walls until concrete has reached 2/3 strength. Compact both sides to evenly distribute soil pressure against foundation.

C. Scheduling:
   1. Notify Testing Agency and Architect seventy-two (72) hours minimum before installation of fill / engineered fill to perform proctor and plasticity index tests on proposed fill or subgrade.
   2. Notify Testing Agency and Architect twenty-four (24) hours minimum before installation of fill / engineered fill to allow inspection.
   3. Allow special inspector to review all subgrades and excavations to determine if site has been prepared in accordance with geotechnical report prior to placing any fill (or concrete).
   4. Allow inspection and testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after inspections and test results for previously compacted work comply with requirements.

1.4 SUBMITTALS

A. Closeout Submittals:
   1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
      a. Record Documentation:
         1) Testing and Inspection Reports:
            a) Testing Agency Testing and Inspecting Reports of fill / engineered fill.

1.5 QUALITY ASSURANCE

A. Testing and Inspection:
   1. Owner is responsible for Quality Assurance. Quality assurance performed by Owner will be used to validate Quality Control performed by Contractor.
   2. Owner will provide Testing and Inspection for fill / engineering fill:
      a. Owner will employ testing agencies to perform testing and inspection for fill / engineering fill as specified in Field Quality Control in Part 3 of this specification.
         1) Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform the Work in strict accordance with requirements of Contract Documents and perform contractor testing and inspection.
         2) See Section 01 1200: 'Multiple Contract Summary'.
   3. Contractor is responsible for Quality Control (QC) testing.

1.6 FIELD CONDITIONS

A. Ambient Conditions:
   1. Do not perform work during unfavorable conditions as specified below:

a. Aggregate Base:
   1) Presence of free surface water.
   2) Over-saturated sub base materials.

1.7 EXCAVATION AND BACKFILL SYSTEM DESIGNS

A. The following descriptions summarize procedures for subgrade preparation and depths for design requirements.
   1. Fill under interior concrete slabs on grade (building):- see A/A305
      a. Excavate as specified in 31 1413 and 31 2213 to remove existing top soil, debris, organic, and 12 inches (305mm) of clay fill material.
      b. Scarify existing clay subgrade 6 inches (152 mm), moisture condition to 2% of optimum moisture content, and re-compact to 98% of the Standard Proctor maximum density. Proof roll as specified in 31 2214.
      c. Following foundation construction, fill with imported Engineered Clay fill in 8 inches (200 mm) maximum lifts and mechanically tamp to 98% Standard Proctor maximum density, up to 20 inches (508 mm) below finished floor level.
         The top 12 inches (305 mm) shall be select pit run granular material compacted in 2 lifts to 100% Standard Proctor maximum density.
      d. 4 inches (100 mm) granular base specified in 31 1123. Compact to 100% Standard Proctor maximum density.
      e. Place laminated vapour retarder barrier specified in 07 2616.
      f. 4 inches (100 mm) concrete slab specified in Division 03.
   2. Back fill under footing (deep).
      a. Not allowed. Deep footings to bear on native clay till.
      b. If needed, at over-excavated areas, use specified footing concrete.
   3. Fill under asphaltic paving surfaces, curbs, gutters, and adjacent walks:- see A/G102
      a. Excavate as specified in 31 1413 and 31 2213 to a minimum of 21 inches (535mm) below new design grades – see New Grading Plan SD102.
      b. Scarify existing clay subgrade 6 inches (152 mm), moisture condition to 2% of optimum moisture content, and re-compact to 98% of the Standard Proctor maximum density. Proof roll as specified in 31 2214.
      c. Place imported Engineered Clay material in compacted lifts not exceeding 8 inches (200mm) and compacted to not less than 98% Standard Proctor maximum density. Create uniform base structure to depth as required to suit new design grades.
      d. Place select pit run fill material in compacted lifts not exceeding 8 inches (200mm) and compacted to not less than 100% Standard Proctor maximum density.
         1) Provide minimum pit run sub-base depth of 12 inches (305mm) after compaction.
         2) Proof roll as specified in 31 2214.
      e. Place 6 inches (152mm) of paving base specified in 31 1123. Compact to 100% Standard Proctor maximum density.
      f. Place 3 inches (75mm) asphalt paving specified in 32 1216 in a single lift. Compact asphalt to 97% of 50 blow marshal design density.
      g. If fill material is required below 21 inches (535mm) below finished grade, provide imported Engineered Clay fill.
         1) Place in 8 inches (200mm) maximum lifts and compact to 98% Standard Proctor maximum density.
   4. Fill under concrete walks and exterior slabs on grade –
      a. Excavate as specified in 31 1413 and 31 2213 to a minimum of 12 inches (305mm) below finish grade.
      b. If sub-base fill is required, use fill material as specified for asphaltic paving surfaces.
      c. Minimum 8 inch (200 mm) granular base specified in 31 1123. Compact to 100% of maximum density.
      d. Place 4" concrete specified in Division 03 (or as detailed).
      e. Allow additional 2 inch (50 mm) for insulation below slabs / walks adjacent building.
   5. Fill in utility trenches:
      a. Excavate as required for services – see Mechanical Site Plan SD201.

b. Provide imported Engineered Clay fill as backfill, moisture condition to 2% of optimum moisture content. Re-compact in 8 inch (200 mm) lifts to 98% of the Standard Proctor maximum density.
c. Existing excavated clay material can be re-used as trench backfill AT CONTRACTOR'S OPTION provided it is moisture conditioned to 2% of optimum moisture content. Re-compact in 8 inch (200 mm) lifts to 98% of the Standard Proctor maximum density. The Owner will not entertain any additional costs to moisture condition existing material.

6. Exterior side of perimeter walls and above exterior footings (landscape areas):
   a. Contractor can place on site excavated clay fill material provided it is moisture conditioned to 2% of optimum moisture content. Re-compact in 8 inch (200 mm) lifts to 95% of the Standard Proctor maximum density. Such backfill should provide a relatively impervious surface layer to reduce seepage into the subsoil. Top 12 inches (305mm) of rough grade shall comprise low plastic inorganic clay and extend minimum of 5 feet (1500mm) horizontally sloping away from the building.
   b. Backfill shall not be placed against a foundation structure until the structure has sufficient strength to withstand the earth pressures resulting from placement and compaction (minimum two-thirds, 28 day strength). Footings, foundation walls and foundation excavation shall not be allowed to freeze prior to backfill. During compaction, careful observation of the foundations for deflection should be carried out continuously. Backfill all sides of foundation structures simultaneously.
   c. Only hand held compaction equipment shall be used in the compaction of fill within 24 inches (600mm) of foundations.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Site Material:
   1. Existing excavated clay fill material on site is suitable for use as fill and backfill to meet Project requirements in landscaped areas only. Excavated clay fill material must be scarified and moisture conditioned to 2% of optimum moisture content prior to being re-used and re-compacted. If existing clay fill material consists of coarse material, then material should be scarified and moisture conditioned to 1% of optimum moisture content prior to being re-used.

B. Imported Fill / Backfill:
   1. Well graded material conforming to ASTM D2487 free from debris, organic material, frozen materials, brick, lime, concrete, and other material which would prevent adequate performance of backfill.
      a. Under Building Footprint And Paved Areas: Fill shall comply with soil classification groups GW, CL, GP, or GM. Fill may not contain stones over 6 inches (150 mm) diameter and ninety-five (95) percent minimum of fill shall be smaller than 1-1/2 inch (38 mm) in any direction.
      b. Under Landscaped Areas:
         1) Fill more than 36 inches (900 mm) below finish grade shall comply with soil classification groups GW, CL, GP, GM, SW, SP, or SM. Fill may not contain stones over 6 inches (150 mm) diameter and ninety (90) percent minimum of fill shall be smaller than 1-1/2 inch (38 mm) in any direction.
         2) Fill less than 36 inches (900 mm) below finish grade shall comply with soil classification groups SW, SP, SM, or SC. Fill may not contain stones larger than 1-1/2 inches (38 mm) in any direction and ninety (90) percent minimum of fill shall be smaller than 3/8 inch (4.7 mm) in any direction.

C. Pit Run:
   1. Select pit run gravel having a maximum particle size of 3 inch (75 mm) minus, free of any form of coating. Any gravel or sand containing clay, loam, or other deleterious materials will be rejected.
   2. Granular fills and gravels should be clean (the % of material passing through the 80 um sieve should not exceed 2/3 of the material passing the 315 nm sieve.

D. Engineered Fill:
   1. Fill must be free of any organic materials, contamination, deleterious construction debris, and stones greater than 3 inch (75 mm) diameter.
   2. Must be of cohesive materials, with low to medium plastic range.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before placing fill, aggregate base, or finish work, prepare existing subgrade as follows:
   1. Do not place fill or aggregate base over frozen subgrade.
   2. Under Building Slab and Equipment Pad Areas:
      a. Scarify subgrade 6 inches (152 mm) deep, moisture condition to uniform moisture content of between optimum and two (2) percent over optimum, and mechanically tamp to ninety-eight (98) percent minimum of relative compaction.
   3. Under Driveways And Parking Areas:
      a. Scarify subgrade 6 inches (152 mm) deep, moisture condition to uniform moisture content between optimum and two (2) percent over optimum, and mechanically tamp to ninety-eight (98) percent minimum of relative compaction.
   4. Under Miscellaneous Concrete Site Elements And Outside Face of Foundation Walls
      a. Scarify subgrade 6 inches (152 mm) deep, moisture condition to uniform moisture content between optimum and two (2) percent over optimum, and mechanically tamp to ninety-eight (98) percent minimum of relative compaction.
   5. Landscape Areas:
      a. Scarify subgrade 6 inches (152 mm) deep, moisture condition to uniform moisture content between optimum and two (2) percent over optimum, and mechanically tamp to ninety-eight (98) percent minimum of relative compaction.

3.2 PERFORMANCE

A. See 1.7 for excavation, scarification, moisture conditioning, proof roll, backfill systems, and compaction requirements.

B. Interface With Other Work:
   1. Section 31 2213: 'Rough Grading' for rough grading and preparation of natural soil subgrades below fill and aggregate base materials.
   2. Section 31 2216: 'Fine Grading' for grading of subgrade below aggregate base and topsoil.

C. Fill / Backfill:
   1. General:
      a. Around Buildings And Structures: Slope grade away from building as specified in Section 31 2216. Hand backfill when close to building or where damage to building might result.
      b. Site Utilities:
         1) In Landscape Areas: Use backfill consisting of on-site clay – see 1.7.
         2) Under Pavement and Concrete Site Elements: see 1.7
      c. Do not use puddling or jetting to consolidate fill areas.
   2. Compacting:
      a. Fill / Backfill And Aggregate Base – see 1.7:
         1) All fill material shall be well-graded granular material with maximum size less than 3 inch (76 mm) and with not more than fifteen (15) percent passing No. 200 sieve.
         2) Under Building Slab and Equipment Pad Areas:
            a) Place in 8 inch (200 mm) maximum layers, moisture condition to plus or minus two (2) percent of optimum moisture content, and mechanically tamp to ninety eight (98) percent minimum of maximum laboratory density as established by ASTM D1557.
            b) Final lifts see 1.7.

3) Under Driveways And Parking Areas:
   a) Place in 8 inch (200 mm) maximum layers, dampen but do not soak, and mechanically tamp to ninety eight (98) percent minimum of maximum laboratory density as established by ASTM D1557.
   b) Final lifts see 1.7.
4) Under Miscellaneous Concrete Site Elements And Outside Face of Foundation Walls:
   a) Place in 8 inch (200 mm) maximum layers, dampen but do not soak, and mechanically tamp to ninety eight (98) percent minimum of maximum laboratory density as established by ASTM D1557.
   b) Final lifts see 1.7.
5) Utility Trenches:
   a) Site:
      (1) Place fill in 8 inch (200 mm) layers and moisture condition to plus or minus two (2) percent of optimum moisture content.
      (2) Compact fill to ninety-eight (98) percent minimum of maximum laboratory density as established by ASTM D1557.
      (3) Final lifts see 1.7.
   b) Under Slabs:
      (1) Under Slabs: Place fill in 8 inch (200 mm) layers, moisture condition to plus or minus two (2) percent of optimum moisture content, and compact to ninety eight (98) percent minimum relative compaction to within 20 inches (508 mm) of finish grade.
      (2) Final 4 inches (100 mm) and 12 inches (305mm) of fill shall be aggregate base as specified in 1.7.
6) Fill Slopes: Compact by rolling or using sheepsfoot roller.
7) Backfill Under Footings not allowed.
8) Landscape Areas:
   a) Compact fill to ninety-five (95) percent minimum relative compaction.
9) Loose material from compacted subgrade surface shall be immediately removed before placing compacted fill or aggregate base course.

3.3 REPAIR / RESTORATION

A. Repair damage to other portions of the Work resulting from work of this Section at no additional cost to Owner. On new work, arrange for damage to be repaired by original installer.

3.4 FIELD QUALITY CONTROL

A. Field Tests and Inspections:
   1. Civil and structural field tests, laboratory testing, and inspections are provided by Owner's independent Testing Agency as specified in Section 01 4523 'Testing And Inspection Services':
      a. Quality Control is sole responsibility of Contractor:
         1) Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform testing and inspection as part of his Quality Control:
            a) Testing and inspections, if performed by Contractor, will be responsibility of Contractor to be performed by an independent entity.
   2. Fill / Engineered Fill:
      a. Testing Agency shall provide testing and inspection for fill.
      b. Number of tests may vary at discretion of Architect.
      c. Testing Agency is to provide one (1) moisture-maximum density relationship test for each type of fill material.
      d. Prior to placement of engineered fill, inspector shall determine that site has been prepared in accordance with geotechnical report.
      e. Footing subgrade: At footing subgrades Certified Inspector is to verify that soils conform to geotechnical report.
      f. Testing Agency will test compaction of soils according to ASTM D1556/D1556M, ASTM D2167, and ASTM D6938, as applicable. Lift thicknesses shall comply with geotechnical report. Inspector shall determine that in-place dry density of engineered fill material

complies with geotechnical report. Tests will be performed at following locations and frequencies:

1) Paved Areas: At each compacted fill and backfill layer, at least one (1) test for every 10,000 sq. ft. (930 sq. m) or less of paved area but in no case less than three (3) tests.
2) Building Slab Areas: At each compacted fill and backfill layer, at least on test for every 2,500 sq. ft. (232 sq. m) or less of building slab area but in no case less than three (3) tests.
3) Foundation Wall/Continuous Footing Backfill: At each compacted backfill layer, at least one (1) test for each 40 linear feet (12 linear m) or less of wall length, but no fewer than two (2) tests.
4) Trench Backfill: At each 8 inch (200 mm) compacted lift for each 100 linear feet (30.5 linear m) or less of trench length but no fewer than two (2) tests.
5) Sidewalks, Curbs, Gutters, Exterior Pads: Minimum of one (1) test for each lift for each 40 lineal feet (12 linear m) or one (1) test for every 5,000 sq. ft. (465 sq. m) or less of pad area but no fewer than three (3) tests.

g. Required verification and inspection of soils as referenced in 2015 IBC (or latest approved edition) Table 1704.7 'Required Verification And Inspection Of Soils'. Periodic and continuous inspections include:

1) Verify materials below shallow foundations are adequate to achieve design bearing capacity (periodic).
2) Verify excavations are extended to proper depth and have reached proper material (periodic).
3) Perform classification and testing of compacted fill materials (periodic).
4) Verify use of proper materials, densities and lift thicknesses during placement and compaction of compacted fill (continuous).
5) Prior to placement of compacted fill, observe subgrade and verify that site has been prepared properly (periodic).

3. Quality Control (QC) Testing by Contractor.

3.5 CLEANING

A. Debris and material not necessary for Project are property of Contractor and are to be removed before completion of Project. However, if material necessary for Project is hauled away, replace with specified fill / backfill material.

END OF SECTION

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SECTION 31 2500

EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Provide permanent erosion and sedimentation controls as described in Contract Documents.
   2. See City approved Erosion and Sediment Control Plans and Report per Development Permit approval process.
   3. Contact the City Erosion Control Inspector, Water Resources, to set up a pre-construction meeting prior to stripping and grading per Development Permit approval process.

B. Related Requirements:
   1. Section 01 5700: Temporary Erosion and Sedimentation Control.
   2. Section 31 0501: Common Earthwork Requirements.
   3. Section 31 1413: Topsoil Stripping And Stockpiling.
   4. Section 32 9300: Sections under heading ‘Site Improvements’.

1.2 REFERENCES

A. References:
   1. The City of Calgary Erosion and Sediment Control Standards, Section 3.0 – current edition.

1.3 SUBMITTALS

A. Informational Submittals:
   1. Delegated Design Submittals:
      a. Sediment and erosion control plan, specific to site, meeting following objectives:
         1) Prevent loss of soil, including soil stockpiled for reuse, by storm water runoff and wind erosion.
         2) Prevent sedimentation of storm sewers and receiving streams.
         3) Prevent air pollution by dust and particulate matter.
         4) See City approved Erosion and Sediment Control Plans and Report per Development Permit approval process.

1.4 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Sediment and erosion control shall conform to local erosion and sedimentation control standards.

B. Qualifications:
   1. Supervisor of erosion control operations shall be thoroughly familiar with types of erosion control materials being installed and best methods for their installation. Supervisor shall be present when work of this Section is being performed and shall direct work performed under this Section.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Design Criteria:
   1. Protect and maintain areas disturbed by the Work, so erosion is adequately controlled and silt and sediments are not allowed to flow into any watercourse, onto adjacent properties, or into storm drains.

B. Materials:
   1. As required to meet local erosion and sedimentation control details.
   2. See City approved Erosion and Sediment Control Plans and Report per Development Permit approval process.
   3. Silt Fences:
      a. Type Two Acceptable Products
         1) 'Geofab Silt Fence' by Mercantile Development Inc.
         2) 'Mirafi 100X by Celanese Fibers Marketing Co.
   4. Equal as approved by Architect before use. See Section 01 6200

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
   1. Take every reasonable precaution to avoid erosion and to prevent silting of rivers, streams, lakes, reservoirs, impoundments, and drainage ditches and swales.
   2. Keep exposure of uncompleted cut slopes, embankments, trench excavations, and site graded areas as short as possible. Initiate seeding and other erosion control measures on each segment as soon as reasonably possible.
   3. Should it become necessary to suspend construction for any length of time, shape excavated and graded areas so runoff will be intercepted and diverted to points where minimal erosion will occur. Provide and maintain temporary erosion and sediment control measures, such as berms, dikes, slope drains, silt stops, and sedimentation basins, until permanent drainage facilities or erosion control features have been completed and are operative.
   4. Handle and treat fine material placed or exposed during The Work so as to minimize possibility of it reaching surface waters. Use diversion channels, dikes, sediment traps, or other effective control measures.
   5. Provide silt stops wherever erosion control measures may not be totally capable of controlling erosion, such as in drainage channels and where steep slopes may exist.
   6. Before water is allowed to flow in any ditch, swale, or channel, install permanent erosion control measures in waterway so waterway will be safe against erosion.
   7. Take precautions in using construction equipment to minimize erosion. Do not leave wheel tracks where erosion might begin.
   8. Continue erosion control measures until permanent measures have been sufficiently established and are capable of controlling erosion on their own.

3.2 REPAIR / RESTORATION

A. If any temporary erosion and sediment control measures are disturbed, repair them immediately.

B. Maintain temporary control measures until permanent control measures are established and no further erosion is likely.

END OF SECTION

DIVISION 32: EXTERIOR IMPROVEMENTS

32 1000 BASES, BALLASTS, AND PAVING

32 1216 ASPHALT PAVING - MARSHALL
32 1723 PAVEMENT MARKINGS

32 3000 SITE IMPROVEMENTS

32 3113 CHAIN LINK FENCES AND GATES

32 8000 IRRIGATION

32 8423 UNDERGROUND SPRINKLERS

32 9000 PLANTING

32 9001 COMMON PLANTING REQUIREMENTS
32 9120 TOPSOIL AND PLACEMENT
32 9122 TOPSOIL GRADING
32 9223 SODDING
32 9300 PLANTS

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SECTION 32 1216

ASPHALT PAVING: Marshall Method

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install asphalt paving in driveways and parking areas as described in Contract Documents including the following, but not limited to:
      a. Tack coat: Application of asphaltic material to new asphalt concrete or new portland concrete surfaces before asphalt concrete pavement.
      b. Blotter materials and procedures for absorbing excess asphalt as required.

B. Related Requirements:
   1. Section 01 1200: 'Multiple Contract Summary' for multiple contracts.
   2. Section 01 3100: 'Project Management and Coordination' for pre-installation conference.
   3. Section 01 4301: 'Quality Assurance - Qualifications' establishes minimum qualification levels required.
   4. Section 01 4523: 'Testing and Inspecting Services' for testing and inspection, and testing laboratory services for materials, products, and construction methods.
   5. Section 01 7800: 'Closeout Submittals'.
   6. Section 31 0501: 'Common Earthwork Requirements' for:
      a. General procedures and requirements for earthwork.
      b. Pre-installation conference held jointly with other common earthwork related sections.
   7. Section 31 1123: 'Aggregate Base' for compaction of aggregate base.
   8. Section 31 2213: 'Rough Grading' for rough grading and preparation of natural soil subgrades below fill and aggregate base materials.
   9. Section 31 2216: 'Fine Grading' for grading of subgrade below aggregate base and topsoil.
   10. Section 31 2323: 'Fill' for compaction procedures and tolerances for base.
   11. Section 32 1723: 'Pavement Markings'.

1.2 REFERENCES

A. Association Publications:
   1. Asphalt Institute, 2696 Research Park Dr., Lexington, KY www.asphaltinstitute.org:
      a. MS-2*, 'Mix Design Methods'* (7th Edition 2015).

B. Definitions:
   1. Aggregate: Hard inert mineral material, such as gravel, crushed rock, slag, or sand.
      a. Coarse Aggregate: Aggregate retained on or above No. 8 (2.36 mm) sieve.
      b. Coarse-Graded Aggregate: Aggregate having predominance of coarse sizes.
      c. Dense-Graded Aggregate: Aggregate that is graded from maximum size down through filler with object of obtaining an asphalt mix with controlled void content and high stability.
      d. Fine Aggregate: Aggregate passing No. 8 (2.36 mm) sieve.
      e. Fine-Graded Aggregate: Aggregate having predominance of fine sizes.
      f. Mineral Filler: Fine mineral product at least 70 percent of which passes a No. 200 (75µm) sieve.
   2. Air Voids: Total volume of small air pockets between coated aggregate particles in asphalt cement concrete (ACC); expressed as percentage of bulk volume of compacted paving mixture.
   3. Anti-Stripping Agent: Chemicals added to bitumen to improve the adhesion of the bitumen to hydrophilic aggregates
   4. Asphalt Binder: Asphalt cement or modified asphalt cement that binds aggregate particles into dense mass.
      a. Asphalt Cement used in paving applications that has been classified according to the Standard Specification for Performance Graded Asphalt Binder, AASHTO Designation MP

320. It can be either unmodified or modified Asphalt Cement, as long as it complies with specifications.

5. Asphalt-Aggregate Designator: Alpha-numeric code that indicates nominal maximum size of aggregate, and type and grade of asphalt in aggregate-asphalt mix.
   a. Example: “12.5 PG70-28” means aggregate asphalt mix shall be composed of aggregate gradation with 12.5 mm (1/2 inch) nominal maximum size and performance grade asphalt binder designed to perform between temperatures of 70 deg C and -28 deg C (158 deg F and -18.4 deg F).
6. Equivalent Single Axle Load (ESAL): Effect on pavement performance of any combination of axle loads of varying magnitude equated to number of 18,000-lb. (80-kN) single-axle loads that are required to produce an equivalent effect.
7. Performance Graded Asphalt Binder (PGAB): Asphalt binder designed to produce HMA that meets certain performance standards. Designations for performance-graded asphalt binders are prefixed with PG. Each grade designation also includes two sets of numbers that denote temperature range. This is a range of climate temperatures to which road may be exposed and still be expected to give superior performance. PG numbers do not indicate viscosity as in conventional liquid asphalt designations.
8. Reclaimed Asphalt Pavement (RAP): Existing asphalt mixture that has been pulverized, usually by milling, and is used like an aggregate in recycling of asphalt pavements.
9. Subgrade (definition varies depending upon stage of construction and context of work being performed):
   a. Prepared natural soils on which fill, aggregate base, or topsoil is placed.
      or
   b. Prepared soils immediately beneath paving.
10. Tack Coat: Very light application of liquid asphalt, or asphalt emulsion diluted with water.

C. Reference Standards:
   1. American Association of State and Highway Transportation Officials:
      a. AASHTO T 304-11, ‘Standard Method of Test for Uncompacted Void Content of Fine Aggregate’.
      b. AASHTO T 322-07(2011), ‘Standard Method of Test for Determining the Creep Compliance and Strength of Hot-Mix Asphalt (HMA) Using the Indirect Tensile Test Device.
   2. ASTM International:
      a. ASTM C29/C29M-16, ‘Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate'.
      b. ASTM C88-13, ‘Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate'.
      c. ASTM C131/C131M-14, 'Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine’.
      d. ASTM C142/C142M-10, ‘Standard Test Method for Clay Lumps and Friable Particles in Aggregates'.
      e. ASTM D242/D242M-09(2014), ‘Standard Specification for Mineral Filler For Bituminous Paving Mixtures'.
      f. ASTM D977-13, 'Standard Specification for Emulsified Asphalt’.
      g. ASTM D979/D979M-15, 'Practice for Sampling Bituminous Paving Mixtures'.
      h. ASTM D2041/D2041M-11, 'Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures’.
      i. ASTM D2172/D2172M-11, ‘Standard Test Methods for Quantitative Extraction of Bitumen From Bituminous Paving Mixtures’.
      j. ASTM D2256/ D2256M-10, ‘Standard Test Method for Tensile Properties of Yarns by the Single-Strand Method’.
      k. ASTM D2397/D2397M-13, 'Standard Specification for Cationic-Emulsified Asphalt’.
      l. ASTM D2419-14, ‘Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate'.
      m. ASTM D2726/D2726M-14, 'Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures’.
      n. ASTM D2950/D2950M-14, ‘Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods'.
      o. ASTM D3203/D3203M-11, ‘Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures'.

p. ASTM D3549/D3549M-11, ‘Standard Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens’.
q. ASTM D3665-12, ‘Standard Practice for Random Sampling of Construction Materials’.
r. ASTM D4318-10, ‘Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils’.
s. ASTM D4552/D4552M-10, ‘Standard Practice for Classifying Hot-Mix Recycling Agents'.
t. ASTM D4791-10, ‘Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate’...
u. ASTM D5444-15, ‘Standard Method for Mechanical Size Analysis of Extracted Aggregate'.
v. ASTM D5821-13, ‘Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate’.
w. ASTM D6307-10, ‘Standard Test Method for Asphalt Content of Hot-Mix Asphalt by Ignition Method'.
x. ASTM D6931-12, ‘Standard Test Method for Indirect Tensile (IDT) Strength of Bituminous Mixtures’.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conferences:
1. Participate in MANDATORY pre-installation conference as specified in Section 31 0501 ‘Common Earthwork Requirements’:
2. In addition to agenda items specified in Section 01 3100 ‘Project Management and Coordination’ and Section 31 0501 ‘Common Earthwork Requirements’, review following:
a. Review surveying and staking of parking areas and installation of sleeves.
b. Review proposed aggregate base schedule.
c. Review rough grading elevations before fine grading operations.
d. Review fine grading elevations of subgrade fine grading operations before placing aggregate base and paving.
e. Review proposed asphalt paving schedule.
f. Review asphalt paving mix design.
g. Review schedule of paint stripes to be applied after asphalt paving surface treatment.
h. Review safety issues.
i. Review Section 01 4523 ‘Testing and Inspecting Services’ for administrative requirements and responsibilities and Field Quality Control tests and inspections required of this section.
1) Review requirements and frequency of testing and inspections.
2) Review Contractor Testing Agency Qualifications.

B. Scheduling: Notify Testing Agency and Architect twenty-four (24) hours minimum before placing asphalt paving.

1.4 SUBMITTALS

A. Informational Submittals:
1. Certificates:
a. Require mix plant to furnish delivery/load tickets for each batch of asphalt. Keep delivery tickets at job-site for use of Owner’s Representative. Tickets shall show following:
1) Name of mix plant.
2) Date.
3) Name of contractor.
4) Name and location of Project.
5) Serial number of ticket.
6) Asphalt mix type.
7) Time loaded.
8) Identity of truck.
b. Installer to provide Manufacturer’s Certificate of Compliance stating material authenticity and properties for review and acceptance by Architect before product use.
2. Design Data:
1) Mix design of asphalt paving must meet Design Criteria minimum requirements.

2) Within thirty (30) days prior to asphalt construction, submit actual design mix to Architect, Civil Engineering Consultant of Record and Independent Testing Laboratory for review and approval.

3. Test And Evaluation Reports:
   a. Hot Mix Asphalt:
      1) Contractor's Testing Agency copies of Field Test results to show compliance with all contract requirements and quality control for quality of asphalt mixture and asphalt installation.
      2) Owner's Testing Agency copies of Field Tests and Inspections used to validate or determine discrepancies with testing by Contractor.
4. Qualification Statement:
   a. Installer:
      1) Provide Qualification documentation if requested by Owner's Representative.

B. Closeout Submittals:
1. Include following in Operations And Maintenance Manual specified in Section 01 7800 ‘Closeout Submittals’:
   a. Record Documentation:
      1) Manufacturer’s documentation:
         a) Asphalt paving design.
         b) Test reports.
         c) Certificates from mix plant of delivery/load tickets.
         d) Manufacturer’s Certificate of Compliance.
      2) Testing and Inspection Reports:
         a) Testing Agency Testing and Inspecting Reports of asphalt paving.

1.5 QUALITY ASSURANCE

A. Qualifications. Requirements of Section 01 4301 ‘Quality Assurance - Qualifications’ applies but not limited to following:
1. Asphalt Paving:
   a. Foreman of asphalt paving crew has completed at least three (3) projects of similar size and nature.
   b. Upon request, submit documentation.

B. Testing and Inspection:
1. Owner is responsible for Quality Assurance. Quality assurance performed by Owner will be used to validate Quality Control testing performed by Contractor.
2. Owner will provide QA Testing and Inspection for asphalt paving:
   a. Owner will employ testing agencies to perform testing and inspection for asphalt paving as specified in Field Quality Control in Part 3 of this specification.
      1) Owner’s employment of an independent Testing Agency does not relieve Contractor of Contractor’s obligation to perform the Work in strict accordance with requirements of Contract Documents and perform contractor testing and inspection.
      2) See Section 01 1200: ‘Multiple Contract Summary’.
3. Contractor will provide Quality Control QC Testing to ensure compliance with project specifications.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery And Acceptance Requirements:
1. Asphalt Material:
   a. Each shipment must:
      1) Be uniform in appearance and consistency.
      2) Show no foaming when heated to specified loading temperature.
   b. Do not supply shipments contaminated with other asphalt types or grades than those specified:
      1) Do not use petroleum distillate as a release agent.

1.7 FIELD CONDITIONS

A. Ambient Conditions:
   1. Tack Coat:
      a. Apply only when air and roadbed temperatures in shade are greater than 40 deg F (4.4 deg C). Temperature restrictions may be waived only upon written authorization from Architect or Civil Engineer.
      b. Do not apply to wet surfaces.
      c. Do not apply when weather conditions prevent tack coat from adhering properly.
   2. Asphalt paving:
      a. Do not perform work during following conditions:
         1) Ambient temperature is below 45 deg F (7.2 deg C) or will fall below 45 deg F (7.2 deg C) during placement.
         2) Temperature of aggregate base below 50 deg F (10 deg C).
         3) Cold Weather Asphalt Paving Plan: If asphalt pavement is placed outside of these temperature limits or those identified in MINIMUM Temperature Degrees, a plan is required which includes:
            a) Haul times.
            b) Placement details.
            c) Compaction aids used in production.
            d) Owner does not assume responsibility for asphalt when placed outside temperature limits.
         4) Presence of free surface water or weather is unsuitable.
         5) Over-saturated aggregate base and subgrade materials.
         6) Wind or ground cools mix material before compaction.

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA:

A. General:
   1. Parking drive lanes, entries, and parking areas to meet heavy duty design loads.
   2. Design for a 40-year minimum life expectancy.

B. Asphalt Mix:
   1. Asphalt Binder:
      a. Performance Graded Asphalt Binder:
         1) Use performance graded asphalt binder identified under Asphalt Mix Design Criteria.
   2. Aggregates:
      a. Use clean, hard, durable, angular, sound, consisting of crushed stone, crushed gravel, slag, sand, or combination.

C. Mix Design:
   1. Develop mix design according to Marshall Method to achieve optimum asphalt content as shown by test data curves based on testing samples containing 1/2 percent increments of asphalt content. Samples shall include minimum of two (2) with asphalt content above optimum and two (2) with asphalt content below optimum.
      a. Make tests in accordance with Marshall Method.
      b. Final design shall meet following criteria:
         1) Marshall blow count: 50.
         2) Stability: 1200 pounds (545 kg) minimum.
         3) Flow: 8 minimum, 16 maximum.
         4) Air voids: 3 percent minimum, 5 percent maximum.
         5) Voids in mineral aggregate: 15 percent minimum.
         6) Voids filled with asphalt: 65 percent minimum, 78 percent maximum.
         7) Asphalt cement by weight of total: 5 percent minimum.
         8) Dry Strength: 200 psi (1.38 mPa).
         9) Index of Retained Strength: 75 percent.

2.2 MATERIAL

A. Aggregate Base: Conform to applicable requirements as specified in Section 31 1123: 'Aggregate Base'.

B. Recycled Asphalt Pavement, RAP. Aggregate Restrictions include:
   1. Allowed up to 25 percent. Asphalt binder shall be one grade softer when more than 15 percent RAP is used.

C. Tack Coat:
   1. Emulsified asphalt meeting requirements of ASTM D977, Grade SS-1H, CQS-1H, or ASTM D2397/D2397M, Grade CSS-1H.

D. Pavement:
   1. Asphalt Cement: meet requirements of City of Calgary Mix "Type B" w/ PG58-31 binder.

PART 3 - EXECUTION

3.1 PREPARATION

A. General:
   1. Aggregate base and paving must be placed before any moisture or seasonal changes occur to subgrade that would cause compaction tests previously performed to be erroneous. Re-compact and retest subgrade soils that have been left exposed to weather.

B. Protection Of In-Place Conditions:
   1. Asphalt Paving:
      a. Protect all structures, including curb, gutter, sidewalks, guard rails and guide posts.
      b. Protect neighborhood, storm drains and down-stream fish habitat.

C. Surface Preparation:
   1. Survey and stake parking surfaces to show grading required by Contract Documents.
   2. Subgrade (soil below aggregate base):
      a. Prepare natural soil subgrade as specified in Section 31 2213 'Rough Grading' or prepare fill subgrade as described in Section 31 2216 'Fine Grading'.
      b. Application shall be no more than one (1) day before installation of granular road base.
   3. Aggregate base:
      a. Finish grade parking surface area to grades required by Contract Documents.
      b. Compact aggregate base as specified in Section 31 1123 'Aggregate Base'.
      c. Tolerances:
         1) Elevation of aggregate base shall be 0.00 inches (0.00 mm) high and no more than 1/2 inch (12.7 mm) low.
         2) Measure using string line from curb to curb, gutter, flat drainage structure, or grade break.
   4. Tack coat:
      a. Clean surface of all materials such as mud, dirt, leaves, etc. that prevent tack from bonding to existing surfaces.
         1) If flushed, allow surface to dry.
   5. Asphalt paving:
      a. Area shall be clean and tack coat applied before placing of asphalt paving.
         1) Remove all moisture, dirt, sand, leaves, and other objectionable material from prepared surface before placing asphalt.
         2) Locate, reference, and protect all utility covers, monuments, curb, and gutter and other components affected by asphalt paving operations.
         3) Allow sufficient cure time for tack coat before placing asphalt.

3.2 APPLICATION

A. Interface With Other Work:
1. Section 31 1123: 'Aggregate Base' for compaction of aggregate base.
2. Section 31 2213: 'Rough Grading' for rough grading and preparation of natural soil subgrades below fill and aggregate base materials.
3. Section 31 2216: 'Fine Grading' for grading of subgrade below aggregate base and topsoil.
4. Section 31 2323: 'Fill' for compaction procedures and tolerances.

B. Tack Coat:
1. General:
   a. Tack coat vertical surfaces of new asphalt cement concrete and portland cement concrete that will be in contact with asphalt paving.
   b. Use tack coat diluted to a 2:1 (concentrate water) ratio.
   c. Use pressure distributor to apply in uniform, continuous spread.
   d. Cover all tacked surface areas with surfacing materials same day of application.
2. Application rate. Typically as follows:
   a. Emulsions, 0.08 to 0.15 gallons per sq yd (0.303 to 0.679 L per sq m) of diluted material:
      1) Apply sufficient to achieve ninety five (95) percent or better coverage of existing surfaces.
      2) Above application rates may vary according to field conditions. Obtain approval from Civil Engineer for quantities, rate of application, temperatures, and areas to be treated before any application.

C. Asphalt Paving:
1. General:
   a. Paving adjacent to cast-in-place concrete site elements shall be between 1/4 inch (6 mm) higher than concrete.
   b. Surface texture of hand worked areas shall match texture of machine-laid areas.
   c. Surface shall be uniform with no 'birdbaths'. Leave finished surfaces clean and smooth. Variations from specified grades shall not exceed 1/2 inch (12.7 mm).
   d. Cross Slope: 1/4 inch (6 mm) in 10 feet (3.0 m) perpendicular to centerline except at cross section grade breaks.
   e. Grade: 1/8 inch (3 mm) in 10 feet (3.0 m) parallel to centerline.
   f. Do not place on frozen aggregate base or during adverse climatic conditions such as precipitation or when roadway surface is icy or wet.
   g. Uniformly mix materials so aggregate is thoroughly coated with asphalt.
   h. Place at temperatures established by the mix design with self-propelled laydown machine.
   i. Use **Table 2 – MINIMUM TEMPERATURE, DEGREES** as guide:

Table 2 – MINIMUM TEMPERATURE, DEGREES

Ambient Air Temperature Deg F.	Ambient Air Temperature Deg C.	Compacted Paving Mat Thickness					
		3/4" (19 mm)	1" (25 mm)	1 1/2" (38 mm)	2" (50 mm)	3" (75 mm)	4" + (100 mm) +
45 – 50	7 – 10	---	---	---	---	280	265
50 – 59	10 – 15	---	---	---	280	270	255
60 – 69	16 – 20	---	---	285	275	265	250
70 – 79	21 – 79	285	285	280	270	265	250
80 - 89	27 - 31	280	275	270	265	260	250
90+	32+	275	270	265	260	250	250

   j. Longitudinal bituminous joints shall be vertical and properly tack coated if cold. Transverse joints shall always be tack coated.
2. Compaction:
   a. **Compact asphalt paving to ninety-seven (97) percent minimum** of Marshall value. Determine percent compaction by ASTM D2950/D2950M.

b. Roll with powered equipment capable of obtaining specified density while providing required smoothness.
c. Begin breakdown rolling immediately after asphalt is placed when asphalt temperature is at maximum:
d. Complete handwork compaction concurrently with breakdown rolling.
e. Execute compaction so visibility of joints is minimized:
f. Complete finish rolling to improve asphalt surface as soon as possible after intermediate rolling and while asphalt paving is still warm.
g. Do not use vibration for finish rolling.

3. Lift Thickness:
   a. Preferred Method:
      1) Apply 3 inch (75mm) thick asphalt paving in single lift.

D. Asphalt Paving Surface Treatments:
1. Apply mandatory Asphalt Paving Surface Treatment no sooner than thirty (30) days or no later than eighteen (18) months of placing Asphalt Paving to be included with this project. Do not apply prior to asphalt curing (refer to 'Asphalt, Concrete and Pervious Concrete Maintenance Guidelines'):
   a. Asphalt Based Penetrating Seal will be performed by Owner.

E. Paint Stripes:
1. Apply paint stripes after asphalt paving surface treatment has been applied to asphalt paving.

3.3 FIELD QUALITY CONTROL

A. Field Tests And Inspections:
1. Civil and structural field tests, laboratory testing, and inspections are provided by Owner's independent Testing Agency as specified in Section 01 4523 'Testing And Inspection Services':
   a. Quality Control is sole responsibility of Contractor:
      1) Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform testing and inspection as part of his Quality Control:
         a) Testing and inspections will be responsibility of Contractor to be performed by an independent entity.
      2) Contractor bears full responsible for compliance with all contract requirements and quality control on project and will be responsible for quality of asphalt mixture and asphalt installation.

B. Field Tests (Provided by Contractor):
1. General:
   a. Contractor bears full responsibility for compliance with all contract requirements and quality control on project and will be responsible for quality of asphalt mixture and asphalt installation.
   b. Testing and Inspection Reports to be distributed as specified in Section 01 4523 'Testing And Inspection Services'.
2. Compaction Tests:
   a. Contractor to provide compaction tests of asphalt being placed to establish rolling patterns and installation procedures.
   b. Compaction tests by Contractor are independent of compaction tests being provided by Owner. See Section 01 4523 'Testing And Inspection Services'.
   c. Compact asphalt paving to ninety-seven (97) percent minimum of Marshall value. Determine percent compaction by ASTM D2041/D2041M:
3. Thickness Tests:
   a. Determine thickness of paving being placed, no less than one (1) test per 10,000 sq. ft. (930 sq. m) of paving or portion thereof, three (3) tests minimum.

C. Field Tests And Inspections (Provided by Owner):
1. General:
   a. Compaction tests provided by Owner will be used to validate or determine discrepancies with testing by Contractor.

b. Civil engineer applies pay factor for Gradation/Asphalt Content, In-Place Density. Civil engineer computes pay factor for each lot.
c. Opening paved surface to traffic does not constitute acceptance.
d. Unless required by the Owner's Representative, Testing Agency is to base compaction testing on the Contractor's submitted mix design for theoretical maximum specific gravity (Rice) or Marshall specific gravity (Bulk) values.
e. Asphalt-aggregate mix sampling as per ASTM D979/D979M.
    1) Test for:
        a) Air voids as per ASTM D3203/D3203M.
        b) Asphalt binder content as per ASTM D6307.
        c) Aggregate gradation as per ASTM D5444.
f. Lot size: 10,000 sq. ft. (930 sq. m) or part thereof.
g. Sub lot size: 5,000 sq. ft. (465 sq. m) or part thereof.

2. At Site Testing and Inspection:
    a. Asphalt Paving:
        1) Testing Agency shall provide full time nuclear density testing and inspection for asphalt paving during asphalt paving operations (nuclear density testing is informational testing only and does not constitute acceptance by Owner).
        2) Inspection to include:
            a) Aggregate coating.
            b) Compaction control and effort required.
            c) Suitability of spreading and asphalt paving equipment.
            d) Temperature of mix as delivered and placed.
                (1) Reject mixes exceeding 325 deg F (163 deg C) in transport vehicle as required in Non-Conforming Work below.
                (2) Dispose of cold mix in paver hopper as thin spread underlay.
        3) Field Tests:
            a) When tested with 10 foot (3 meter) straight edge, surface of completed work shall not contain irregularities in excess of 1/4 inch (6 mm).
            b) Determine percent compaction per ASTM D2950/D2950M unless other nondestructive nonnuclear methods such as sonar are used.
            c) Provide written nuclear density testing, or other nondestructive nonnuclear methods such as sonar,of asphalt paving at minimum rate of one (1) per 2,500 sq. ft. (232 sq. m). Select test locations by ASTM D3665 and sample per ASTM D979/D979M before compaction. Minimum of three (3) tests required.
            d) Compact asphalt paving to ninety-seven (97) percent minimum of Marshall/Bulk value. Determine percent compaction by ASTM D2950/D2950M:
            e) Maximum average total air voids in completed hot mix asphalt shall be eight (8) percent but more than three (3) percent as determined by ASTM D2041/D2041M.
            f) Determine thickness of paving being placed, no less than one (1) test per 10,000 sq. ft. (930 sq. m) of paving or portion thereof, three (3) tests minimum.

3. At Laboratory Testing:
    a. General:
        1) Provide at least one (1) laboratory test series for every 10,000 sq. ft. (930 sq. m) or part thereof (minimum of one (1) test):
            a) Test reports will show compliance with Contract Documents regarding type of aggregate base, depth of aggregate base, depth and density of asphalt paving, asphalt content, aggregate gradation, flow and stability, bulk specific gravity and maximum specific gravity.
            b) Reports will also give test procedures used by testing laboratory.
    b. Compaction and Final Density:
        1) Pavement thickness and final density to be determined by results of coring. Provide one (1) core per 10,000 sq. ft. (930 sq. m) or part thereof. Minimum of three (3) tests required:
            a) Based upon core samples, compaction is acceptable if test deviations are within pay factor 1.00 limits.
            b) At Project Manager's discretion, after consulting with design team, a Lot with a sub-lot test deviation greater than Reject may stay in place at fifty (50) percent cost.

c) Select test locations by ASTM D3665 and sample per ASTM D979/D979M after compaction.

c. Compaction Pay Factor:
1) Based upon core samples, compaction is acceptable if test deviations are within pay factor 1.00 limits.
2) At Project Manager's discretion, after consulting with design team, a Lot with a sub-lot test deviation greater than Reject may stay in place at fifty (50) percent cost.
3) Average Density, in percent as per **Table 3 – COMPACTION PAY FACTORS**:

Table 3 – COMPACTION PAY FACTORS
(97 percent of laboratory required – Marshall Method ASTM D2726/D2726M)

Actual Density percent As Compared Marshall/Bulk Density	Pay Factor Applied to Bid Asphalt Qualities
97.0	100.0
96.9	99.9
96.8	99.7
96.7	99.4
96.6	99.1
96.5	98.7
96.4	98.2
96.3	97.7
96.2	97.1
96.1	96.3
96.0	95.5
95.9	94.6
95.8	93.6
95.7	92.5
95.6	91.3
95.5	89.9
95.4	88.4
95.3	86.7
95.2	84.8
95.1	82.7
95.0	80.3
Under 95.0	REJECT

d. Pavement Thickness:
1) Pavement thickness and final density to be determined by results of coring. Provide one (1) core per 10,000 sq. ft. (930 sq. m) or part thereof. Minimum of three (3) tests required if under 30,000 sq. ft. (2 787 sq. m).
a) Acceptance will be based on the average of all thickness tests.
b) At Project Manager's discretion, after consulting with design team, payment may be made for areas deficient in thickness by more than 0.75 inches (19.05 mm) at fifty (50) percent. If not, remove and replace at no additional cost to the Owner in following **Table 5 – THICKNESS PAY FACTORS**:

Table 5 – THICKNESS PAY FACTORS	
Pay Factors	Thickness Deficiency, in Inches (ASTM D3549/D3549M)
1.00	0.00 to 0.25
0.90	0.26 to 0.50
0.70	0.51 to 0.75
Reject	0.76 to 1.00

e. Air Voids:
   1) Basis of evaluation is laboratory compacted samples (not field compacted samples).
   2) Air voids will be mix design target plus or minus one (1) percent.
   3) If test results are not within this Section's limits, options include correction of production procedures or alternate mix design acceptable to Civil Engineer.

D. Non-Conforming Work: Non-conforming work as covered in the General Conditions applies, but is not limited to the following:
   1. Asphalt Paving:
      a. Deficient asphalt paving thickness:
         1) Place additional material over deficient areas. Do not skin patch. Mill for inlay if necessary. Correct deficient asphalt paving thickness at no additional cost to the Owner.
      b. Rejection and Removal of Asphalt Paving:
         1) Remove asphalt paving found defective after installation and install acceptable product at no additional cost to the Owner.
      c. Removal of Asphalt Paving:
         1) Remove spatter, over-coat, or mar at no additional cost to the Owner.
         2) Remove asphalt from borrow pits or gutters at no additional cost to the Owner.
      d. Repair of Asphalt Paving:
         1) Repair or replace defective joints, seams, edges at no additional cost to the Owner.

3.4 PROTECTION

A. Tack Coat:
   1. Protect all surfaces exposed to public view from being spattered or marred. Remove any spattering, over-coating, or marring at no additional cost to Owner.
   2. Traffic:
      a. Do not permit traffic to travel over tacked surface until tack coat has cured and dried.

B. Asphalt Paving:
   1. Protect hot mixed asphalt (HMA) pavement from traffic until mixture has cooled enough not to become marked.

END OF SECTION

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SECTION 32 1723

PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish acrylic paint and apply pavement and curb markings as described in Contract Documents including:
   2. Colour and stencils to match the City of Calgary current standard details.

1.2 REFERENCES

A. Reference Standards:
   1. Federal Specifications and Standards:
      a. FED-STD-595C, 'Federal Standard: Colors Used in Government Procurement' (16 Jan 2008).
      b. FED TT-P-1952F, 'Paint, Traffic and Airfield Marking, Waterborne' (17 Feb 2015).
   2. U.S. Department of Transportation Federal Highway Administration:
      a. FHWA MUTCD-10, 'Manual on Uniform Traffic Control Devices'.

1.3 SUBMITTALLS

A. Action Submittal:
   1. Product Data:
      1) Manufacturer's published product data and certification that product supplied meets requirements of this specification.

B. Informational Submittal:
   1. Test And Evaluation Reports:
      a. Acrylic Paint:
         1) Provide reports showing compliance to FED TT-P-1952F.

C. Closeout Submittals:
   1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
      a. Record Documentation:
         1) Manufacturer's Documentation:
            a) Product data.
            b) Specification compliance documentation.
         2) Testing and Inspection Reports:
            a) Reports showing compliance.

1.4 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Paint must meet requirements of FED TT-P-1952-F and local regulations for VOC.
   2. Paint handicap spaces to conform to 2019 National Building Code – Alberta Edition and local code (AHJ) requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements:
   1. Materials shall be delivered in original, unopened containers with labels intact.
      a. Labels to include:
         1) Manufacturer's name and address.
         2) TT-P-1952F reference.
         3) Classification Type.
         4) Color.

B. Storage And Handling Requirements:
   1. Follow Manufacturer's storage and handling requirements.
   2. Protect stored material from freezing at temperatures above 35 deg F (2 deg C) or above 115 deg F (46.1 deg C).
   3. Do not invert or roll containers.

1.6 FIELD CONDITIONS

A. Ambient Conditions:
   1. Acrylic Paint:
      a. Apply only on dry clean surfaces, during favorable weather (not excessively windy, dusty, or foggy), and when damage by rain, fog, or condensation not anticipated.
      b. Paving surface and Ambient temperature shall be minimum 50 deg F (10 deg C) and rising.
      c. Temperature shall not drop below 50 deg F (10 deg C) within twenty-four (24) hour period following application.
      d. Acetone based paints that are one hundred (100) percent acrylic shall not drop below 32 deg F (0 deg C) within twenty-four (24) hour period following application.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Acrylic Paint:
   1. Description:
      a. Low VOC, ready-mixed, one- component, acrylic waterborne traffic marking paint suitable for application on concrete, asphalt, sealers, and previously painted areas of these surfaces.
   2. Design Criteria:
      a. General:
         1) Traffic Paint.
         2) Non-volatile portion of vehicle for all classification types shall be composed of one hundred (100) percent acrylic.
         3) Meet FED TT-P-1952F specification requirements.
         4) Fast drying when applied at ambient conditions requirement.
         5) Low VOC.
         6) Non-Reflectorized.
         7) Traffic paints not intended for use as floor paints. Do not use on pedestrian walkways or large surfaces such as ramps, floors and stairs which may become slippery when wet.
      b. Classification:
         1) Type I for use under normal conditions.
      c. Composition:
         1) Non-volatile portion for all types shall be composed of one hundred (100) percent acrylic polymer as determined by infrared spectral analysis.
         2) Prohibited material:

a) Product does not contain mercury, lead, hexavalent chromium, toluene, chlorinated solvents, hydrolysable chlorine derivatives, ethylene-based glycol ethers and their acetates, nor any carcinogen.

d. Qualitative Requirements:
1) Meet FED TT-P-1952F requirements for:
a) Abrasion resistance.
b) Accelerated package stability.
c) Accelerated weathering.
d) Appearance.
e) Color requirements:
(1) Color Match (all colors except white and yellow).
(2) Daylight directional reflectance.
(3) Yellow color match.
f) Condition in container.
g) Dry-through (early washout) for Type II only.
h) Flexibility.
i) Freeze/thaw stability.
j) Heat-shear stability.
k) Scrub resistance.
l) Skinning.
m) Titanium dioxide content.
n) Water resistance.

e. Quantitative requirements:
1) Meet FED TT-P-1952F requirements (Table 1).
2) Acetone based paints that are one hundred (100) percent acrylic and have exempt status under Federal law are exempt from meeting FED TT-P-1925F requirements.

3. Colors:
a. General:
1) Traffic Paint will be furnished in white and any Federal Standard 595 color in accordance to FED-STD-595C:
a) Yellow: 33538.
b) Blue: 35180.
c) Red: 31136.

b. White (Yellow may be used at Owner Representative's discretion):
1) Lane lines, edge lines, transverse lines, arrows, words, symbol markings, speed bump markings, parking space markings.

c. Yellow:
1) Cross-hatching in medians, cross hatching in safety zones separating opposing traffic flows, crosswalk stripes, safety markings, centerlines, edge lines along left edge of one-way roadway or one-way ramp.

d. Blue And White:
1) In parking spaces specifically designated as reserved for disabled.

e. Red:
1) Fire lanes, no parking zones, special raised pavement markers that are placed to be visible to "wrong-way" drivers.

4. Type Two Acceptable Products:
a. Any product meeting design criteria of this specification as approved by Architect/Owner's Representative before application. See Section 01 6200.

PART 3 - EXECUTION

3.1 PREPARATION

A. Acrylic Paint:
1. Asphalt Surfaces:
a. Do not apply paint until asphalt has cooled.
b. Allow new seal coated surfaces to cure for at least twenty-four (24) hours before applying paint.

B. Surfaces shall be dry and free of grease and loose dirt particles.

C. Perform layout with chalk or lumber crayon only.

3.2 APPLICATION

A. General:
   1. Mix in accordance and apply as per Manufacturer's instructions.
   2. Apply at locations and to dimensions and spacing as shown on Contract Drawings.

B. Tolerances:
   1. General: Make lines parallel, evenly spaced, and with sharply defined edges.
   2. 4 inch (100mm) wide Line Widths:
      a. Plus or minus 1/4 inch (6 mm) variance on straight segments.
      b. Plus or minus 1/2 inch (13 mm) variance on curved alignments.

C. Coverage:
   1. Paint stripes added to new asphalt surfaces:
      a. Apply single coat.
   2. Apply traffic paint at rate of 13 to 15 mils minimum wet thickness, 8 to 9 mils dry thickness. Application at more than 15 mils may result in extended dry times and may cause lifting or cracking on some asphalt surfaces.

3.3 FIELD QUALITY CONTROL

A. Non-Conforming Work:
   1. Replace or correct defective material not conforming to requirements of this specification or any work performed that is of inferior quality at no cost to Owner.

3.4 CLEANING

A. General:
   1. Remove drips, overspray, improper markings, and paint material tracked by traffic by sand blasting, wire brushing, or other method approved by Architect/Owner’s Representative before performance.

B. Waste Management:
   1. Remove debris resulting from work of this Section. Dispose of or recycle all trash and excess material in manner conforming to current AHJ regulations and local laws.

END OF SECTION

SECTION 32 3113

CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install complete fence as described in Contract Documents.

B. Related Requirements:
   1. Section 03 3111: 'Cast-In-Place Structural Concrete' for mow strips at fencing.

1.2 REFERENCES

A. Association Publications: / Organizations:
   1. Chain Link Fence Manufacturers Institute (CLFMI), Columbia, MD www.chainlinkinfo.org.
      a. WLG 2445, *'Chain Link Fence Wind Load Guide for the Selection of Line Post and Line Post Spacing*' (2012).
      b. CLF-SFR0111, *'Chain Link Fence Manufacturers Institute Security Fencing Recommendations'*.
      c. CLF-PM0610, *'Field Inspection Guide'*.
      d. CLF-TP0211, *'Tested and Proven Performance of Security Grade Chain Link Fencing Systems'*.

B. Reference Standards:
   1. ASTM International:
      a. ASTM A123/A123M-17, 'Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products'.
      b. ASTM A153/A153M-16a, 'Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware'.
      c. ASTM A392-11a(2017), 'Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric'.'
      d. ASTM A1011/A1011M-18a, 'Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength'.
      e. ASTM F1043-18, 'Standard Specification for Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework'.
      f. ASTM F1083-18, 'Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures'.
      g. ASTM F3000/F3000M-13(2018), 'Standard Specification for Polymer Privacy Insert Slats for Chain Link Fabric and Privacy Chain Link Fabric Manufactured Containing Pre-Installed Privacy Slats'.

1.3 SUBMITTALS

A. Action Submittals:
   1. Product Data: Manufacturer literature or cut sheets on fence components.
   2. Samples: Types of vision slats and colors for Architect's selection.

B. Closeout Submittals:
   1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
      a. Warranty Documentation:
         1) Vision Slats:

a) Final, executed copy of Warranty.

1.4 WARRANTY

A. Vision Slats:
1. Manufacturers twenty-five (25) year, pro-rata limited Warranty.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Materials:
1. Fabric:
a. Chain Link Fabric of 9 ga (3.7 mm) wire, galvanized before or after weaving with 1.2 ounce (34 grams) zinc coating conforming to requirements of ASTM A392, Class I.
b. Mesh:
1) With Visual Privacy / Security Slats (at recycle / garbage collection area):
a) 2 inch (50 mm) square mesh required by specified vision slat.
2) Without Visual Privacy / Security Slats (at property fence East):
a) 2 inch (50 mm) square mesh as selected by Architect.
c. Knuckle both selvages.
d. Colour: Black.
2. Framework:
a. Posts and Rails shall be roll-formed, self-draining shapes meeting strength requirements of ASTM F1043, Table 3, and with 2 ounce (56.7 grams) zinc coating per 1 sq ft (0.0929 sq meter) of surface area conforming to ASTM A123/A123M.
b. Line Posts:
1) Line Posts:
a) 2.375 inch (60 mm) outside diameter Schedule 40 tubular section weighing 3.65 lbs (1.6 kg) per lineal 1 ft (305 mm) meeting requirements of ASTM F1083.
b) 2.375 inch (60 mm) outside diameter Schedule 40 tubular section weighing 3.12 lbs (1.42 kg) per lineal 1 ft (305 mm) formed from steel meeting requirements of ASTM A1011/A1011M.
c. Terminal Posts:
1) Posts:
a) 3 inch (76 mm) outside diameter Schedule 40 pipe weighing 5.79 lbs (2.63 kg) per lineal 1 ft (305 mm) meeting requirements of ASTM F1083.
b) 3 inch (76 mm) outside diameter Schedule 40 tubular section weighing 4.64 lbs (2.11 kg) per lineal 1 ft (305 mm) formed from steel meeting requirements of ASTM A1011/A1011M.

d. Top And Brace Rail:
1) 1.660 inch 42 mm outside diameter Schedule 40 pipe weighing 2.27 lbs (1.03 kg) per lineal 1 ft (305 mm) meeting requirements of ASTM F1083.
2) 1.660 inch 42 mm outside diameter Schedule 40 tubular section weighing 1.84 lbs (0.83 kg) per lineal 1 ft (305 mm) formed from steel meeting requirements of ASTM A1011/A1011M.
e. Fittings:
1) Pressed steel or malleable iron, hot-dip galvanized conforming to ASTM A153/A153M.
2) Tie wires shall be 12 ga (2.05 mm) minimum galvanized steel or 9 ga (3 mm) minimum aluminum wire.
f. Tension Wire: 7 ga (3.66 mm) minimum galvanized spring steel.

B. Mixes:
1. Post Foundation Concrete:

a. One cu ft cement, 2 cu ft (0.0566 cu m) sand, 4 cu ft (0.1132 cu m) gravel, and 5 gallons (18.93 liters) minimum to 6 gallons (22.71 liters) maximum water.
b. Mix thoroughly before placing.

2.2 ACCESSORIES

A. Vision Slats And Fabric (slats at recycle / garbage collection area):
1. Manufacturer Contact List:
a. *Privacy*Link, Hyde Park, UT www.eprivacylink.com.
2. Description:
a. High-density polyethylene (HDPE), double-walled, self-locking or with locking feature that prevents slats from being removed
b. Slats pre-woven and pre-inserted into chain link fabric.
3. Design Criteria:
a. Meet ASTM F3000/F3000M requirements for pre-installed privacy slats.
b. Provide slats with ultra violet (UV) inhibitors.
4. Visual Privacy / Security:
a. Near-Total Privacy:
1) Description:
a) When installed, slats will provide 98 percent minimum visual privacy/security.
b) Mesh: 2 inch x 2 inch (50 mm x 50 mm).
2) Pre-inserted Slats:
a) Double-wall with wings on each side of slat that wedge slats tightly into mesh and secured in place at both top and bottom of fence by flexible round tubes.
3) Type Two Acceptable Product:
a) Noodle Link Plus by *Privacy*Link.
b) Equal as approved by Architect before installation. See Section 01 6200.
5. Color:
a. Slats:
1) Black to match vinyl coated mesh.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fence shall be installed by mechanics skilled and experienced in erecting fences of this type and in accordance with Contract Documents.
1. When general ground contour is to be followed, make changes of grade in gradual, rolling manner.
2. Evenly space posts in line of fence a maximum of 10 feet (3.050 meter) center to center.

B. Post Foundations:
1. Set posts with concrete post foundations as specified below:
a. Line Posts:
1) Diameter 8 inch (200 mm)
2) Depth 36 inch (915 mm).
b. End and Corner Posts:
1) Diameter 12 inch (305 mm)
2) Depth 42 inch (1 065 mm).
c. At mow strips, set top of post foundation below grade sufficient to allow for placing of mow strip. Measure post foundation depth from top of mow strip.
d. Where fences are incorporated into slabs, measure post foundation depth from top of slab. Extend bottom of slab footing sufficient to allow specified amount of concrete around post.

C. Fence:

1. After posts have been permanently positioned and concrete cured for one (1) week minimum, install framework, braces, and top rail. Join top rail with 6 inch (150 mm) minimum couplings at not more than 21 foot (6.40 meter) centers.
2. Stretch fabric by attaching one end to terminal post and supplying sufficient tension to other end of stretch so slack is removed.
   a. Fasten fabric to line posts with tie wires. Pass ties over one strand of fabric and hook under line post flange.
   b. Place one tie as close to bottom of fabric as is possible with additional ties equally spaced between top and bottom band on approximately equal spacing not to exceed 14 inches (355 mm) on center.
   c. Attach fabric to roll formed terminals by weaving fabric into integral lock loops formed in post. Attach fabric to tubular terminals with tension bars and bands.
   d. Hold fabric approximately 2 inches (50 mm) above finish grade line.
   e. On top rail, space tie wires at no more than 24 inches (610 mm) on center.
   f. Securely attach fittings and firmly tighten nuts.

3.2 CLEANING

A. Spread dirt from foundation excavations evenly around surrounding area unless otherwise directed. Leave area free of excess dribbles of concrete, pieces of wire, and other scrap materials.

END OF SECTION

SECTION 32 8423

UNDERGROUND SPRINKLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install planting irrigation system as described in Contract Documents complete with accessories necessary for proper function.

B. Related Requirements:
   1. Section 01 4301: 'Quality Assurance – Qualifications'.
   2. Section 22 1116: 'Domestic Water Piping' for stop and waste valve.
   3. Section 31 2213: 'Rough Grading'.
   4. Section 31 2216: 'Fine Grading'.
   5. Section 31 2316: ‘Excavation’.
   6. Section 31 2323: 'Fill' for trench compaction.
   7. Section 32 9001: 'Common Planting Requirements'.
      a. Pre-installation conference held jointly with other common planting related sections.
   8. Section 32 9120: ‘Topsoil And Placement’ for topsoil evaluation and placement required for topsoil grading.
   9. Section 32 9122: ‘Topsoil Grading’ for preparation of topsoil and addition of amendments prior to landscaping.
   10. Section 32 9223: 'Sodding'.
   11. Section 32 9300: 'Plants'.
   12. Divisions 26 and 27: Power and data to irrigation controller.

1.2 REFERENCES

A. Definitions:
   1. Dielectric Fittings: Special type of fitting used between dissimilar metals to prevent galvanic action from causing corrosion failure.
   2. High Wind Area: As defined in this specification, area with average sustained wind speed of over 7.5 mph (12 km/hr).
   3. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
   4. Landscape Management Plan (LMP): See Section 32 9001 for definition.
   5. Lateral Line: Downstream from electric control valves to pop-up spray heads and drip valve assemblies to emitters. Piping or tubing is under pressure during flow.
   6. Main Line: Downstream from point of connection to electric control valves. Piping is under water-distribution-system pressure when activated by master valve or hydrometer.
   7. Peak Flow: Maximum required flow for given month based on six (6) day week, nine (9) hour day watering window to be used for irrigation system design and to be used in hydraulic analysis.
   8. Plant Establishment Period: See Section 32 9001 for definition.
   9. Point of Connection: Location where meter for irrigation system is located.
   10. Smart Controller: Irrigation clocks that automatically adjust irrigation run times in response to environmental changes using sensors and weather information to manage watering times and frequency. As environmental conditions vary, controller will increase or decrease irrigation. Smart controllers have ability to turn off sprinklers automatically during rain, high wind or low temperature.
   11. Static Water Pressure: Pressure at point of connection when system is not operable.
   12. Source Pressure Test: Test to determine water source pressure.
   13. System Pressure Test: Test to evaluate system when pressurized.
   14. Working Pressure: Pressure at point of connection when system is operable.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Provide Coordination for required tests and inspections as described under Field Quality Control in Part 3 EXECUTION for following:
      a. Manufacturer's Field Service: Provide necessary manufacturer's field service.
      b. Pressure Test: In presence of Landscape Architect or designated Representative(s), provide pressure test.
      c. Substantial Completion Walkthrough: In presence of Landscape Architect or designated Representative(s), plan and provide walk through after completion of irrigation system.
      d. Irrigation Final Acceptance: In presence of Landscape Architect or designated Representative(s), plan and provide final walk through after completion of all work listed on Substantial Completion walk through list provided by Landscape Architect.

B. Pre-Installation Conference:
   1. Participate in pre-installation conference as specified in Section 32 9001.
      a. Irrigation Subcontractor's Representative and Foreman responsible for installation of irrigation system required to be in attendance.
      b. Schedule pre-installation conference before irrigation system installation begins.
      c. In addition to agenda items specified in Section 01 3100, review following:
         1) Review mockup requirements.
         2) Review required tests and inspections and submittal requirements.
         3) Review smart controller and submittal requirements.
         4) Review Landscape Management Plan (LMP) requirements.

C. Sequencing:
   1. Install PVC sleeves before installation of cast-in-place concrete site elements and paving.

1.4 SUBMITTALS

A. Action Submittals:
   1. Product Data:
      a. Manufacturer's cut sheets for each element of system.

B. Informational Submittals:
   1. Certificates:
      a. Irrigation System Acceptance:
         1) Upon acceptance of irrigation system, Landscape Architect will provide signed certificate:
            a) Certificate will include name and signature of Landscape Architect, Landscape Architect's company, Landscape Architect's telephone number, and date of review.
            b) Certificate will state to best of Landscape Architect's knowledge that the system is in full compliance with Contract Documents.
      b. Establishment Period Acknowledgement (coordinate with 32 9000 sections):
         1) Establishment Period begins at date of Substantial Completion. Landscape Architect will provide certificate acknowledging Establishment Period commencement:
            a) Certificate will include name and signature of Installer, Installer's company, Installer's telephone number, and date.
            b) Certificate will include name and signature of Owner's Representative, Owner's Representative Group name, Owner's Representative Group telephone number, and date.
            c) Certificate will acknowledge date when Establishment Period begins and that it extends one (1) year from that time.
      c. Training Acknowledgement:
         1) Landscape Architect will provide certificate acknowledging training has been performed:
            a) Certificate will include name and signature of Installer, Installer's company, Installer's telephone number, and date.

b) Certificate will include name and signature of Owner's Representative, Owner's Representative Group name, Owner's Representative Group telephone number, and date.
c) Certificate will acknowledge Owner's Representative has been trained in operation and maintenance of system.
d) Certificate will acknowledge Owner's Representative has been trained in the operation and the smart controller.

2. Test And Evaluation Reports:
   a. Provide report for results of main line service pressure testing before burial of mainline.
   b. Provide following from Main Line Irrigation test and observation:
      1) Record and submit documentation of Irrigation Main Line tests, issues, and measure taken to correct problems.
3. Manufacturer Instructions:
   a. Manufacturer's printed literature on operation and maintenance of operating elements of system.
   b. Instruction Manual:
      1) Complete system operation and maintenance directions, including winterizing, controller program worksheet, and irrigation scheduling based on local site specific conditions.
      2) Provide plant establishment schedule and long term maintenance establishment schedule.
4. Special Procedure Submittals:
   a. Manufacturer's Smart Controller Approved Distributor Installer:
      1) Signed 'Smart Controller Installation Checklist' to be included in Closeout Submittals.

C. Closeout Submittals:
1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
   a. Submittal Format: Digital format only.
   b. Operations And Maintenance Data:
      1) Include additional copy for Landscape Management Plan (LMP) of the following information:
         a) Provide irrigation system operation and maintenance recommendations.
         b) Provide irrigation system operation and maintenance recommendations from manufacturers.
         c) Provide irrigation system winterization instructions.
         d) Provide plant establishment period watering schedule.
         e) Provide post plant establishment period watering schedule.
   c. Warranty Documentation (include additional copy for Landscape Management Plan (LMP):
      1) Irrigation System Warranty.
      2) Manufacturer's extended Warranty for smart controller.
   d. Record Documentation:
      1) Provide manufacturer's printed literature and cut sheets for each element of system.
      2) Certificates:
         a) Irrigation System Acceptance.
         b) Establishment Period Acknowledgement.
         c) Training Acknowledgement.
      3) Testing and Inspection Reports:
         a) Pressure Test.
         b) Completed 'Smart Controller Installation Checklist'.
      4) Irrigation Record Drawings. As installation occurs, prepare accurate record drawing to be submitted before final inspection, including:
         a) Detail and dimension changes made during construction. Record at time of installation.
         b) Significant details and dimensions not shown in original Contract Documents.
         c) Field dimensioned locations of valve boxes, manual drains, quick-coupler valves, control wire runs not in mainline ditch, and both ends of sleeves.
         d) Take dimensions from permanent constructed surfaces or edges located at or above finish grade.
         e) Take and record dimensions at time of installation.

5) Photographs: Provide photographs prior to burial of key elements including but not limited to:
   a) Valves.
   b) Drains.
   c) Flow meter, Master Control Valve.

2. Irrigation Drawings:
   a. Irrigation Plan:
      1) Laminated reduced size:
         a) Size: 11 by 17 inches (275 by 425 mm).
         b) Show color key circuits and laminated both sides with 5 mil thick or heavier plastic.
         c) Mount on 12 x 18 inch (300 by 450 mm) hard board drilled with two (2) 1/2 inch (13 mm) holes at top of board.
         d) Hang on hooks in Fire 124 or location designated by Owner's Representative.
      2) Un-Laminated reduced size to be included in Landscape Management Plan (LMP):
         a) Size: 11 by 17 inches (275 by 425 mm).
         b) Show color key circuits.
3. Landscape Management Plan (LMP):
   a. Submittal Format: Digital format and hard copy of each:
      1) Irrigation Section: Include additional copies included in Operations and Maintenance Manual of following:
         a) Provide irrigation system operation and maintenance recommendations.
         b) Provide irrigation system operation and maintenance recommendations from manufacturers.
         c) Provide irrigation system winterization instructions.
         d) Provide plant establishment period watering schedule.
         e) Provide post plant establishment period watering schedule.
         f) Provide Warranty Documentation: Irrigation System Warranty and Manufacturer's extended Warranty for smart controller.
         g) Provide Un-Laminated, Reduced Size Irrigation Plan.
4. Final payment for system will not be authorized until Closeout Submittals are received and accepted by Architect and Landscape Architect.

D. Maintenance Material Submittals:
   1. Tools:
      a. Furnish following items before Final Closeout Review:
         1) One (1) quick coupler key with brass hose swivel.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. General:
      a. Work and materials shall be in accordance with latest rules and regulations, and other applicable state or local laws.
      b. Nothing in Contract Documents is to be construed to permit work not conforming to these codes.

B. Qualifications: Requirements of Section 01 4301 applies, but not limited to following:
   1. Irrigation Subcontractor:
      a. Company specializing in performing work of this section.
      b. Minimum five (5) years experience in irrigation sprinkler installations.
      c. Minimum five (5) satisfactorily completed irrigation sprinkler installations in past three (3) years of projects similar in size, scope, and complexity required for this project before bidding.
      d. Use trained personnel familiar with required irrigation sprinkler procedures and with Contract Documents.
      e. Foreman or supervisor required to attend pre-installation conference.
      f. Agree to use only approved installers for smart controller technology.
      g. Upon request, submit documentation.
   2. Irrigation Installer:

a. Perform installation under direction of foreman or supervisor.
b. Minimum three (3) years experience in irrigation sprinkler installations similar in size, scope, and complexity.
c. Upon request, submit documentation.

3. Smart Controller Installer:
   a. Manufacture approved certified installers familiar with required irrigation system and smart controller installation procedures:
      1) Agree to follow requirements as described under Installers in PART 3 EXECUTION.
      2) Agree to complete reporting documents.
      3) Agree to instruct Owner's designated personnel in complete operation and maintenance of smart controller.
      4) Agree to assist Landscape Architect in completing Watering Schedule for Landscape Management Plan (LMP).

C. Mockups:
1. Provide Mockups of each detail within valve box at staging area for review by Landscape Architect prior to installation of irrigation system.
2. These mockups may be installed with or without fused weld so that they can later be used in field.
3. Mockups shall include complete installation including weed barrier fabric, gravel sump, equipment assembly, and valve box placement and branding in conformance with these specifications.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Storage And Handling Requirements:
1. Protect materials from damage and prolonged exposure to sunlight.

1.7 WARRANTY

A. Warranty:
1. Irrigation System:
   a. In addition to standard one (1) year guarantee stipulated in General Conditions Article 12.2., warranty shall include:
      1) Filling and repairing depressions and replacing plantings due to settlement of irrigation system trenches.
2. Smart Controller:
   a. Provide Manufacturer's extended warranty for two (2) years to be free of design, materials and workmanship defects.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Manufacturers:
1. Manufacturer Contact List:
   a. 3M, Austin, TX www.3m.com/elpd.
   b. Action Machining Inc, Bountiful, UT www.actionfilters.com.
   c. Amiad www.amiadusa.com.
   d. Apollo Valves by Conbraco Industries, Matthews, NC www.apollovalves.com.
   e. Carson Industries LLC, Glendora, CA www.carsonind.com.
   f. GPH Irrigation Products, Fontana, CA www.gphirrigation.com.
   g. Harrington Corporation (Harco), Lynchburg, VA www.harcofittings.com.
   h. Hunter Industries, San Marcos, CA www.hunterindustries.com.
   i. HydroRain, North Salt Lake, UT www.hydrorain.com.
   j. King Innovation, St Charles, MO www.kinginovation.com.
   k. IPS Corporation, Compton, CA www.ipscorp.com.
   l. Leemco, Colton, CA www.leemco.com.

m. Netafim, Inc. www.netafimusa.com.
n. Nibco Inc, Elkhart, IN www.nibco.com.
o. Northstar Industries, LLC, Methuen MA www.northstarind.com.
p. Orbit Irrigation Products, Inc. Bountiful, UT www.orbitonline.com.
q. Paige Electric, Union, NJ www.paigewire.com.
r. Rain Bird Sprinkler Manufacturing Corp, Glendora, CA www.rainbird.com.
s. Rain Master, Simi Valley, CA www.rainmaster.com.
t. Salco by Weathermatic Irrigation Products, Garland, TX www.weathermatic.com.
u. Toro Company, Irrigation Div, Riverside, CA www.toro.com.
v. T. Christy Enterprises, Inc. (Christy's), Anaheim, CA www.tchristy.com.
w. VAF Filtration Systems, Arvada, CO www.vafusa.com.
x. Weathermatic Irrigation Products, Garland, TX www.weathermatic.com.
y. Wilkins a Zurn Company, Paso Robles, CA www.zurn.com.

B. Materials:
1. Rock-Free Soil:
a. For use as backfill around pipe.
2. Native Material:
a. Soil having rocks no larger than 1/2 inch (13 mm) in any dimension.
3. Pea Gravel:
a. For use around drains, valves, and quick couplers.
b. 1/2 inch (13 mm) maximum dimension, washed rock.
4. Sand: Fine granular material naturally produced by rock disintegration and free from organic material, mica, loam, clay, and other deleterious substances.
5. Native Material: Soil native to project site free of wood and other deleterious materials and rocks
6. Topsoil:
a. Use soil as described in Section 32 9120 and Section 32 9122.
b. Achieve depths as described in Section 32 9122.
7. Pipe, Pipe Fittings, And Connections:
a. General:
1) Pipe shall be continuously and permanently marked with Manufacturer's name, size, schedule, type, and working pressure.
2) Pipe sizes shown on Contract Drawings are minimum. Larger sizes may be substituted at no additional cost to Owner.
3) Main line piping will be HDPE fuse welded (butt joints) from the building to valve boxes / valves. After the valve the lateral piping will be low density 100 psi poly w/ clamps to better facilitate future maintenance.
b. Piping:
1) Main Line: See New Irrigation Plan L103 for HDPE.
2) Lateral Lines: See New Irrigation Plan L103 for low density 100 psi poly.
3) Backflow Assembly Piping: See Plumbing tree details.
4) Quick Coupler Piping: Galvanized steel.
c. Fittings: Same material as pipe, except where detailed otherwise.
1) Fittings 3 inch (76 mm) or larger: Harco or Leemco of matching size.
2) Use dielectric union fittings between dissimilar metal pipes and fittings.
d. Sleeves:
1) Under Parking Area And Driveway Paving: Schedule 40 PVC Pipe.
2) All Other: Class 200 PVC Pipe.
3) Sleeve diameter shall be two (2) times larger than pipe installed in sleeve.
4) Provide separate sleeve for control wiring.
8. Sprinkler Heads:
a. Each type of head shall be product of single manufacturer.
b. Rotary Stream Heads in Lawn Areas:
1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
a) Hunter: PRS40 with MP Rotator nozzle – see New Irrigation Plan L103 for sizes and types.
9. Sprinkler Risers:
a. Spray Heads (Pre-Manufactured Swing Assemblies):
1) Type Two Acceptable Products:

a) Hunter: SJ-512 (12 inch (305 mm) x 1/2 inch (12.7 mm)) thread) or SJ-7512 (12 inch (305 mm) x 3/4 inch (19 mm) x 1/2 inch (12.7 mm)) thread).
b) Rain Bird model SA125050.
c) Hydrorain: Blu-lock model BLJ-050-MC-1..
d) Equal as approved by Architect before use. See Section 01 6200.

10. Automatic Irrigation Controller And Control Wiring:
    a) Hunter Pro HC-12 WiFi Indoor Controller:
        (1) c/w wireless rain / solar sensor
        (2) c/w HC flow meter sized to suit irrigation line diameter
        (3) c/w Hydrawise software
        (4) c/w touchscreen
        (5) UL, C-UL, and FCC approved.
        (6) All other components required for complete and operational system.

b. Control Wiring:
    1) Wiring:
        a) Traditional control wire shall be UF-UL / ULC listed, color coded PE insulated copper conductor direct burial size 14. For wire runs exceeding 3,300 feet (1 005.84 meter), use 12 AWG wire. Do not use green color coded wire.
        b) Aside from connectivity to automatic control valves, this material will be used to connect to master valve portion of hydrometer.
    c) .Communication:
        d) Communication wire between controller and flow sensor portion of hydrometer to be Paige Electric PE-393. Run communication wire in gray electrical conduit:
            (1) Class Two Quality Standards. See Section 01 6200:
                (a) Paige Electric Cadweld Connection.
    2) Waterproof Wire Connectors:
        a) Control wire connections shall consist of properly-sized wire nut inserted in waterproof grease cap:
        b) Type Two Acceptable Products:
        c) Valve Box Support:
            (1) DBY or DBR by 3M.
            (2) 'One Step' 20111SP by King Innovation.
            (3) DB 57905, 57505 by Orbit.
            (4) Equal as approved by Architect before installation. See Section 01 6200.

c. Conduit:
    1) Inside Fire 124 room:
    a) Grey PVC conduit from controller to hydrometer and from controller to exterior stub location. Provide PVC sweep elbow / sleeve through floor and foundation wall.
    b) Conduit is not required for control wire to zone valves along landscape route (exterior) as it will be direct bury -see details.
    c) PVC sleeves are required for control wiring passing under asphalt or concrete elements.
    2) Size conduit as follows:
    3) Traditional Wiring:

Galvanized IMC Conduit						
Wire Size (AWG)	Number of Wires					
14	7	13	22	32	47	67
12	6	8	18	25	38	59
Conduit Size	3/4 inch (19 mm)	1 inch (25 mm)	1 1/4 inch (32 mm)	1 1/2 inch (38 mm)	2 inch (50 mm)	2 1/2 inch (64 mm)

PVC Sch. 40 Conduit						
Wire Size (AWG)	Number of Wires					
14	6	11	20	29	43	61
12	5	7	17	23	35	54
Conduit Size	3/4 inch (19 mm)	1 inch (25 mm)	1 1/4 inch (32 mm)	1 1/2 inch (38 mm)	2 inch (50 mm)	2 1/2 inch (64 mm)
PVC Sch. 80 Conduit						
Wire Size (AWG)	Number of Wires					
14	5	9	17	24	39	55
12	4	6	14	19	32	49
Conduit Size	3/4 inch (19 mm)	1 inch (25 mm)	1 1/4 inch (32 mm)	1 1/2 inch (38 mm)	2 inch (50 mm)	2 1/2 inch (64 mm)

11. Valves:
    a. Manual Drain Valves:
        1) Brass ball valve with 'T' handle on main lines and in valve boxes on lateral lines.
        2) See Plumbing tree detail for interior and exterior blow-out locations.
        3) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
            a) Apollo Valves: 78-621-01 Series ball valve, 3/4 inch (19 mm).
    b. Automatic Valves:
        1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
            a) Hunter: ICV series – see New Irrigation Plan L103.
    c. Isolation Valves:
        1) Non-rising stem gate valve, size to match pipe size (use in cold, northern climates- eco-regions 1.0, 5.0, 6.0, 7.0, 9.1, 9.2, and 10.1).
        2) See Plumbing tree detail for isolation valves.
        3) Class Two Quality Standards. See Section 01 6200:
            a) Nibco: T-113 (cold, northern climates).
    d. Backflow Preventer:
        1) Standard Backflow Preventer:
            a) Acceptable Products:
                (1) Make and Model shown on Contract Drawings or as required by AHJ.
                (2) Modify as required for local conditions.
    e. Master Control Valve:
        1) Hunter IBV-FS:
            a) Sized to suit irrigation tree – see details
            b) Brass electric c/w globe configuration, NPT threaded inlet / outlet, Filter sentry, and control wires as required to irrigation controller.
    f. Pressure Reducing Valve:
        1) See Plumbing tree detail:
            a) Type Two Acceptable Products:
                (1) Netafim: quick acting pressure relief valve.
                (2) Equals as approved by Architect before use. See Section 01 6200.
    g. Quick Coupling Valves and Keys:
        1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
            a) Hunter: HQ-33D Series with RC or with HK-33 and HSO swivel.
            b) See New Irrigation Plan L103
12. Valve Accessories:

a. Valve manifolds:
   1) Type Two Acceptable Products.
      a) Action Machining: 1800 Series, Models 18001, 18001-1-5, and 18001-2.0, 1, 1-1/2, and 2 inch (25, 38, and 50 mm) sizes.
      b) Hydro-Rain: HRM Series.
      c) Equals as approved by Architect before use. See Section 01 6200.
b. Valve Boxes And Extensions:
   1) Lid Colors:
      a) Green: all turf areas.
      b) Tan: all planter areas.
   2) Type Two Acceptable Products:
      a) Carson Industries:
         (1) 12 Inch (300 mm) Model 1419-12.
         (2) 10 Inch (255 mm) Model 0910.
      b) Equal as approved by Architect before use. See Section 01 6200.
c. Valve ID tags:
   1) Type Two Acceptable Products:
      a) Christy's: Stamped ID tag: 2.25"x2.7" yellow plastic tag with alpha-numeric labeling matching zone. Contact Christy's for local supplier.
      b) Equal as approved by Architect before use. See Section 01 6200.
d. Valve Box Supports:
   1) Standard size fired clay paving bricks without holes.
   2) Standard size 6 inch x 8 inch x 16 inch (150 mm x 200 mm x 400 mm) CMU Block.

13. Drip System:
a. Drip Valve Assembly:
   1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      a) Netafim Techline:
         (1) See New Irrigation Plan L103 and details.
b. Distribution Tubing (from lateral lines to emitter):
   1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      a) See New Irrigation Plan L103 and details.
c. Drip Emitters:
   1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      a) See New Irrigation Plan L103 and details.
d. Distribution Tubing (from lateral lines to in-line emitter tubing).
   1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      a) Flexible polyethylene pipe – see New Irrigation Plan L103 and details.
e. In-Line Emitter Tubing:
   1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      a) Netafim: Techline CV tubing, flush valves, and fittings. See New Irrigation Plan L103 and details.
f. Valve Boxes and Extensions:
   1) Lid Colors:
      a) Green: all turf areas.
      b) Tan: all planter areas.
   2) Type Two Acceptable Products:
      a) Carson Industries.
         (1) 15 inch (380 mm) Model 1320-15 Super Jumbo.
         (2) 12 Inch (300 mm) Model 1220-12 Jumbo.
         (3) 12 Inch (300 mm) Model 1419-12.
         (4) 10 Inch (255 mm) Model 0910.
      b) Equal as approved by Architect before use. See Section 01 6200.
g. Valve ID Tags:
   1) Type Two Acceptable Products:
      a) Christy's: Stamped ID tag: 2.25"x2.7" yellow plastic tag with alpha-numeric labeling matching zone. Contact Christy's for local supplier.
      b) Equal as approved by Architect before use. See Section 01 6200.
h. Valve Box Supports:
   1) Standard size fired clay paving bricks without holes.
   2) Standard size 6 inch x 8 inch x 16 inch (150 mm x 200 mm x 400 mm) CMU Block.

14. Solvent Cement:
    a. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
    b. Note main line is fuse welded pipe, laterals are low density 100 psi poly clamped pipe – see New Irrigation Plan L103.
        1) Primer:
            a) Meet ASTM F656 standard and applicable sections of latest edition of *'Uniform Plumbing Code'.*
            b) Meet NSF/ANSI standard for use on potable water applications.
            c) Low VOC emissions and compliant with LEED.
            d) Product: Weld-On P-70 primer by IPS.
        2) PVC Solvent Cement:
            a) Heavy bodied, medium setting, high strength:
                (1) Meet ASTM D2564 standard and applicable sections of latest edition of *'Uniform Plumbing Code'.*
                (2) Meet NSF/ANSI standard for use on potable water applications.
                (3) Meet CSA standards for use in pressure and non-pressure potable water applications.
                (4) Low VOC emissions and compliant with LEED.
                (5) Product: Weld-On 711 Low VOC PVC Cement by IPS.
            b) Flexible, medium bodied, fast setting, high strength (flexible pipe only):
                (1) Meet ASTM D2564 standard and applicable sections of latest edition of *'Uniform Plumbing Code'.*
                (2) Meet NSF/ANSI standard for use on potable water applications.
                (3) Low VOC emissions and compliant with LEED.
                (4) Product: Weld-On 795 Low VOC Flex PVC Cement by IPS.
15. Other Components:
    a. Recommended by Manufacturer and subject to Architect's review and acceptance before installation.
    b. Provide components necessary to complete system and make operational.

PART 3 - EXECUTION

3.1 INSTALLERS

A. Acceptable Installers:
    1. Meet Quality Assurance Installer Qualifications as specified in Part 1 of this specification.

3.2 EXAMINATION

A. Verification Of Conditions:
    1. Perform source pressure test at stub-out on main water line provided for irrigation system, or at near-by fire hydrant.
    2. Notify Architect if pressures over 70 psi (480 kPA) or under 55 psi (379 kPA) are found to determine if some re-design of system is necessary before beginning work on system.

3.3 PREPARATION

A. Protection:
    1. Protection Of In-Place Conditions:
        a. Repair or replace work damaged during course of Work at no additional cost to Owner. If damaged work is new, installer of original work shall perform repair or replacement.
        b. Do not cut existing tree roots measuring over 2 inches (50 mm) in diameter in order to install irrigation lines.

B. Surface Preparation:
    1. Layout of Irrigation Heads:

a. Location of heads and piping shown on Contract Drawings is approximate. Actual placement may vary slightly as is required to achieve full, even coverage without spraying onto buildings, sidewalks, fences, etc.
b. During layout, consult with Architect to verify proper placement and make recommendations, where revisions are advisable.
c. Minor adjustments in system layout will be permitted to avoid existing fixed obstructions.
d. Make certain changes from Contract Documents are shown on Record Drawings.

3.4 INSTALLATION

A. Trenching And Backfilling:
1. Pulling of pipe is not permitted.
2. Excavate trenches to specified depth. Remove rocks larger than 1-1/2 inch (38 mm) in any direction from bottom of trench. Separate out rocks larger than 1-1/2 inch (38 mm) in any direction uncovered in trenching operation from excavated material and remove from areas to receive landscaping.
3. Cover pipe both top and sides with 2 inches (50 mm) of rock-free soil or sand as specified under PART 2 PRODUCTS. Remainder of backfill to topsoil depth as specified in Section 32 9122 using native material as specified under PART 2 PRODUCTS and topsoil as specified in Section 32 9120 and Section 32 9122.
4. Do not cover pressure main, irrigation pipe, or fittings until Architect has inspected and approved system.

B. Sleeving:
1. Sleeve water lines and control wires under walks and paving. Extend sleeves 12 inches (305 mm) minimum beyond walk or pavement edge. Cover sleeve ends until pipes and wires are installed to keep sleeve clean and free of dirt and debris.
2. Position sleeves with respect to buildings and other obstructions so pipe can be easily removed.
3. Install one spare sleeve for every sleeve installed and cap for “future”.

C. Grades And Draining:
1. In localities where winterization is required, grade piping so system can be completely drained or blown out with compressed air. See Plumbing tree detail for interior and exterior blow-out access locations to winterize system.

D. Installation of Pipe:
1. Install pipe in manner to provide for expansion and contraction as recommended by Manufacturer.
2. Unless otherwise indicated on Contract Drawings, install main lines with minimum cover of 18 inches (450 mm) based on finished grade. Install lateral lines, including those connecting drip tubing, with minimum of 12 inches (300 mm) of cover based on finish grade.
3. Install pipe and wires under driveways or parking areas in specified sleeves 18 -24 inches (450 - 600 mm) below finish grade or as shown on Contract Drawings.
4. Locate pipe so no sprinkler head will be closer than 12 inches (300 mm) from building foundation.
5. Cut plastic pipe square. Remove burrs at cut ends before installation so unobstructed flow will result.
6. See New irrigation Plan L103 for fuse welded main line and clamped lateral pipe.
7. Make solvent weld joints as follows:
   a. Do not make solvent weld joints if ambient temperature is below 35 deg F (2 deg C).
   b. Clean mating pipe and fitting with clean, dry cloth and apply one (1) coat of primer to each surface.
   c. Apply uniform coat of solvent cement to outside of pipe.
   d. Apply solvent cement to fitting in similar manner.
   e. Insert pipe completely into fitting.
   f. Give pipe or fitting quarter turn to insure even distribution of solvent and make sure pipe is inserted to full depth of fitting socket.
   g. Allow joints to set at least twenty four (24) hours before applying pressure to pipe.
8. Tape threaded connections with teflon tape.
9. Isolation Valves:

a. Install as detailed on Plumbing tree.

E. Control Valves And Control Valve Wiring:
1. Install valves in plastic boxes with reinforced heavy duty plastic covers. Locate valve boxes within 12 inches (300 mm) to 24 inches (600 mm) of sidewalks and shrub bed edges with tops at finish grade. Do not install more than two (2) valves in single box.
2. Place 3 inches (75 mm) minimum of pea gravel below bricks supporting valve boxes to drain box. Set valve boxes over valve so all parts of valve can be reached for service. Set cover of valve box even with finish grade. Valve box cavity shall be reasonably free from dirt and debris.
3. Wiring:
   a. For traditional wiring, tape control wire to side of main line every 10 feet (3.050 m). Where control wire leaves main or lateral line, enclose it in gray conduit.
   b. Use waterproof wire connectors consisting of properly-sized wire nut and grease cap at splices and locate all splices within valve boxes.
   c. Use white or gray color for common wire and other colors for all other wire. Each common wire may serve only one (1) controller.
   d. Run one (1) spare control wire from panel continuously from valve to valve throughout system similar to common wire for use as replacement if wire fails:
      1) Run spare wire to each branch of system.
      2) Spare wire shall be different color than other wires. Use of green wire is not acceptable.
      3) Mark spare control wire visibly within valve box as an 'Un-Connected Wire'. Extend spare control wires 24 inches (600 mm) and leave coiled in each valve box. Mark spare wire visibly within controller as 'Un-Connected Wire'.

F. Smart Controller:
1. Fill out 'Smart Controller Installation Checklist' provided by Manufacturer.
2. Install smart controller as per Controller Manufacturer's details and installation recommendations.
3. Install grounding as per Manufacturer's recommendations:
   a. Note: if controller is mounted within building, coordinate grounding with Electrical Engineer.
4. Install automatic rain sensor as per Manufacturer's recommendations.
5. Provide sticker with Facility Manager's Contact information inside Controller, but in plain view.
6. Install communication connections as required: Wireless and/or ethernet.

G. Hydrometer:
1. Install as detailed and as per manufacturer's recommendations.
2. Connect communication cables to smart controller. Run cables within conduit as specified in specification.

H. Pressure Reducing Valve:
1. Install as per details and manufacturer's recommendations.

I. Sprinkler Heads And Rotor Pop-ups:
1. Set sprinkler heads and quick-coupling valves perpendicular to finish grade.
2. Do not install sprinklers using side inlets. Install using base inlets only.
3. Heads immediately adjacent to mow strips, walks, or curbs shall be one inch (25 mm) below top of mow strip, walk, or curb and have one inch (25 mm) to 3 inch (75 mm) clearance between head and mow strip, walk, or curb.
4. Set sprinkler heads at consistent distance from walks, curbs, and other paved areas and to grade by using specified components or other method demonstrated in Pre-Construction Conference.

J. Drip Assembly:
1. Install pipe providing for expansion and contraction as recommended by Manufacturer.
2. Cut tubing square and remove burrs at cut ends.
3. Distribution tubing shall be between 14 inches (350 mm) minimum and 48 inches (1 200 mm) maximum long. Layout lateral lines as necessary to keep distribution tubing lengths within specified tolerances.
4. Locate drip emitter on uphill side of plant within rootball zone.
5. Layout in-line tubing for trees as indicated on Contract Drawings. Layout in-line tubing for shrubs and groundcovers so plants receive water within rootball zones.

6. Locate in-line tubing on top of soil but under rock mulch and weed barrier fabric.
7. Staple in-line tubing to ground at 6 foot (1 800 mm) maximum intervals and within 12 inches (300 mm) of ends and intersections.
8. Assembly Using Solvent Weld Joints:
   a. Do not make solvent weld joint if ambient temperature is below 35 deg F (2 deg C).
   b. Clean mating pipe and fitting with clean, dry cloth.
   c. Apply uniform coat of PVC solvent cement to outside of pipe and inside socket of fitting.
   d. Insert pipe completely into fitting.
   e. Give pipe or fitting quarter turn to insure even distribution of solvent and make sure pipe is inserted to full depth of fitting socket.
   f. Allow joints to set twenty four (24) hours minimum before applying pressure to pipe.
9. Assembly Using 'Funny Pipe' Type Joints:
   a. Connect distribution tubing to lateral line using barbed ell fitting.
   b. Connect fitting to distribution tubing using straight barbed fitting with 1/2 inch (13 mm) threaded end.

K. Before installation of sprinkler heads and drip emitters, open control valves and use full head of water to flush out system.

L. Arrange valve stations to operate in an easy-to-view progressive sequence around building. Tag valves with waterproof labels showing final sequence station assignments.

3.5 FIELD QUALITY CONTROL

A. Field Tests and Inspections:
   1. Irrigation System:
      a. System Pressure Test:
         1) Notify Landscape Architect two (2) working days minimum before conducting test.
         2) In presence of Landscape Architect, pressure test main line with all valves installed.
         3) Test pressure at 100 psi (690 kPA) minimum for two (2) hours minimum.
         4) Verify there are no leaks.
         5) Receive Landscape Architect approval to proceed prior to backfilling.
      b. Test report:
         1) Following pressure test, create pressure test report. Document pressure test results through providing photos, listing processes used, issues encountered, and measures taken to correct problems.
   2. Smart Controller Testing:
      a. Use 'Smart Controller Installation Checklist' or 'Manufacturer's Operational Report' to test system to verify following:
         1) Verify all aspects of smart controller installation checklist or 'Manufacturer's Operational Report' are complete.
         2) Verify controller is installed correctly and will automatically adjust irrigation run times in response to environmental changes using sensor and weather information to manage watering times and frequency.
         3) Sign 'Smart Controller Installation Checklist' to be included in Closeout Submittals.
   3. Substantial Completion Walkthrough:
      a. Landscape Architect or designated representative(s) will inspect site and create list of non-conforming items to be resolved prior to Irrigation Final Acceptance. Date on this list will act as date of Landscape Substantial Completion.
      b. Installations completed after water source has been turned off for season, as determined by Landscape Architect, will be inspected following spring after system can be checked for proper operation.
   4. Irrigation Final Acceptance:
      a. Irrigation Final Acceptance will be awarded when all non-conforming work is brought into conformance.

B. Non-Conforming Work: Non-conforming work as covered in General Conditions applies, but is not limited to following:
   1. Underground Sprinkler System:

a. Correct any work found defective or not complying with Contract Document requirements at no additional cost to Owner.

3.6 ADJUSTING

A. Sprinkler Heads:
1. Adjust sprinkler heads to proper grade when turf is sufficiently established to allow walking on it without appreciable harm. Such lowering and raising of sprinkler heads shall be part of original contract with no additional cost to Owner.
2. Adjust sprinkler heads for proper distribution and trim so spray does not fall on building.

B. Watering Time:
1. Adjust watering time of valves to provide proper amounts of water to plants.

3.7 CLOSEOUT ACTIVITIES

A. Training:
1. After system is installed and approved, instruct Owner's designated personnel in complete operation and maintenance procedures using Landscape Management Plan (LMP).
   a. Describe difference between plant establishment schedule and long term maintenance schedule.
   b. Describe annual and regular filter maintenance.
2. Smart Controller Training:
   a. Instruct Owner's designated personnel in complete operation and maintenance of smart controller and review terms of Warranty.

B. Winterization and Spring Start-Up:
1. During first year of operation, Installer shall shut-down irrigation system prior to freezing temperatures and re-start irrigation system at beginning of growing season:
   a. Winter Shut-Down is intended to remove all potentially damaging water from irrigation system. Perform following as well as any other efforts necessary to properly winterize system:
      1) Turn off water source at point of connection.
      2) Blow out system with pressurized air, turning on each valve until water is cleared out of system. Run through system twice. Only blow out components suitable to receive pressurized air. Hydrometers, for instance, should not be blown out. Do not use excessive air pressure that will damage pipes and parts.
      3) Turn controller off.
      4) Open all manual drain valves.
      5) Drain and remove pumps for Owner’s Representative storage.
      6) Drain filters using manufacturer’s recommendations.
      7) Check sprinkler heads to make sure they are below sidewalk and curb levels and not vulnerable to snowplow damage. Lower heads to proper elevation.
      8) Notify Owner’s Representative when system has been turned off.
   b. Spring start-up shall include following:
      1) Close all manual valves.
      2) Remove freeze protection as required.
      3) Turn on water source at point of connection.
      4) Verify that controller(s), rain sensor and moisture sensor(s) (if applicable) are properly operating. Change battery in controller(s) and sensor(s) as required.
      5) Flush entire system. Run each valve for two (2) minutes to check for damage, leaks, and coverage.
      6) Repair and adjust system as needed. Fine tune heads for efficient coverage.
      7) Notify Owner’s Representative when system has been charged and is in full repair.

END OF SECTION

SECTION 32 9001

COMMON PLANTING REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Common procedures and requirements for landscaping work.
   2. Provide maintenance for new landscaping as described in Contract Documents.

B. Related Requirements:
   1. Pre-Installation conferences held jointly with Section 32 9001 as described in Administrative Requirements on Part 1 of this specification section:
   2. Section 01 4301: 'Quality Assurance – Qualifications'.
   3. Section 31 0501: ‘Common Earthwork Requirements’.
   4. Section 31 1413: ‘Topsoil Stripping And Stockpiling’.
   5. Section 31 2213: ‘Rough Grading’.
   6. Section 31 2216: 'Fine Grading'.
   7. Section 31 2316: ‘Excavation’.
   8. Section 31 2323: ‘Fill’.
   9. Section 32 8423: 'Underground Sprinklers'.
   10. Section 32 9120: ‘Topsoil And Placement’.
   11. Section 32 9122: ‘Topsoil Grading’.
   12. Section 32 9219: 'Seeding'.
   13. Section 32 9222: 'Hydro-Seeding'.
   14. Section 32 9223: 'Sodding'.
   15. Section 32 9300: 'Plants'.

1.2 REFERENCES

A. Definitions:
   1. Landscape Management Plan (LMP): LMP is an Owner’s Representative’s quick reference maintenance document. It is a combination of Irrigation Sections from 32 8000 and Planting Sections from 32 9000. The LMP document is created from Operations and Maintenance Data, Warranty Documentation, and Record Documentation
   2. Landscape Final Acceptance: Inspection, no less than (30) days following substantial completion, when all work has been completed, demonstrated, and approved by the Landscape Architect. Coordinate with Sections 32 8423 and Sections under 32 9000 ‘Planting’.
   3. Plant Establishment Period: Time required for plants to successfully develop root systems into surrounding soil. Following this period, irrigation run times are typically modified. For purposes of this contract, the plant establishment period is assumed to be one (1) year from date of Substantial Completion.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:
   1. Participate in MANDATORY pre-installation conference and held jointly with following sections:
      a. Section 32 8423: 'Underground Sprinklers'.
      b. Section 32 9120: ‘Topsoil And Placement’.
      c. Section 32 9122: ‘Topsoil Grading’.
      d. Section 32 9223: 'Sodding'.
      e. Section 32 9300: 'Plants'.
   2. In addition to agenda items specified in Section 01 3100, review the following:
      a. Site Visits:

1) Landscape Architect to visit site four (4) times during project construction.
2) If site conditions necessitate additional visits, Landscape Architect can schedule addition site visits with approval from Architect prior to bid.
3) During construction, addition site visits may be approved in writing by Architect or Owner for special considerations before commencement.
4) Site visits caused by lack of work progress by Landscape Subcontractor shall reimburse Landscape Architect amount determined by Architect or Owner for additional site visits.

b. Coordination:
1) Landscape Subcontractor and Landscape Architect to coordinate site visits and include Architect and General Contractor in communications.

c. Landscape Maintenance:
1) Establish responsibility for maintenance of new landscaping during all phases of construction period.

3. Approved Site Visits:
a. Start-up Site Visit by Architect:
1) Description:
a) Landscape pre-installation Conference.
2) Schedule: Conduct pre-installation conference after completion of Fine Grading specified in Section 31 2216, but one (1) week minimum before beginning landscape work.
3) Required Attendees:
a) Project Manager, Facilities Manager, Architect, General Contractor, Landscape Subcontractor, and Excavator.
b) Include Landscaping Subcontractor Foreman and those responsible for installation of landscaping to be in attendance.
4) Related Sections:
a) Section 31 0501: 'Common Earthwork Requirements'.
b) Section 32 8423: 'Underground Sprinklers'.
c) Section 32 9120: ‘Topsoil And Placement’.
d) Section 32 9122: ‘Topsoil Grading’.
e) Section 32 9223: 'Sodding'.
f) Section 32 9300: 'Plants'.
5) Notes:
a) Verify project site conditions and review scope of work before installation begins.
b) Verify appropriate sub-grades have been established.

b. Site Visit No. 1:
1) Description:
a) Irrigation system pressure test compliance, main line inspection, valve inspection.
2) Schedule: Conduct site visit one (1) week minimum after notification before beginning irrigation system pressure test.
3) Required Attendees:
a) General Contractor, Landscape Subcontractor, Landscape Architect.
4) Recommended Attendees:
a) Project Manager, Facilities Manager.
5) Related Sections:
a) Section 32 8423: 'Underground Sprinklers'.
b) Section 32 9120: ‘Topsoil And Placement’.
c) Section 32 9122: ‘Topsoil Grading’.
6) Notes:
a) Verify finish grading in preparation for planting.

c. Site Visit No. 2:
1) Description:
a) Inspect and approve plant quality, plant quantity, plant pits, plant pit backfill, planting depths, and removal of packaging/distribution materials, wire, and ties.
2) Schedule: Conduct site visit one (1) week minimum after notification from Contractor before beginning site visit no. 2.
3) Required Attendees:
a) General Contractor, Landscape Subcontractor, Landscape Architect.
4) Recommended Attendees:
a) Project Manager, Facilities Manager.
5) Related Sections:

a) Section 32 9300: 'Plants'.
6) Notes:
a) Inspect irrigation system installation, inspect weed barrier fabric.
d. Site Visit No. 3:
1) Description:
a) Comprehensive Substantial Completion inspection prior to beginning thirty (30) day Landscape Subcontractor maintenance period.
2) Schedule: Conduct site visit one (1) week minimum after notification before beginning site visit no. 3.
3) Required Attendees:
a) Project Manager, Facilities Manager, General Contractor, Landscape Subcontractor, and Landscape Architect.
4) Related Sections:
a) Section 32 8423: 'Underground Sprinklers'.
b) Section 32 9300: 'Plants'.
5) Notes:
a) Verify contract requirements have been followed including but not limited to: planting compliance, irrigation system coverage and irrigation system operation.
e. Site Visit No. 4:
1) Description:
a) At the end of thirty (30) day Landscape Subcontractor maintenance period, verify deficient items have been corrected and verify no others exist.
2) Schedule: Conduct site visit one (1) week minimum after notification before beginning site visit no. 4.
3) Required Attendees:
a) Project Manager, Facilities Manager, General Contractor, Excavation Subcontractor, Landscape Subcontractor, Landscape Architect.
4) Related Sections:
a) Section 32 8423: 'Underground Sprinklers'.
b) Section 32 9300: 'Plants'.
5) Notes:
a) Review Landscape Management Plan (LMP) with Owner's Representative. Provide landscape maintenance training.

1.4 SUBMITTALS

A. Informational Submittals:
1. Certificates:
a. Landscape Architect will provide certificate acknowledging 'Plant Establishment Period' commencement:
1) Certificate will include name and signature of Contractor, Contractor’s company, Contractor’s telephone number, and date.
2) Certificate will include name and signature of Owner’s Representative, Owner’s Representative’s Group name, Owner’s Representative Group telephone number, and date.
3) Certificate will acknowledge date when Establishment Period begins and that it extends one (1) year from that time.
2. Special Procedure Submittals:
a. Installer to provide two (2) copies of following recommendations to be included in Closeout Submittals:
1) Landscape maintenance recommendations.
2) Individual landscape maintenance recommendations.
3) Plant establishment maintenance recommendations.
4) Post-plant establishment maintenance recommendations.
3. Qualification Statement:
a. Landscape Subcontractor:
1) Provide Qualification documentation if requested by Landscape Architect or Owner.
b. Installer:
1) Provide Qualification documentation if requested by Landscape Architect or Owner.

B. Closeout Submittals:
   1. Include following in Operations And Maintenance Manual specified in Section 01 7800 (combine with sections of 32 8000 and sections of 32 9000 if applicable):
      a. Record Documentation:
         1) Submit one (1) copy certificate for 'Plant Establishment Period' acknowledgement.
         2) Submit one (1) copy of recommendations specified in Special Procedure Submittals.
         3) Record Drawings:
            a) As installation occurs, prepare accurate record drawings. Submit one (1) full size copy prior to final inspection. Drawing shall include:
               (1) Detail and dimension changes made during construction.
               (2) Take dimensions from permanent constructed surfaces or edges located at or above finish grade.
      b. Landscape Management Plan (LMP):
         1) Landscape Section:
            a) Submit one (1) copy certificate for 'Plant Establishment Period' acknowledgement.
            b) Submit one (1) copy of recommendations specified in Special Procedure Submittals.

1.5 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Herbicides:
      a. Products shall be recognized for intended use by AHJ.
   2. Invasive and Non-native plants:
      a. Comply with all applicable laws governing invasive and non-native plants.

B. Qualifications:
   1. Landscape Subcontractor. Requirements of Section 01 4301 applies, but not limited to following:
      a. Company specializing in performing work of this section.
      b. Minimum five (5) years' experience in landscaping installations.
      c. Minimum five (5) satisfactorily completed installations in past three (3) years of projects similar in size, scope, and complexity required for this project before bidding.
      d. Upon request, submit documentation.
   2. Installer:
      a. Planting shall be performed under direction of foreman or supervisor with minimum three (3) years' experience in landscape installations similar in size, scope, and complexity.
      b. Foreman or supervisor required to attend pre-installation conference.
      c. Use trained personnel familiar with required planting procedures and with Contract Documents.
      d. Upon request, submit documentation.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Storage And Handling Requirements:
   1. Deliver packaged materials in containers showing weight, analysis, and name of Manufacturer.
   2. Deliver sod, plants, trees, and shrubs in healthy and vigorous condition.
   3. Protect materials from deterioration during delivery.

B. Storage And Handling Requirements:
   1. Store in location on site where they will not be endangered and where they can be adequately watered and kept in healthy and vigorous condition.
   2. Protect materials from deterioration while stored at site.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 INSTALLERS

A. Acceptable Installers:
   1. Meet Quality Assurance Installer Qualifications as specified in Part 1 of this specification.

3.2 EXAMINATION

A. Verification Of Conditions:
   1. Inspect site and Contract Documents to become thoroughly acquainted with locations of irrigation, ground lighting, and utilities.

3.3 PREPARATION

A. Before proceeding with work, verify dimensions and quantities. Report variations between Drawings and site to Architect before proceeding with landscape work.
   1. Plant totals are for convenience of Contractor only and are not guaranteed. Verify amounts shown on Drawings.
   2. All planting indicated on Contract Documents is required unless indicated otherwise.

B. Protection:
   1. Take care in performing landscaping work to avoid conditions that will create hazards. Post signs or barriers as required.
   2. Provide adequate means for protection from damage through excessive erosion, flooding, heavy rains, etc. Repair or replace damaged areas.
   3. Keep site well drained and landscape excavations dry.

3.4 INSTALLATION

A. Interface With Other Work:
   1. Do not plant trees and shrubs until major construction operations are completed. Do not commence landscaping work until work of Section 31 2216 and Section 32 8423 has been completed and approved.

B. Coordinate installation of planting materials during normal planting seasons for each type of plant material required.

C. Hand excavate as required.

D. Maintain grade stakes until parties concerned mutually agree upon removal.

E. When conditions detrimental to plant growth are encountered, such as rubble fill or adverse drainage conditions, notify Architect before planting.

3.5 FIELD QUALITY CONTROL

A. Field Inspection:
   1. Landscape Architect will inspect landscaping installation for Substantial Completion.

B. Non-Conforming Work. Non-conforming work as covered in the General Conditions applies, but is not limited to the following:
   1. Replace damaged plantings within (10) days of notification at no additional cost to Owner.
   2. Repair damage to irrigation, ground lighting, utilities, paving, concrete curb and gutters and other items adjacent to landscaping caused by work of this Section or replace at no additional cost to Owner.

3.6 CLEANING

A. Waste Management:
   1. Immediately clean up soil or debris spilled onto pavement and dispose of deleterious materials.

3.7 CLOSEOUT ACTIVITIES

A. Instruction to Owner:
   1. Include following training:
      a. Review Landscape Management Plan (LMP):
         1) Review maintenance recommendations.
      b. Review Maintenance as specified at the end of this specification.
   2. Establishment Period Acknowledgement (coordinate with 32 8000 section):
      a. Landscape Architect will acknowledge Establishment Period commencement.

3.8 PROTECTION

A. Protect planted areas against traffic or other use immediately after planting is completed by placing adequate warning signs and barricades.

B. Provide adequate protection of planted areas against trespassing, erosion, and damage of any kind. Remove this protection after Architect has accepted planted areas.

3.9 MAINTENANCE

A. General:
   1. Before beginning maintenance period, plants shall be in at least as sound, healthy, vigorous, and in approved condition as when delivered to site, unless accepted by Architect in writing at final landscape inspection.
   2. Maintain landscaping for thirty (30) continuous days minimum after Substantial Completion. If maintenance period is interrupted by non-growing season or irrigation winter shut-down, begin maintenance period after start of growing season (starting May 01 the following season), and continue one (1) continuous month therefrom.
   3. Replace landscaping that is dead or appears unhealthy or non-vigorous as directed by Architect before end of maintenance period. Make replacements within ten (10) days of notification. Lawn being replaced shall be guaranteed and maintained an additional thirty (30) days from date of replacement.

B. Sodded Lawn:
   1. Maintain sodded lawn areas until lawn complies with specified requirements and throughout maintenance period.
   2. Water sodded areas in sufficient quantities and at required frequency to maintain sub-soil immediately under sod continuously moist 3 to 4 inches (75 to 100 mm) deep.
   3. Cut grass first time when it reaches 3 inches (75 mm) high. Continue to mow at least once each week throughout maintenance period. Remove clippings.
   4. Apply herbicide as necessary to maintain weed-free lawn. Apply herbicide in accordance with manufacturer's instructions during calm weather when air temperature is between 50 and 80 deg F (10 and 27 deg C).
   5. At end of thirty (30) day maintenance period, fertilize lawns as recommended in Section 32 9122.

C. Trees, Shrubs, And Plants:
   1. Maintain by pruning, cultivating, and weeding as required for healthy growth.
   2. Restore planting basins.
   3. Tighten and repair stake and guy supports and reset trees and shrubs to proper grades or vertical positions as required.
   4. Spray as required to keep trees and shrubs free of insects and disease.
   5. Provide supplemental water by hand as needed in addition to water from sprinkling system.

END OF SECTION

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SECTION 32 9120

TOPSOIL AND PLACEMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Perform topsoil evaluation and placement required prior to topsoil grading as described in Contract Documents.
   2. Perform test of imported topsoil as noted in attachment.

B. Related Requirements:
   1. Section 31 0501: 'Common Earthwork Requirements':
   2. Section 31 1413: 'Topsoil Stripping And Stockpiling' for stripping and storing of existing topsoil.
   3. Section 31 2216: ‘Fine Grading’ for landscaping and planting areas.
   4. Section 32 9001: 'Common Planting Requirements':
      a. Pre-installation conference held jointly with other common planting related sections.
   5. Section 32 9122: ‘Topsoil Grading’ for preparation of topsoil and addition of amendments prior to landscaping.

1.2 REFERENCES

A. Reference Standards:
   1. ASTM International:
      a. ASTM D1557-12, ‘Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3))’.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:
   1. Participate in MANDATORY pre-installation conference as specified in Section 32 9001.
   2. In addition to agenda items specified in Section 01 3100 and Section 32 9001, review following:
      a. Review finish grade elevation and tolerance requirements.
      b. Review surface preparation requirements including disking, tilling, ripping, or aerating.
      c. Review Attachment 'Topsoil Testing Report' including:
         1) Landscape Architect, Contractor, Testing, and Soil Testing Laboratory Instructions.
      d. Review Field Quality Control testing requirements for 'Topsoil Testing Report' including:
         1) Corrections required for topsoil not meeting requirements of this specification.
         2) Approval requirement of ‘Topsoil Testing Report’ by Landscape Architect.
         3) Submittals required as identified in Closeout Submittals.

1.4 SUBMITTALS

A. Informational Submittals:
   1. Testing And Evaluation Reports:
      a. Use ‘Topsoil Testing Report’ attachment to this specification for Topsoil Testing as specified in 'Field Quality Control' in Part 3 of this specification for imported and site topsoil and account of recent use:
         1) Contractor will pay for topsoil testing.
         2) Submit two (2) copies of Final ‘Topsoil Testing Report’ approved by Landscape Architect to be included with Closeout Submittals.
   2. Field Quality Control Submittals:

a. Submit report stating location of source of imported topsoil and account of recent use.
b. Submit delivery slips indicating amount of physical amendments delivered to Project site.

B. Closeout Submittals:
1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
a. Record Documentation:
1) Submit one (1) copy Final approved 'Topsoil Testing Report'.
2) Provide report stating location of source of imported topsoil and account of recent use.
b. Landscape Management Plan (LMP):
1) Landscape Section:
a) Submit one (1) copy in LMP Landscape Section Final approved 'Topsoil Testing Report'.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil:
1. Design Criteria:
a. Topsoil used in landscaped areas, whether imported, stockpiled, or in place, shall be weed free, fertile, loose, friable soil meeting following criteria:
1) Chemical Characteristics:
a) pH 5.5 to 8.0.
b) Soluble Salts: less than 3.0 mmhos/cm.
c) Sodium Absorption Ratio (SAR): less than 6.0.
d) Organic Matter: greater than one percent.
2) Physical Characteristics:
a) Gradation as defined by USDA triangle of physical characteristics as measured by hydrometer.
(1) Sand: 15 to 60 percent.
(2) Silt: 10 to 60 percent.
(3) Clay: 5 to 30 percent.
b) Clean and free from toxic minerals and chemicals, noxious weeds, rocks, and other objectionable materials.
c) Soil:
(1) Soil shall not contain more than five (5) percent by volume of rocks measuring over 1/4 inch (6 mm) in largest size.
(2) Soil shall be topsoil in nature.
(3) Soil resembling road base or other like materials are not acceptable.
2. Project Topsoil Requirements:
a. It is anticipated that all of the required topsoil material for the site will be imported.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification Of Conditions:
1. Do not commence work of this Section until grading tolerances specified in Section 31 2216 are met.
2. Do not commence work of this Section until coordination with Section 32 9122 'Topsoil Grading' if required prior to placement.
3. Receive approval from Landscape Architect of subgrade elevations prior to commencement of this Work.

3.2 PREPARATION

A. Protection Of In-Place Conditions:
   1. Protect utilities and site elements from damage.

B. Surface Preparation:
   1. Surfaces to receive Imported and Stockpiled Topsoil:
      a. Disk, till, rip, or aerate with approved agricultural aerator to depth of 6 inches (150 mm).
      b. Place specified and approved topsoil on prepared surface.
      c. See G102 and Landscape details in Drawings.

3.3 PERFORMANCE

A. General:
   1. After Surface Preparation requirements are completed, limit use of heavy equipment to areas no closer than 6 feet (1.80 meter) from building or other permanent structures. Use hand held tillers for preparation of subsoil in areas closer than 6 feet (1.80 m).
   2. Do not expose or damage existing shrub or tree roots.

B. Topsoil Depth/Quantity:
   1. Topsoil depth of 5 inches (125 mm) minimum is required in all lawn areas. Mix 1 inches (25mm) minimum of humus into top 2 inches (50mm) of soil for a total topsoil depth of 6 inches (150mm) – see details in Drawings.
   2. Topsoil depth of 12 inches (305 mm) minimum is required in all planter areas - see details in Drawings.
   3. Provide no less than quantity required to achieve tolerance described in Section 32 9122 'Topsoil Grading'. Installer of this section responsible for providing sufficient topsoil material.

C. Imported Topsoil:
   1. Place tested and approved topsoil:
      a. Before placing topsoil, remove organic material, rocks and clods, and other objectionable materials.
      b. Do not place topsoil whose moisture content makes it prone to compaction during placement process.
      c. Do not place topsoil when subgrade is either wet or frozen enough to cause clodding.

D. Stockpiled Topsoil:
   1. It is assumed that any existing topsoil material on site will be removed and is not to be re-used on site.

E. Grading:
   1. Slope grade away from building as indicated on New Grading Plan SD102.
      a. High point of finish grade at building foundation shall be 6 inches (150 mm) minimum below finish floor level.
      b. Direct surface drainage in manner indicated on Contract Documents by molding surface uniform to facilitate natural run-off of water.
      c. Fill low spots and pockets with clay to maintain a uniform sloped subgrade prior to placing topsoil depths and grade to drain properly.

3.4 FIELD QUALITY CONTROL

A. Testing And Inspections:
   1. Topsoil Testing:
      a. Test topsoil for project suitability using Owner supplied ‘Topsoil Testing Report,’ attachment to this specification:
         1) Testing requirements:

a) If testing report shows topsoil does not meet topsoil Design Criteria and 'Topsoil Testing Report: Soil Test Data' requirements, topsoil is non-conforming. Corrections and re-testing are required until topsoil meets requirements.
b) Use new 'Topsoil Testing Report', each time topsoil is tested.
c) After topsoil testing is approved by Landscape Architect, submit two (2) copies of Final 'Topsoil Testing Report as specified in Part 1 'Submittals' of this specification.

B. Non-Conforming Work:
1. If topsoil does not meet topsoil Design Criteria and 'Topsoil Testing Report: Soil Test Data' requirements topsoil will be re-tested at no cost to Owner.
a. Correction procedures:
1) Topsoil not meeting specified physical characteristics of sand, silt, and clay shall be removed from site.
2) Topsoil not meeting specified organic or fertility specifications may be amended in place with materials recommended in Topsoil Testing Report.
3) If amendments are necessary, submit proposed amendments and application rates required to bring topsoil up to minimum specified requirements.
4) Re-test topsoil and remove and amend as required until it meets minimum specified requirements.
b. Submit report to Landscape Architect for approval.
c. Receive approval from Landscape Architect prior to planting.

END OF SECTION

ATTACHMENTS

Topsoil Testing Report

Project	Name		Property Number
	Site Street Address, City, Province		
Person Submitting Test	Name	Date Requested	Phone
	Address, City, Province		Fax
Soil Testing Laboratory	Name	Date Submitted	Phone
	Address, City, Province		Fax

General

1. Contractor will pay for testing.

Landscape Architect Instructions

1. Landscape Architect shall determine by investigation quality and quantity of topsoil on site before landscape design. Add physical and fertility recommendations from laboratory recommendations to relevant Owner specifications.

Contractor Instructions

1. Test imported topsoil. Installed topsoil shall comply with Project Specifications.
2. If installed topsoil does not comply, Contractor will enhance and test at no cost to Owner until installed topsoil complies with Project Specifications.

Testing Instructions

1. Collect at least two (2) samples of imported topsoil and each anticipated topsoil source. If site soil profile or borrow pit are not uniform, additional samples shall be taken. Uniform composite samples may also be used if properly acquired and documented.
2. Submit required soil samples to soil testing laboratory along with all required (for this report and laboratory) information.

Soil Testing Laboratory Instructions

1. This report must be completely filled out and provide soil interpretation and amendment, fertilizer, and soil conditioner recommendations for use by Landscape Architect. These recommendations should consider lawn areas, tree and shrub areas, and native plant areas.
2. Provide appropriate times for fertilizing.
3. Return completed Topsoil Testing Report to person submitting the test.

SOIL SAMPLE LOG		
Soil Sample No.	Description of location where sample was taken	History of use of the soil

Existing Conditions Test Report

("Acceptable Levels" refers to the allowable soil specifications prior to being amended)

SOIL TEST DATA												
Sample No.	pH(1)	EC[(1)] Mmhos/cm	SAR[(1)]	% Sand	% Silt	% Clay	Text[(2)] Class	%[(3)] OM	NO3-N[(4)] ppm	P[(5)] ppm	K[(5)] ppm	Fe[(5)] Ppm
Acceptable Level(s)	5.5 - 8.4	<3.0	<6.0	15-60	10-60	5-30	(2)	>1.0	>20	>11	>130	>10

[(1)] Saturated soil paste 1:1 soil:water method (please Indicate)

[(2)]Hydrometer method (Acceptable soil- sand:15-60 percent, silt:10-60 percent, clay-5-30 percent)

[(3)]Potassium dichromate method (Walkey-Black) or loss of ignition

[(4)]Chromotropic acid method

[(5)]AB-DTPA method

If other methods are used for NO3-N, P, K, and Fe, then note.

ROCKS (Coarse Fragments)		
Sample No.	Percent > 1/4 inch (6.4 mm)	Rocks Present ≥ 1.5 inch (38 mm) Indicate as present or not present
	percent	
	percent	
Acceptable Level	≤ 5.0 percent	< 1.5 inch (38 mm)

Landscape Area Description

Lawn Areas: Receive 5 inch (125 mm) topsoil plus recommended amendments and fertilizers.

Shrub/Tree Areas: Unless otherwise indicated, plant pits are to be backfilled with three (3) parts native soil and one part compost or other recommended amendments. Additionally, contractor will add recommended fertilizer.

Native Grass/Shrub/Tree Areas: Planting to receive minimum recommended amendments and fertilizers for establishment.

INFILTRATION RATE	
Documented Infiltration rate of test sample(s) based on texture at 90 percent relative density (to nearest 1/10th of an inch)	
Sample No.	Rate
	Inches/Hour
	Inches/Hour

Interpretation Summary of Test Results:

Soil Amendments, Fertilizer and Soil Conditioner – Recommendations:

Lawn Areas

Shrub/Tree Areas

Native Grass/Shrub/Tree Areas

Long Term (5 Year) Fertilizer and Soil Conditioner – Recommendations:

Lawn Areas

Shrub/Tree Areas

Native Grass/Shrub/Tree Areas

SECTION 32 9122

TOPSOIL GRADING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Perform topsoil grading required to prepare site for installation of landscaping as described in Contract Documents.
   2. Perform topsoil placement and finish grading work required to prepare site for installation of landscaping as described in Contract Documents.
   3. Furnish and apply soil amendments as described in Contract Documents.
   4. See G102 and Landscape details in Drawings.

B. Related Requirements:
   1. Section 31 0501: ‘Common Earthwork Requirements’:
   2. Section 31 1413: ‘Topsoil Stripping And Stockpiling’ for stripping and storing of existing topsoil.
   3. Section 31 2216: ‘Fine Grading’ for landscaping and planting areas.
   4. Section 32 9001: 'Common Planting Requirements':
      a. Pre-installation conference held jointly with other common planting related sections.
   5. Section 32 9120: ‘Topsoil And Placement’ for topsoil evaluation and placement required for topsoil grading.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:
   1. Participate in MANDATORY pre-installation conference as specified in Section 32 9001.
   2. In addition to agenda items specified in Section 01 3100, review the following:
      a. Review compost requirements to be within acceptable range as per Attachment 'Compost Quality Guidelines For Landscaping' and 'Compost Verification Report' in this specification.
      b. Review soil fertility amendments and fertilizer requirements as per Attachment 'Topsoil Testing Report' in Section 32 9120.

1.3 SUBMITTALS

A. Action Submittals:
   1. Material Data:
      a. Soil Amendments and Fertilizer:
         1) Product literature and chemical / nutrient analysis of soil amendments and fertilizers.
         2) Proposed application rates necessary to bring topsoil up to specified requirements.
         3) Source location of products.
         4) Submit to Landscape Architect for approval prior to installation.
   2. Samples:
      a. Soil Fertility Amendments and Fertilizer:
         1) Soil conditioner sample for approval before delivery to site.
         2) Product analysis.

B. Informational Submittals:
   1. Testing And Evaluation Reports:
      a. ‘Compost Verification Report’:
         1) Provide signed copy certifying that compost meets requirements of this specification.
   2. Field Quality Control Submittals:
      a. Soil Fertility Amendments and Fertilizer:

1) Delivery slips indicating amount of soil amendments, compost, conditioner, and fertilizer delivered to Project site.

C. Closeout Submittals:
1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
a. Record Documentation:
1) Submit ‘Compost Verification Report’.
2) Submit delivery slips indicating amount of physical amendments delivered to Project site.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Soil Amendments:
1. Incorporate following soil amendments into imported topsoil used for Project:
a. Acceptable Soil Amendments, Soil Conditioners, And Application Rates:
1) As prescribed by the Imported Topsoil Test results.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification Of Conditions:
1. Do not commence work of this Section until imported topsoil is placed as specified in Section 32 9120 'Topsoil And Placement'.

3.2 PREPARATION

A. Protection Of In-Place Conditions:
1. Protect utilities and site elements from damage.

B. Surface Preparation:
1. Surfaces that meet specified topsoil elevations.
a. Seven (7) days maximum before beginning seeding and planting:
1) Loosen topsoil 6 inch (150 mm) deep, dampen thoroughly, and cultivate to properly break up clods and lumps.
2) Rake area to remove clods, rocks, weeds, roots, debris or other objectionable material.
3) Grade and shape landscape area to bring surface to true uniform planes free from irregularities and to provide drainage and proper slope to catch basins.
2. Addition of Soil Amendments:
a. Add specified soil amendments at specified rates to topsoil as directed by Topsoil Testing Report found in Section 32 9120 'Topsoil And Placement'.
b. Add specified fertilizers at specified rates into topsoil as directed by Soil Testing Laboratory.
c. Roto-till or otherwise mix soil amendments evenly into topsoil.

3.3 PERFORMANCE

A. General:
1. Limit use of heavy equipment to areas no closer than 6 feet (1.80 meter) from building or other permanent structures. Use hand held tillers for preparation of subsoil in areas closer than 6 feet (1.80 m).
2. Do not expose or damage existing shrub or tree roots.

B. Finish Grade Tolerances (As shown on G102 and Landscape details in Contract Documents):
   1. Finish topsoil grade of planting areas before planting and after addition of soil additives shall be specified distances below top of adjacent pavement of any kind:
      a. Sodded Areas: 2 inches (50 mm) below.
      b. Planter Areas: 4 inches (100 mm) below.

C. Placed Topsoil:
   1. At locations where topsoil has been placed as per Section 32 9120 'Topsoil And Placement', perform the following:
      a. Remove existing vegetation as required in preparation for new landscaping.
      b. Remove organic material, rocks and clods, and other objectionable materials.

D. Grading:
   1. Coordinate grading as described in Section 32 9120 'Topsoil And Placement'.

E. Immediately before planting lawn and with topsoil in semi-dry condition, roll areas that are to receive lawn in two directions at approximately right angles with water ballast roller weighing 100 to 300 lbs (45 to 135 kg), depending on soil type.

F. Rake or scarify and cut or fill irregularities that develop as required until area is true and uniform, free from lumps, depressions, and irregularities.

3.4 PROTECTION

A. After landscape areas have been prepared, take no heavy objects over them except lawn rollers.

END OF SECTION

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SECTION 32 9223

SODDING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install sodded lawn as described in Contract Documents.

B. Related Requirements:
   1. Section 32 8423: Irrigation system.
   2. Section 32 9001: Common Planting Requirements:
      a. Pre-installation conference held jointly with other common planting related sections.
   3. Section 32 9120: 'Topsoil And Placement'.
   4. Section 32 9122: 'Topsoil Grading'.

1.2 REFERENCES

A. Definitions:
   1. Crop Coefficients and Hydro-Zones: Crop coefficients (Kc) are used with ETo to estimate specific plant evapotranspiration rates. The crop coefficient is a dimensionless number (between 0 and 1.2) that is multiplied by the ETo value to arrive at a plant ET (ETc) estimate. Plants grouped by water needs, organized into one irrigation zone.
   2. Eco-Region Irrigation Design: A bio-regional approach to irrigation and planting design that is relevant to the geographic area for which the planting plan and irrigation system is designed. These geographic areas are defined by the Environmental Protection Agency and have been modified by the LDS church into 15 geographical areas throughout North America, and the Hawaiian Islands.
   3. Hardiness Zone: A hardiness zone is a more precisely geographically-defined zone within an Eco-Region in which a specific category of plant life is capable of growing, as defined by temperature hardiness, or ability to withstand the minimum temperatures of the zone. Hardiness Zones may be defined by one of two sources:
      a. Sunset Western Garden Book Maps.
      b. USDA Hardiness Zone Map.

      Plant Hardiness zone sources shall be listed by the architect through the planting and irrigation design process.
   4. Hydro-Zone: Plants grouped by water needs (similar Crop Coefficients (Kc), organized into one irrigation zone.
   5. Reference Evapotranspriation (ETo): The total water lost from the soil (evaporation) and from the plant surface (transpiration) over some period.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:
   1. Participate in pre-installation conference as specified in Section 32 9001.

1.4 SUBMITTALS

A. Informational Submittals:
   1. Certificates:
      a. Written certification confirming sod seed mix and quality:
         1) Include all species used.

2) Include name and contact information of supplier.

B. Closeout Submittals:
1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
a. Record Documentation:
1) Submit one (1) copy certificate for sod seed quality and mix.
b. Landscape Management Plan (LMP):
1) Landscape Section:
a) Submit one (1) copy certificate for sod seed quality and mix.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery And Approval Requirements:
1. Harvest, deliver, store, and handle sod in accordance with requirements of Turfgrass Producers International (TPI) (formally American Sod Producers Association) Specifications for Turfgrass Sod Materials and Transplanting / Installing.
2. Schedule deliveries to coincide with topsoil operations and laying. Keep storage at job site to minimum without causing delays.
a. Deliver, unload, and store sod on pallets within 24 hours of being lifted.
b. Do not deliver small, irregular, or broken pieces of sod.

B. Storage And Handling Requirements:
1. Cut sod in pieces approximately 3/4 to one inch (19 to 25 mm) thick. Roll or fold sod so it may be lifted and handled without breaking or tearing and without loss of soil.
2. During wet weather, allow sod to dry sufficiently to prevent tearing during lifting and handling.
3. During dry weather, protect sod from drying before installation. Water as necessary to insure vitality and to prevent excess loss of soil in handling. Sod that dries out before installation will be rejected.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Description:
1. Superior sod grown from certified, high quality, seed of known origin or from plantings of certified grass seedlings or stolons:
a. Assure satisfactory genetic identity and purity.
b. Assure over-all high quality and freedom from noxious weeds or an excessive amount of other crop and weedy plants at time of harvest.
2. Sod shall be composed of three varieties minimum of 40% Kentucky bluegrass, 30% Perennial Ryegrass, and 30% Creeping Red Fescue.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Interface With Other Work:
1. Do not commence work of this Section until work of Sections 32 9122 and 32 9300 has been completed and approved.

B. Tolerances:
1. Final grade of soil after sodding of lawn areas is complete shall be one inch (25 mm below top of adjacent pavement of any kind.

C. Laying of Sod:
   1. Lay sod during growing season and within 48 hours of being lifted.
   2. Lay sod while top 6 inches (150 mm) of soil is damp, but not muddy. Sodding during freezing temperatures or over frozen soil is not acceptable.
   3. Lay sod in rows perpendicular to slope with joints staggered. Butt sections closely without overlapping or leaving gaps between sections. Cut out irregular or thin sections with a sharp knife.
   4. Lay sod flush with adjoining existing sodded surfaces.
   5. Do not sod slopes steeper than 3:1. Consult with Architect for alternate treatment.

D. After Laying of Sod Is Complete:
   1. Roll horizontal surface areas in two directions perpendicular to each other.
   2. Repair and re-roll areas with depressions, lumps, or other irregularities. Heavy rolling to correct irregularities in grade will not be permitted.
   3. Water sodded areas immediately after laying sod to obtain moisture penetration through sod into top 6 inches (150 mm) of topsoil.

3.2 FIELD QUALITY CONTROL

A. Field Inspection:
   1. Sodded areas will be accepted at Project closeout if:
      a. Sodded areas are properly established.
      b. Sod is free of bare and dead spots and is without weeds.
      c. No surface soil is visible when grass has been cut to height of 2 inches (50 mm).
   2. Sodded areas have been mowed a minimum of twice.

END OF SECTION

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SECTION 32 9300

PLANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install landscaping plants as described in Contract Documents.

B. Related Requirements:
   1. Section 32 8423: 'Underground Sprinklers' for irrigation system.
   2. Section 32 9001: 'Common Planting Requirements' for:
      a. Pre-installation conference held jointly with other common planting related sections.
   3. Section 32 9120: ‘Topsoil And Placement’.
   4. Section 32 9122: ‘Topsoil Grading’.
   5. Section 32 9223: 'Sodding'.

1.2 REFERENCES

A. Definitions:
   1. Crop Coefficients and Hydro-Zones: Crop coefficients (Kc) are used with ETo to estimate specific plant evapotranspiration rates. Crop coefficient is dimensionless number (between 0 and 1.2) that is multiplied by ETo value to arrive at plant ET (ETc) estimate. Plants grouped by water needs, organized into one irrigation zone.
   2. Eco-Region Irrigation Design: Bio-regional approach to irrigation and planting design that is relevant to geographic area for which planting plan and irrigation system is designed. These geographic areas are defined by Environmental Protection Agency and have been modified by the Church into 15 geographical areas throughout North America, and Hawaiian Islands.
   3. Hardiness Zone: Hardiness zone is more precisely geographically-defined zone within an Eco-Region in which specific category of plant life is capable of growing, as defined by temperature hardiness, or ability to withstand minimum temperatures of zone. Hardiness Zones may be defined by one of two sources:
      a. Sunset Western Garden Book Maps.
      b. USDA Hardiness Zone Map.

      Plant Hardiness zone sources shall be listed by Landscape Architect through planting and irrigation design process.
   4. Hydro-Zone: Plants grouped by water needs (similar Crop Coefficients (Kc), organized into one irrigation zone.
   5. Landscape Management Plan (LMP): See Section 32 9001 for definition.
   6. Plant Establishment Period: See Section 32 9001 for definition.
   7. Reference Evapotranspriation (ETo): Total water lost from the soil (evaporation) and from plant surface (transpiration) over some period.

B. Reference Standards:
   1. American Nursery & Landscape Association / American National Standards Institute:
      a. ANLA / ANSI Z60.1-2004, 'American Standard for Nursery Stock’.
   2. American National Standard Institute / Tree Care Industry Association (TCIA):
      a. ANSI A300 (Part 1)-2017 Pruning, ‘American National Standard for Tree Care Operations – Tree, Shrub, and Other Woody Plant Maintenance – Standard Practices (Pruning)’.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:

1. Participate in MANDATORY pre-installation conference as specified in Section 32 9001.

1.4 SUBMITTALS

A. Action Submittals:
   1. Samples:
      a. Rock and Bark Mulch for approval before delivery to site.

B. Closeout Submittals:
   1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
      a. Warranty Documentation:
         1) Include written warranty.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery And Acceptance Requirements:
   1. Deliver trees, shrubs, ground covers, and plants after preparations for planting have been completed and install immediately.
   2. Do not prune before delivery, except as approved by Landscape Architect.
   3. Protect bark, branches, and root systems from sun scald, drying, whipping, and other handling and tying damage.
   4. Do not bend or bind-tie trees or shrubs in such a manner as to destroy natural shape.
   5. Provide protective covering during delivery.

B. Storage And Handling Requirements;
   1. Handle balled stock by root ball or container. Do not drop trees and shrubs during delivery.
   2. If planting is delayed more than six hours after delivery, set planting materials in shade and protect from weather and mechanical damage.
   3. Set balled stock on ground and cover ball with soil, saw dust, or other acceptable material approved by Landscape Architect.
   4. Do not remove container-grown stock from containers before time of planting.
   5. Do not store plant material on pavement.
   6. Water root systems of trees and shrubs stored on site with fine spray. Water as often as necessary to maintain root systems in moist condition. Do not allow plant foliage to dry out.

1.6 WARRANTY

A. Special Warranty:
   1. Provide written warranties as follows:
      a. Warranty shrubs, ground covers, and vines to live and remain in strong, vigorous, and healthy condition for 90 days minimum from date of Substantial Completion and meet or exceed material standards set forth in Materials heading of Part 2 of this specification.
      b. Warranty trees to live and remain in strong, vigorous, and healthy condition and meet or exceed material standards set forth in Materials heading of Part 2 of this specification for one year from date of Substantial Completion.
      c. When trees are completely accepted at end of warranty period, remove staking.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Plants:
   1. Conform to requirements of Plant List and Key on Contract Documents and to ANLA / ANSI Z60.1.

2. Nomenclature:
   a. Plant names used in Plant List conform to 'Standardized Plant Names' by American Joint Committee on Horticultural Nomenclature except in cases not covered. In these instances, follow custom of nursery trade. Plants shall bear tag showing genus, species, and variety of at least 10 percent of each species delivered to site.
3. Quality:
   a. Plants shall be sound, healthy, vigorous, free from plant disease, insect pests or their eggs, noxious weeds, and have healthy, normal root systems. Container stock shall be well established and free of excessive root-bound conditions.
   b. Do not prune plants or top trees prior to delivery.
   c. Plant materials shall be subject to approval by Landscape Architect as to size, health, quality, and character.
   d. Bare root trees are not acceptable.
   e. Provide plant materials from licensed nursery or grower.
4. Measurements:
   a. Measure height and spread of specimen plant materials with branches in their normal position as indicated on Contract Documents or Plant List.
   b. Measurement should be average of plant, not greatest diameter. For example, plant measuring 15 inches (375 mm) in widest direction and 9 inches (225 mm) in narrowest would be classified as 12 inch (300 mm) stock.
   c. Plants properly trimmed and transplanted should measure same in every direction.
   d. Measure caliper of trees 6 inches (150 mm) above surface of ground.
   e. Where caliper or other dimensions of plant materials are omitted from Plant List, plant materials shall be normal stock for type listed.
   f. Plant materials larger than those specified may be supplied, with prior written approval of Landscape Architect, and:
      1) If complying with Contract Document requirements in all other respects.
      2) If at no additional cost to Owner.
      3) If sizes of roots or balls are increased proportionately.
5. Shape and Form:
   a. Plant materials shall be symmetrical or typical for variety and species and conform to measurements specified in Plant List.
   b. Well grown material will generally have height equal to or greater than spread. However, spread shall not be less than 2/3's of height.

2.2 ACCESSORIES

A. Planting Mix:
   1. Mixture of three (3) parts excavated soil and one part well rotted composted manure, approved commercial mix, or other amendment recommended in 'Topsoil Testing Report'.

B. Fertilizer:
   1. Fertilizer as recommended on ‘Topsoil Testing Report’.

C. Tree Stakes:
   1. Type Two Acceptable Products:
      a. 2 inch (50 mm) diameter Lodgepole Pine, Douglas Fir, White Fir, or Hemlock Fir.
      b. Equal as approved by Landscape Architect before installation. See Section 01 6200.

D. Tree Staking Ties:
   1. Type Two Acceptable Products:
      a. 32 inch (800 mm) Cinch-Tie tree ties by V.I.T. Products Inc, Escondido, CA www.vitproducts.com.
      b. Equal as approved by Landscape Architect before installation. See Section 01 6200.

E. Tree Guys:
   1. Type Two Acceptable Products:
      a. Duckbill Model 68DTS guying kit.

b. Equal as approved by Landscape Architect before installation. See Section 01 6200.

F. Pre-Emergent Herbicide:
1. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
a. Chipco Dimension Granular by The Andersons Inc, Maumee, IL www.andersonsinc.com.
b. Elanco XL2G granular by Crop Data Management Systems, Marysville, CA www.cdms.net.
c. Ronstar G granular by Bayer Crop Science, Monheim, Germany www.bayercropscience.com.
d. Surflan AS liquid by United Phosphorous Inc, Trenton, NJ www.upi-usa.com.
e. Oryzalin 4 A.S. liquid by FarmSaver, Seattle, WA www.farmsaver.com.

G. Weed Barrier:
1. Type Two Acceptable Products:
a. DeWitt 4.1 oz (116 g) 20 year woven polypropylene weed barrier.
b. Hanes Pro-Platinum 4.1 oz (116 g) 20 year woven polypropylene weed barrier.
c. Equal as approved by Landscape Architect before bidding. See Section 01 6200.

H. Bark Mulch (at stand-alone Deciduous trees in turf areas):
1. Type Two Acceptable Products:
a. Shredded pine bark.
b. Shredded Cedar.
c. Equal as approved by Landscape Architect before installation. See Section 01 6200.

I. Rock Mulch (at all planter beds):
1. Type Two Acceptable Products:
a. Washed Round River Rock.
1) Size:
a) 1 ½ inch (38mm) in size.
b) Submit standard samples of Supplier mix for final colour choice.
2) Equal as approved by Landscape Architect before installation. See Section 01 6200.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Evaluation And Assessment:
1. Before proceeding with work, check and verify dimensions and quantities. Report variations between Drawings and site to Landscape Architect before proceeding with work of this Section.
2. Plant totals are for convenience only and are not guaranteed. Verify amounts shown on Contract Documents. All planting indicated on Contract Documents is required unless indicated otherwise.
3. Do not commence with this Work until all work including grading tolerances specified in Section 32 9122 ‘Topsoil Grading’ are completed and approved.

3.2 PREPARATION

A. Plant Approval:
1. Compliance:
a. Prior to any plant installation, evaluate plants for compliance with material standards.
b. Remove plants from site that do not comply.
2. Inspection:
a. Prior to any tree installation, inspect one (1) extra deciduous tree and one (1) extra evergreen tree for root health.
b. In presence of Landscape Architect or by video recording, remove root container/packing material and inspect root balls for soil depth, firmness and root structure by washing soil off of roots.

c. If delivered plants exhibit soil 1 inch (25 mm) or more above root collar, demonstrate that all trees have had excess soil removed prior to planting or that they meet standard.
d. Remove and replace tree plant material if roots are loose, significantly circling, significantly asymmetrical or damaged.
e. Continue inspection process until trees meet standard.

B. Layout individual tree and shrub locations and areas for multiple plantings:
1. Stake locations and outline areas.
2. Secure Landscape Architect's approval before planting.
3. Make minor adjustments as may be requested.

3.3 INSTALLATION

A. Excavation:
1. If underground construction work or obstructions are encountered in excavation of planting holes, Landscape Architect will select alternate locations.
2. Plant Excavation Size:
a. Diameter: Twice diameter of root ball or container minimum.
b. Depth: Equal to container or rootball depth.
3. Unless excavated material meets topsoil requirements as specified in Section 32 9120, remove from landscape areas and do not use for landscaping purposes.
4. Roughen sides and bottoms of excavations.
5. With approval of Landscape Architect, select five (5) typical planting excavations throughout site for drainage testing.
a. Fill selected excavations with water and verify that water drains away at rate of 3 inches (75 mm) per hour minimum. Inform Landscape Architect in writing of excavations where water does not drain properly.
b. Select three (3) excavations approximately 5 feet (1 500 mm) away from each non-draining excavation and repeat tests. Continue testing process until non-draining areas have been identified.
c. In excavations located in identified non-draining areas, auger 6 inch (150 mm) diameter hole 4 feet (1 200 mm) deep in low point of each excavation and fill with tamped planting mix.
d. Do not plant trees or shrubs in holes that do not properly drain.

B. Planting:
1. Removing Binders And Containers:
a. Remove top one / third of wire basket and burlap binders.
b. Remove plastic and twine binders from around root ball and tree trunk.
c. Remove plastic containers.
d. Remove wood boxes from around root ball. Remove box bottoms before positioning plant in hole. After plant is partially planted, remove remainder of box without injuring root ball.
2. Plant immediately after removing binding material and containers:
a. Place tree and shrub root balls on undisturbed soil.
b. After watering and settling, top of tree root balls shall be approximately two inches (50 mm) higher than finished grade and trunk flare is visible.
c. Shrub root balls shall be approximately one inch (25 mm) higher than finished grade.
3. Properly cut off broken or frayed roots.
4. Center plant in hole, remove remaining wire basket and burlap taking care not do damage root ball:
a. Replace damaged material.
b. Backfill with specified planting mix.
5. Add fertilizer in plant pit as per ‘Topsoil Testing Report’ and during proper season.
6. Fill landscape excavations with tamped planting mix and recommended fertilizer:
a. Compact in 6 inch (150 mm) lifts.
b. Settle by watering to ensure top of root ball is 2 inches (50 mm) higher for trees and one inch (25 mm) higher for shrubs than surrounding soil following compaction and settling.
7. Do not use muddy soil for backfilling.
8. Make adjustments in positions of plants as directed by Landscape Architect.
9. Thoroughly water trees and shrubs immediately after planting.

10. At base of each tree in turf areas, leave 36 inch (900 mm) diameter circle free of any grass (to be covered by bark mulch).

C. Tree and Shrub Pruning:
   1. Prune trees and shrubs to remove dead, broken, and split branches in conformance with ANSI A300 (Part 1) Pruning.

D. Supports for New Trees:
   1. Provide new supports for trees noted on Contract Documents to be staked.
      a. Remove nursery stakes delivered with and attached to trees.
      b. Support shall consist of at least two (2) tree stakes driven into hole base before backfill so roots are not damaged. Place stakes vertically and run parallel to tree trunk. Install stakes so 3 feet (900 mm) of stake length is below finish grade.
      c. Deciduous Trees:
         1) Place tree ties 6 to 12 inches (150 to 300 mm) below crotch of main tree canopy. Second set of tree ties may be required 18 to 24 inches (450 to 600 mm) above finish grade, if directed by Landscape Architect.
         2) Remove tops of tree stakes so top of stake is 6 inches (150 mm) below main tree canopy to prevent damage to tree branches and canopy growth.
      d. Evergreen Trees:
         1) Place tree ties 2/3's of height of tree up from root ball.
   2. Provide root guying kits to support 24 inch (600 mm) box, 3 inch (75 mm) caliper and larger trees.
   3. Staking and guying should allow some tree movement.

E. Ground Covers:
   1. Container-grown unless otherwise specified on Contract Documents. Space evenly to produce a uniform effect, staggered in rows and intervals shown.

F. Post Planting Weed Control:
   1. Apply specified pre-emergent herbicide to shrub and ground cover planting areas and grass-free areas at tree bases after completion of planting.
   2. Areas shall be weed free prior to Landscape Final Acceptance.

G. Weed Barrier Fabric:
   1. After planting and application or herbicide in shrub beds, apply covering of specified weed barrier fabric.
   2. Achieve 100 percent coverage over ground areas while allowing space for growth from root ball.
   3. Overlap seams 6 inches (150 mm) minimum.
   4. Staple at 5 feet (1500 mm) on center each way and within 3 inches (75 mm) of edge of shrub bed, with two (2) at each corner.

H. Mulching:
   1. After application of herbicide, mulch shrub and ground cover planting areas with 3 inches (75 mm) deep layer of specified rock mulch.
   2. Cover grass-free area at tree bases with 3 inches (75 mm) of bark mulch where applicable.
   3. Place mulch to uniform depth and rake to neat finished appearance.

END OF SECTION

DIVISION 33: UTILITIES

33 1000 WATER UTILITIES

33 1119 FIRE SUPPRESSION UTILITY WATER DISTRIBUTION PIPING

33 3000 SANITARY SEWERAGE UTILITIES

33 3313 SANITARY UTILITY SEWERAGE

33 4000 STORM DRAINAGE UTILITIES

33 4116 SITE STORM UTILITY DRAINAGE PIPING
33 4613 FOUNDATION DRAINAGE PIPING

33 5000 FUEL DISTRIBUTION UTILITIES

33 5100 NATURAL-GAS DISTRIBUTION

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SECTION 33 1119

FIRE SUPPRESSION UTILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Perform excavation and backfill required for installation of work of this Section.
   2. Furnish and install fire water system as described in Contract Documents.
   3. Furnish and install connection to water main.
   4. See Mechanical Site Plan SD201.

B. Related Requirements:
   1. Section 03 1113: 'Structural Cast-In-Place Concrete Forming' for installation of sleeve where piping penetrates slab.
   2. Section 03 3111: ‘Cast-In-Place Structural Concrete’ for:
      a. Mix Type concrete mixes and admixtures.
      b. Pre-installation conference held jointly with other concrete specifications.
   3. Section 21 1313: 'Wet-Pipe Sprinkler Systems'.
   4. Section 31 2316: 'Excavation' for procedures and quality of excavating.
   5. Section 31 2323: 'Fill' for procedures and quality of backfilling and compacting.

1.2 REFERENCES

A. Association Publications:
   1. American Water Works Association:
      a. AWWA M41, ‘Ductile-Iron Pipe Fittings’ (Manual) (3rd Edition 2009).

B. Reference Standards:
   1. American Water Works Association:
      a. AWWA C110/A21.10-12, ‘Ductile-Iron and Gray-Iron Fittings'.
      b. AWWA C111/A21.11-12, ‘Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings'.
      c. AWWA C150-A21.50-14, ‘Thickness Design of Ductile-Iron Pipe'.
      d. AWWA C151/A21.51-09, ‘Ductile-Iron Pipe, Centrifugally Cast'.
      e. AWWA C502-14 ‘Dry-Barrel Fire Hydrants'.
      f. AWWA C606-10, 'Installation of Ductile-Iron Water Mains and Their Appurtenance'.
      g. AWWA C900-07, 'Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm) for Water Transmission and Distribution'.
   2. ASTM International:
      a. ASTM A126-04(2014), ‘Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings'.
      b. ASTM A197/A197M-00(2015), ‘Standard Specification for Cupola Malleable Iron'.
      c. ASTM A307-14, ‘Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength'.
      d. ASTM A506-16, ‘Standard Specification for Alloy and Structural Alloy Steel, Sheet and Strip, Hot-Rolled and Cold-Rolled'.
      e. ASTM A575-96(2018), ‘Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades'.
   3. National Fire Protection Association:
      a. NFPA 13: 'Standard for the Installation of Sprinkler Systems' (2019 or most recent edition adopted by AHJ).
         1) Contractor's Material & Test Certification for Underground Piping'.
      b. NFPA 24 'Standard for the Installation of Private Fire Service Mains and Their Appurtenances' (2019 or most recent edition adopted by AHJ).

4. NSF International Standard / American National Standards Institute:
   a. NSF/ANSI 61-2017, 'Drinking Water System Components - Health Effects'.
5. 2019 National Building Code – Alberta Edition.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:
   1. Participate in pre-installation conference as specified in Section 03 3111.

1.4 SUBMITTALS

A. Informational Submittals:
   1. Certificates:
      a. Provide one (1) copy of completed NFPA 13 'Contractor's Material and Test Certification for Underground Piping' as specified in 'Field Quality Control' in Part 3 of this specification:

B. Closeout Submittals:
   1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
      a. Record Documentation:
         1) Signed NFPA 13 'Contractor's Material and Test Certification for Underground Piping' with ‘In-Building Riser’ information included.

1.5 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Install exterior fire water system according to NFPA 13, NFPA 24, and AWWA Manual M41, ‘Ductile-Iron Pipe and Fittings’ procedures unless specified otherwise below.
   2. Install hydrant in accordance with AWWA C502.
   3. Install exterior fire water system up to and including pipe flange 12 inches (300 mm) above floor inside building.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Manufacturers:
   1. Manufacturer Contact List:
      a. Ames Fire & Waterworks (A Watts Brand), Woodland, CA www.amesfirewater.com.
      b. Ipex Inc, Englewood, CO www.ipexinc.com.
      c. Mueller Company, Decatur, IL www.muellerflo.com.
      d. Nibco Inc, Elkhart, IN www.nibco.com.
      e. Potter Electric Signal Company, St Louis, MO www.pottersignal.com.
      f. Potter-Roemer, Santa Ana, CA www.potterroemer.com.

B. Materials:
   1. Pipe:
      a. PVC DR18 meeting AWWA C900 requirements:
         1) Blue-Brut by Ipex Inc.
         2) Blue Brute by JM Eagle.
      b. Fittings: Ductile iron pipe fitting for riser in accordance with AWWA C110 and rubber gaskets joints in accordance with AWWA C111/A21.11.
   2. Hydrants:

a. Dry-barrel fire hydrant (base valve type) complying with AWWA C150-A21.50, with 150 psi (1.03 MPa) working pressure with two 2-1/2 inch (64 mm) hose connections and one 4-1/2 inch (115 mm) pumper connection with caps and chains.
b. Nozzle cap nuts to match operating stem nuts.
c. Minimum 6 inch (150 mm) supply pipe.
d. Class Two Quality Standard. See Section 01 6200:
1) Hydrants accepted by authority having jurisdiction are approved.

3. Gate Valves:
a. Cast iron body with bolted bonnet.
b. Indicator post pattern.
c. Non-rising stem.
d. 175 psi (1.21 MPa) working pressure.
e. Category Four Approved Products. See Section 01 6200 for definition of Categories:
1) Nibco:
a) Model M-609 with mechanical connection.
b) Model F-609 with flanged connection.
2) Mueller:
a) Model A-2052-5 with mechanical connection.
b) Model A-2052-6 with flanged connection.

4. Tamper Switch:
a. UL/ULC listed and FM approved.
b. Weather and tamper resistant.
c. Single Pole Double Throw Switch.
d. Category Four Approved Products. See Section 01 6200 for definition of Categories:
1) Potter Electric Signal: Model PCVS.

5. Anchorages:
a. Provide anchorages for tees, plugs, caps, bends, and hydrants in accordance with NFPA 24.
b. Miscellaneous Fittings:
1) Clamps, Straps, And Washers: Steel, meeting requirements of ASTM A506.
2) Rods: Steel, meeting requirements of ASTM A575.
3) Rod Couplings: Malleable iron, meeting requirements of ASTM A197/A197M.
4) Bolts: Steel, meeting requirements of ASTM A307.
5) Cast Iron Washers: Meeting requirements of ASTM A126, Class A.
6) Thrust Block: 2500 psi (17.92 MPa) concrete.

6. In-Building Riser:
a. See Fire Sprinkler and Plumbing details for riser configuration.

7. Pipe Sleeve at slab penetration:
a. Class Two Quality Standard. See Section 01 6200:
1) Any material rigid enough to resist deformation when concrete poured.
2) Size: Provide 2 inch (50 mm) minimum space between piping assembly and sleeve.
3) Fill void with mastic when completed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before installation, inspect pipe for defects and cracks. Do not use defective, damaged, or unsound pipe.

3.2 PREPARATION

A. Excavate and backfill as specified in Sections 31 2316 and 31 2323 with following additional requirements:
1. Runs shall be as close as possible to those shown on Contract Documents.
2. Excavate to required depth.
3. Grade to obtain fall required.

4. Bottom of trenches shall be hard and smooth. Tamp as required.
5. Remove debris from trench prior to laying of pipe.
6. Do not cut trenches near footings without consulting Architect.
7. Excavate to inverts and descriptions noted on Mechanical Site Plan SD201.
8. Cover pipe only after testing is complete and accepted by Architect.

3.3 INSTALLATION

A. General:
   1. When work is not in progress, close open ends of pipe and fittings so no trench water, soil, or other substances will enter pipes or fittings.
   2. Keep trenches free from water until pipe jointing material has set. Do not lay pipe when condition of trench or weather is unsuitable for such work.

B. Placing And Laying of Underground Pipe:
   1. Deflections from straight line or grade, as required by vertical curves, horizontal curves, or offsets, shall not exceed 6/D inches per linear foot (12 500/D mm per m) of pipe where D represents nominal diameter of pipe expressed in inches (mm).
   2. Deflections to be determined between center lines extended of two connecting pipes.
   3. If alignment requires deflection in excess of these limitations, provide special bends or sufficient number of shorter lengths of pipe to provide angular deflections within limits approved by Architect.
   4. Laying:
      a. Shape trench bottom to give substantially uniform circumferential support to lower third of each pipe.
      b. Pipe laying shall proceed up-grade with spigot ends of bell-and-spigot pipe pointing in direction of flow.
      c. Lay each pipe true to line and grade and in such manner as to form close concentric joint with adjoining pipe and to prevent sudden offsets of flow line.
      d. Support fittings at bends in pipe line by concrete thrust blocks firmly wedged against vertical face of trench. Blocks shall be at least two cu ft (0.06 cu m) in size. See details for larger riser thrust block.
      e. As work progresses, clear interior of pipe of dirt and superfluous materials. Where cleaning after laying is difficult because of small pipe, keep suitable swab or drag in pipe and pull forward past each joint immediately after jointing has been completed.

C. Make joints between ductile iron and cast iron pipe and other types of pipe with standard manufactured cast-iron adapters and fittings.

D. Provide cast iron valve box for fire protection valve. Encase valve box in concrete.

E. Install In-Building Riser:
   1. Connect vertical leg must extend 12 inches (300 mm) above finished floor.
   2. Horizontal leg must extend at least 3 feet (900 mm) out from foundation.
   3. Provide 2 inch (50 mm) minimum clearance around pipe at penetration through floor.
   4. Fill clearance with mastic.

F. Make joints between ductile iron and other types of pipe with standard manufactured adapters and fittings. Make connections between new work and existing mains using specials fittings to suit actual conditions.

G. Fire Hydrant Color-Code:
   1. Laps and Nozzle caps should be painted IAW NFPA 24:
      a. Less ten 1893 lpm: Red
      b. 1893 to 3785 lpm: Orange
      c. 3785 to 5674 lpm: Green
      d. 5678 lpm and above Light Blue
      e. Painting to comply with City of Calgary Fire Prevention Bureau (AHJ).

3.4 FIELD QUALITY CONTROL

A. Field Tests:
   1. Test system according to NFPA 13 (2010, 2013, and 2016), figure 10.10.1, 'Contractor's Material and Test Certification for Underground Piping':
      a. Provide signed copy of certificate with field test information with Closeout Submittals:
         1) Certificate to include following information in ‘Additional explanation and notes’ area of certificate with following:
            a) In-Building Riser: Manufacturer brand, size, material and size of trust blocking.

END OF SECTION

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SECTION 33 3313

SANITARY UTILITY SEWERAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Perform excavating and backfilling required for work of this Section.
   2. Furnish and install sanitary sewage system as described in Contract Documents beginning at 5 feet (1.50 meter) from where it enters building and connecting to serving sewer system.
   3. See Mechanical Site Plan SD201.

B. Related Requirements:
   1. Section 03 3111: 'Cast-In-Place Structural Concrete' for:
      a. Pre-installation conference held jointly with concrete specifications.
   2. Section 22 1313: 'Facility Sanitary Sewers' for sanitary sewage system within building and within 5 feet (1.50 meter) of building.
   3. Section 31 0501: ‘Common Earthwork Requirements’ for:
      a. Pre-installation conference held jointly with other common earthwork related sections.
   4. Section 31 2316: 'Excavation' for criteria for performance of excavation.
   5. Section 31 2323: 'Fill' for criteria for performance of backfill and compaction.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conferences:
   1. Participate in pre-installation conference as specified in Section 03 3111.
   2. Participate in pre-installation conference as specified in Section 31 0501.

1.3 REFERENCES

A. Reference Standards:
   1. ASTM International:
      a. ASTM D2235-04(2016), ‘Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings'.
      b. ASTM D2321-18, ‘Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications'.
      c. ASTM D2564-12(2018), ‘Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems'.
      d. ASTM D2661-14, ‘Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings'.
      e. ASTM D2665-14, ‘Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings'.
      f. ASTM D3034-16, ‘Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings'.
      g. ASTM F656-15, ‘Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings'.
   2. CSA Group (Canadian Standards Association):
      a. CSA B602-16, 'Mechanical Couplings for Drain, Waste, and Vent Pipe and Sewer Pipe'.
      b. CSA B1800-18, 'Thermoplastic Nonpressure Pipe Compendium':
         1) CSA-B182.1-15, ‘Plastic Drain and Sewer Pipe and Pipe Fittings'.
         2) CSA B182.2-15, ‘PSM Type Polyvinylchloride (PVC) Sewer Pipe Fittings'.
   3. International Code Council:
      a. ICC IPC-2018, 'International Plumbing Code'.

4. 2019 National Building Code – Alberta Edition.

1.4 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals
   1. Install cleanouts in accordance with local governing authority and Provincial and National codes.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. ABS:
   1. ABS Schedule 40 solid wall plastic pipe and fittings meeting requirements of CSA B181.1 joined with pipe cement meeting requirements of ASTM D2235.

B. PVC:
   1. PVC Schedule 40 solid wall plastic pipe and fittings meeting requirements of CSA B182.2, SDC 28 joined using cement primer meeting requirements of ASTM F656 and pipe cement meeting requirements of ASTM D2564.
   2. Under areas subject to vehicular travel, use Blue Brute pipe and fittings by Ipex Inc, Englewood, CO www.ipexinc.com.
   3. PVC SDR 35 solid wall plastic pipe and fittings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification Of Conditions:
   1. Before installation, inspect pipe for defects and cracks.
   2. Do not use defective, damaged, or unsound pipe.

3.2 PREPARATION

A. Excavate and backfill as specified in Sections 31 2316 and Section 31 2323 with following additional requirements:
   1. Runs shall be as close as possible to those shown on Contract Drawings.
   2. Excavate to required depth and grade to obtain fall required.
   3. Bottom of trenches shall be hard. Tamp as required.
   4. Remove debris from trench before laying pipe.
   5. Do not cut trenches near footings without consulting Architect/Engineer.
   6. Excavate to inverts and descriptions noted on Mechanical Site Plan SD201.

3.3 INSTALLATION

A. General:
   1. When work is not in progress, close open ends of pipe and fittings so no trench water, soil, or other substances will enter pipes or fittings.
   2. Keep trenches free from water until pipe jointing material has set. Do not lay pipe when condition of trench or weather is unsuitable for such work.
   3. Trench width at top of pipe:
      a. Minimum: 18 inches (450 mm) or diameter of pipe plus one foot (305 mm), whichever is greater.

b. Maximum: Outside diameter of pipe plus two feet (610 mm).

B. Placing And Laying of Underground Pipe:
1. Deflections from straight line or grade, as required by vertical curves, horizontal curves, or offsets, shall not exceed 6/D inches per linear foot (12 500/D mm per m) of pipe where D represents nominal diameter of pipe expressed in inches mm
2. Deflections to be determined between center lines extended of two connecting pipes.
3. If alignment requires deflection in excess of these limitations, provide special bends or sufficient number of shorter lengths of pipe to provide angular deflections within limits approved by Architect.
4. Laying:
   a. Pipe laying shall proceed up-grade with spigot ends of bell-and-spigot pipe pointing in direction of flow.
   b. Lay each pipe true to line and grade and in such manner as to form close concentric joint with adjoining pipe and to prevent sudden offsets of flow line.
   c. As work progresses, clear interior of pipe of dirt and superfluous materials. Where cleaning after laying is difficult because of small pipe, keep suitable swab or drag in pipe and pull forward past each joint immediately after jointing has been completed.

C. Thermoplastic Pipe And Fittings:
1. Install in accordance with Manufacturer's recommendations and ASTM D2321.
2. Stabilize unstable trench bottoms.
3. Bed pipe true to line and grade with continuous support from firm base.
   a. Bedding depth: 4 to 6 inches (100 to 150 mm).
   b. Material and compaction to meet ASTM standard noted above.
   c. See Mechanical Site Plan SD201 for bedding notes.
4. Excavate bell holes into bedding material so pipe is uniformly supported along its entire length. Blocking to grade pipe is forbidden.
5. Piping and joints shall be clean and installed according to Manufacturer's recommendations. Break down contaminated joints, clean seats and gaskets and reinstall.
6. Do not use back hoe or power equipment to assemble pipe.
7. Initial backfill shall be 12 inches (305 mm) above top of pipe with material specified in referenced ASTM standard.
8. Minimum cover over top of pipe:
   a. 36 inches (915 mm) before allowing vehicular traffic over pipe.
   b. 48 inches (1 200 mm) before use of compaction equipment other than hand or impact tampers.

3.4 FIELD QUALITY CONTROL

A. Non-Conforming Work:
1. Failure to install joints properly shall be cause for rejection and replacement of piping system at no additional cost to Owner.

END OF SECTION

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SECTION 33 4116

SITE STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Perform excavating and backfilling required for work of this Section.
   2. Furnish and install storm drainage system using PVC SDR 35 Polyethylene Pipe and fittings as described in Contract Documents from point of water collection to terminating point.
   3. See Mechanical Site Plan SD201.

B. Related Requirements:
   1. Section 31 2316: 'Excavation' for criteria for performance of excavation.
   2. Section 31 2323: 'Fill' for criteria for performance of backfill and compaction.

1.2 REFERENCES

A. Reference Standards:
   1. ASTM International:
      a. ASTM D2321-18, ‘Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications'.
      b. ASTM D3034-16, ‘Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings'.
      c. ASTM D3212-07(2013), ‘Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals'.
      d. ASTM F794-03(2014), ‘Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter'.
      e. ASTM F1336-15, ‘Standard Specification for Poly (Vinyl Chloride) (PVC) Gasketed Sewer Fittings'.
   2. Canadian Standards Association / CSA Group:
      a. CSA B602-16, 'Mechanical Couplings for Drain, Waste, and Vent Pipe and Sewer Pipe'.
      b. CSA B1800-18, 'Thermoplastic Nonpressure Pipe Compendium':
         1) CSA-B182.1-15, ‘Plastic Drain and Sewer Pipe and Pipe Fittings'.
         2) CSA B182.2-15, ‘PSM Type Polyvinylchloride (PVC) Sewer Pipe Fittings'.
   3. International Code Council:
      a. ICC IPC, '2015 International Plumbing Code'.
   4. 2019 National Building Code – Alberta Edition.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Materials:
   1. Bedding Material: 3/8 inch (9.5 mm) crushed gravel to depths required by City of Calgary standard details (AHJ).
   2. Catch Basins, Curb Inlets, Etc:
      a. Concrete:
         1) Construct of 5000 psi (34.47 MPa) minimum Type 50 HS concrete.
         2) Include cover inlet with cast iron frame and grate as shown on Drawings.
         3) Meet City of Calgary standard details (AHJ).
   3. Oil and Grit Separator:

a. Rainwater Management:
1) See Mechanical Site Plan SD201 for Model #.

4. PVC Pipe And Fittings:
a. Meet requirements of ASTM D3034, SDR 35 or CSA 182.1.
5. Fittings: Slip Joint type with elastomeric seals.
6. Yard Drains (roof water leaders):
a. Zurn Z-610-G-H-YC complete with sediment bucket – see J/G103.

PART 3 - EXECUTION

3.1 PREPARATION

A. Excavate and backfill as specified in Section 31 2316 and Section 31 2323 with following additional requirements:
1. Runs shall be as close as possible to those shown on Contract Documents.
2. Excavate to required depth.
3. Grade to obtain fall required.
4. Remove debris from trench before laying bedding and pipe.
5. Do not cut trenches near footings without consulting Architect.
6. Backfill only after pipe lines have been tested, inspected, and approved by Architect/Engineer.

3.2 INSTALLATION

A. PVC / Polyethylene Pipe:
1. Install in accordance with ASTM D2321.
2. See Mechanical Site Plan SD201 for invert information.

B. Use jacks to make-up gasketed joints.

3.3 FIELD QUALITY CONTROL

A. Non-Conforming Work:
1. Failure to install joints properly shall be cause for rejection and replacement of piping system at no additional cost to Owner.

3.4 CLEANING

A. Remove excess earth from site or place as directed by Architect.

END OF SECTION

SECTION 33 4613

FOUNDATION DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Perform excavating and backfilling for work of this Section.
   2. Furnish and install foundation drainage system as described in Contract Documents.
   3. See Mechanical Site Plan SD201 for man hole connection inverts.
   4. See Plumbing Plan for foundation piping route.
   5. See Plumbing Plan for Radon piping and details.
   6. Provide exterior clean outs as detailed – see L/G102.

B. Related Requirements:
   1. Section 31 2316: ‘Excavation’ for procedure and quality of excavating.
   2. Section 31 2323: 'Fill' for procedure and quality of backfilling.

1.2 REFERENCES

A. Reference Standards:
   1. Canadian Standards Association:
      a. CAN/CSA B182-1-M92 or current edition “Plastic Drain and Sewer Pipe and Pipe Fittings”.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:
   1. In addition to agenda items specified in Section 01 3100, review following:
      a. Schedule conference after excavation and stripping of concrete forms, but before installation of any components of system.

1.4 SUBMITTALS

A. Informational Submittals:
   1. Manufacturer Instructions:
      a. Provide printed installation instructions.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Materials:
   1. Drainage Gravel:
      a. Clean, washed drain rock ¾” (20mm) diameter – see N/G102.
   2. Filter Fabric:
      a. Type One Acceptable Products:
         1) 4547 Fabric by Amoco
         2) 140N by Mirafi
         3) 4.5 by EMCO
         4) Equal as approved by Architect before bidding. See Section 01 6200.

3. Drainage Pipe:
   a. 4 inches (100mm) diameter rigid PVC perforated drainage pipe meeting requirements of ASTM D2729.
   b. Perforations drilled into 2/3 of pipe cross section maximum.
   c. Use of "big O" flexible pipe is <u>not allowed.</u>

PART 3 - EXECUTION

3.1 PREPARATION

A. Wet and tamp fill under pipe to form firm bottom.

3.2 INSTALLATION

A. General:
   1. Form sharp turns or angles, branch connections, and joints to drain lines with pipe fittings as required.
   2. Protect lines from entrance of dirt.
   3. Provide cleanouts as required using long sweep elbow fittings - see L/G102.
   4. Extend gravel as shown on Drawings.
      a. Width of backfill at bottom shall be 24 inches (600 mm) minimum and fill width of trench above.
      b. Before placing fill, remove caved-in or loose earth over drains.

B. Tolerances:
   1. See Plumbing Plan for starting and ending inverts as well as slope route.
   2. Lay with minimum uniform slope of 0.5%. Use engineer's level in checking.

3.3 FIELD QUALITY CONTROL

A. Field Tests And Inspections:
   1. Test system as required by Architect/Engineer.
   2. Do not cover lines until approved by Architect/Engineer.

END OF SECTION

SECTION 33 5100

NATURAL-GAS DISTRIBUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Perform excavation and backfill required for work of this Section.
   2. Furnish and install gas piping and fittings as described in Contract Documents from gas main to meter.
   3. Provide, make necessary arrangements for, and pay necessary fees to local gas utility company for gas service lines and proper size gas meter.
   4. See Mechanical Site Plan SD201.
   5. See Plumbing Plans.

B. Related Requirements:
   1. Section 03 3111: 'Cast-In-Place Structural Concrete' for concrete meter base (if required by AHJ).
   2. Section 05 0523: 'Metal Fastening' for welding standards and requirements.
   3. Section 31 2316: 'Excavation' for procedure and quality of excavating.
   4. Section 31 2323: 'Fill' for procedure and quality of backfilling and compacting.

1.2 REFERENCES

A. Reference Standards:
   1. ASTM International:
      a. ASTM A53/A53M-18, ‘Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless'.
      b. ASTM A234/A234-18a, ‘Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service'.
      c. ASTM D2513-18a, ‘Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings'.
   2. CSA Group (Canadian Standards Association):
      a. CAN/CSA B137 Series-17, 'Thermoplastic Pressure Piping Compendium' (6th edition):
         1) CSA-B137.4, ‘Polyethylene (PE) Piping Systems For Gas Services'.

1.3 SUBMITTALS

A. Informational Submittals:
   1. Certificates:
      a. Welder certificates certifying welders comply with requirements specified under Quality Assurance Article of this Section.

1.4 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Lay underground pipe in accordance with federal pipeline safety regulations and local gas utility company regulations and specifications.

B. Qualifications: Requirements of Section 01 4301 applies, but not limited to following:
   1. Polyethylene Pipe Installers:
      a. Properly trained and certified in procedure for joining polyethylene pipe.

2. Welders:
   a. Certified and bear evidence of certification 30 days before commencing work on project.
   b. If there is doubt as to proficiency of welder, Owner's Representative may require welder to take another test.
   c. This shall be done at no cost to Owner.
   d. Certification shall be by Pittsburgh Testing Laboratories or other approved authority.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Storage And Handling Requirements:
   1. Do not store polyethylene pipe so it is exposed to sunlight.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Above-Ground Pipe And Fittings:
   1. Black carbon steel, butt welded, Schedule 40 pipe meeting requirements of ASTM A53/A53M.
   2. Welded forged steel fittings meeting requirements of ASTM A234/A234M.

B. Below-Ground Pipe And Fittings:
   1. Polyethylene pipe and fittings meeting requirements of ASTM D2513 or CSA-B137.4 with No. 14 coated copper tracer wire.

C. Valves:
   1. Iron body, 125 psi (862 kPa) square head cock, with bronze plug.
   2. Class One Quality Standard: Powell No. 2200:
      a. Crane Valves, Long Beach, CA www.cranevalve.com or Crane Canada Inc, Plumbing Div, Montreal, QB (514) 735-3592.
      b. The Powell Co, Cincinnati, OH www.powellvalves.com.
      c. Stockham Valve, Birmingham. AL www.stockham.com.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Excavate and backfill as specified in Section 31 2316 and 31 2323 with following additional requirements:
   1. Runs shall be as close as possible to those shown on Contract Drawings.
   2. Excavate to required depth.
   3. Bottom of trenches shall be hard. Tamp as required.
   4. Remove debris from trench before laying pipe.
   5. Do not cut trenches near footings without consulting Architect.
   6. Place 4 inches (100 mm)of sand around pipe before trench is backfilled.
   7. Bury outside pipe to meet Utility Provider standard details. Compact fill over pipe to meet Section 31 2323.
   8. Backfill only after pipe lines have been tested, inspected, and approved by Architect.

B. General installation shall be as specified in Division 23:
   1. Steel pipe 2-1/2 inches (64 mm) and larger shall have welded fittings and joints.
   2. Provide 24 inch (600 mm) minimum steel pipe between vertical rise of riser and end of polyethylene line if anode-less riser is not used. Use plastic-to-steel transition or compression fitting between end of service line and steel meter riser. Provide cathodic protection for steel riser or use anode-less riser.

3. Place tracer wire along side of polyethylene pipe from meter to main.

C. Mount meter within A/C enclosure. Install to meet Utility Provider requirements.

3.2 PROTECTION

A. Provide necessary protection against damage for meter.

B. Provide necessary clearances between spark and gas vent.

END OF SECTION

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