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PART 1 - GENERAL

1.1 SCOPE

- A. The Vendor performing the work of this section shall provide all necessary labor, materials, equipment, services, and other items required, whether specified or not, to furnish a complete and functional pathway (infrastructure) system for voice, data, wireless 801.11xx, and CATV systems.
- B. Work Included: Among the items that may be required are:
1. Main Distribution Frame (MDF) room and Intermediate Distribution Frame (IDF) rooms provisioning
 2. Grounding and bonding system
 3. Interconnecting raceway between campus network and Riser Rooms (MDF and IDFs)
 4. Vertical riser sleeves and conduit
 5. Horizontal distribution tray and conduit
 6. Ladder-rung cable tray in MDF/IDF Rooms
 7. Station drop conduits
 8. Communication outlet boxes
 9. Surface-mounted raceway (SMR)
 10. NEMA 4X box, specified in Section 27 17 53 "Wireless"
- C. Coordination Requirements: The Vendor performing the work of this section shall coordinate work of this Section with Sections 27 17 52, 27 17 53 and 27 17 54 to assure infrastructure is installed to meet project scope requirements.

1.2 REGULATORY REQUIREMENTS

- A. All work shall be performed in accordance with the latest revisions of all national, state, and local governing codes and standards in effect as of the Bid date including:
1. ANSI American National Standards Institute
 2. ASTM American Society for Testing and Materials
 3. BICSI Building Industry Consulting Services International
 4. EIA Electronic Industries Association
 5. FCC Federal Communications Commission
 6. ICEA Insulated Cable Engineers Association
 7. IEEE Institute of Electrical & Electronics Engineers
 8. NCTA National Cable & Telecommunications Association
 9. NEC National Electrical Code
 10. NECA National Electrical Vendors Association
 11. NEMA National Electrical Manufacturers Association
 12. NESC National Electrical Safety Code
 13. NETA National Electrical Testing Association
 14. NFPA National Fire Protection Association
 15. NIST National Institute of Standards & Technology
 16. OSHA Occupational Safety and Health Administration
 17. TIA Telecommunications Industries Association
 18. UL Underwriters Laboratories, Inc.

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1.3 QUALITY ASSURANCE

- A. Vendor/Subcontractor Qualifications: The Vendor performing the work of this section shall have:
 - 1. Minimum Experience & Qualifications ... reference RFQQ 4.3.1.
- B. Project Meetings:
 - 1. Pre-installation meeting: Early in the construction time line, and before any Shop Drawings are produced, if required, the Vendor performing the work of this section shall schedule a pre-installation meeting where communications infrastructure installation issues shall be discussed.
 - 2. Pre-installation walk-through: Prior to commencing installation of copper, fiber optic, and coaxial communications infrastructure, the Vendor performing the work of this section shall coordinate a pre-installation walk-through with the Owner's UW-IT personnel and all trades having work within or connected to IDF's and/or MDF's.
 - a. The walk-through shall address installation of penetrations, sleeves, conduit, cable tray, grounding and bonding, and electrical power and other building support infrastructure requirements for MDF and IDF's (such as lights, sprinklers, cooling, etc.).
 - b. The Lead or Forman who will be on site for the execution of the project shall be at this walk-through.
 - c. At Owner's sole discretion, this walk-through may occur as part of the pre-installation meeting.
 - 3. Pathway review walkthrough with UWIT prior to Outside Plant (OSP) infrastructure installation.

1.4 CONSTRUCTION PROGRESS SCHEDULE - DETAIL

- A. In addition to the Work activity detail requirements described in Section 01 32 16, the following communications milestones shall be referenced in the Progress Schedule (at a minimum, include line items as placeholders):
 - 1. For Vendor's field office, date Owners communications service is required.
 - 2. Start/completion of communications continuity-of-service work.
 - 3. Communications Infrastructure pre-installation meeting and walk through.
 - 4. Completion of infrastructure for outside cable plant and inspection walk-through for early building service pathway.
 - 5. Start/Completion of MDF/IDF work by room.
 - 6. Walk-through for inspection of early building service pathway.
 - 7. Date temporary power is converted to permanent building power.

1.5 SUBMITTALS

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A. Prepare and submit Shop Drawings including product data as required.

1. Product data shall include:

- a. Complete manufacturer's product literature (not generic distributor's catalog sheets) for all products specified herein, referenced to the applicable paragraph in Part II of this Specification.
- b. Manufacturer's installation instructions including storage, handling, protection, examination, preparation, and installation.

1.6 Project Record Drawings

- A. The Vendor shall maintain redline Drawings showing pathway routing modifications and locations of pull boxes that shall be available on site during construction for review by the Owner and a color copy turned over to the Owner at the completion of the project.
- B. When requested in the project scope of work the Vendor shall submit to the Owner project record Drawings that incorporate all modifications and construction redline Drawings. These Drawings shall conform to requirements of 01 77 00 "As-built Shop Drawings".
 1. As-built Drawings: Maintain black line prints of the bid set Contract Drawings and approved Shop Drawings. Mark the drawings to show new information that was not shown on the bid set Drawings, and on the approved Shop Drawings, including the actual installation where the installation varies substantively from the work as originally shown. Mark drawings to show conditions fully and accurately. Where Shop Drawings are used, record a cross-reference at the corresponding location on the Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.

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PART 2 – PRODUCTS

2.1 GENERAL

- A. No “custom” items (e.g., to meet unusual physical requirements of the installation site) shall be used except as specified or as reviewed and approved by the Owner.
- B. The installation standards for the cable plant infrastructure system are described below.

2.2 OUTSIDE “SITE” INFRASTRUCTURE

- A. Handholes shall be pre-cast concrete or molded PVC with square access lid. Prior to labeling, confirm actual wording with Owner.
 - 1. Communications Handholes: Strength of lid shall be determined by its location. Lids shall be provided to assure performance to installed environment. Oldcastle Precast Utility Vault 25-TA, Oldcastle Utility Vault 3030-LA or approved equal.
 - 2. Maintenance Handholes: The utility handhole shall be pre-cast concrete with square access lid.. Oldcastle Precast Utility Vault 38-TA, or approved equal.

2.3 MDF/IDF PROVISIONING

- A. Equipment ground bus: The equipment ground bar shall be 1/4-inch copper, minimum 4 inches high by 10 inches wide, mounted with 4-inch stand-off brackets. Chatsworth Products Inc., CPI – 10622-010, or approved equal.

2.4 WALL MOUNTED IDF

- A. For indoor or covered area use only.
- B. Constructed of riveted or bolted steel with epoxy-polyester hybrid powder coated paint finish.
- C. Shall be UL Listed to support up to 200 lb.
- D. Hinge design shall allow for opening the front of cabinet and swinging the cabinet out from the rear panel.
- E. Color to be selected from standard colors to meet design requirements.
- F. Products:

CUBE-iT Plus Wall-Mounted Cabinet or approved equal. 24” Height – 12U
CUBE-iT Plus Wall-Mounted Cabinet or approved equal. 26” Height – 18U
CUBE-iT Plus Wall-Mounted Cabinet or approved equal. 48” Height – 26U
Or approved equal

2.5 WALL MOUNTED EXTERIOR IDF

- A. For outdoor exposed areas.

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- B. Constructed Corrosion-resistant Aluminum with epoxy-polyester urethane powder coated paint finish.
- C. Shall be UL Listed to support up to 200 lb.
- D. Shall have solar shield that directs liquids away from the cabinet opening.
- E. Shall have environmental seal with foam-in-place gaskets.
- F. Shall have NEMA 4 classification or greater.
- G. Color to be selected from standard colors to meet design requirements.
- H. Products:

COMLINE Wall-Mounted Cabinet or approved equal. 23.62" Height – 12U
COMLINE Wall-Mounted Cabinet or approved equal. 50.43" Height – 18U
COMLINE Wall-Mounted Cabinet or approved equal. 62.24" Height – 25U
Or approved equal

2.6 COMMUNICATIONS CABLE TRAY

- A. Fabrication and Materials:
 - 1. MATERIALS shall be adequately protected against corrosion or made of corrosion-resistant material.
 - 2. Straight sections and fitting side rails shall be extruded aluminum. Other components shall be aluminum.
 - 3. Transverse members (rungs) and solid bottom materials shall be welded to side rails. Tray rung spacing shall be designed to prevent sagging as follows:
 - a. Rungs shall have minimum cable-bearing surface of 7/8" with radius edges.
 - b. No portion of rungs shall protrude below bottom plane of side rails.
 - 4. Provide splice plates with straight sections and fittings.
 - 5. Splice plate construction shall be designed to permit splice to be located at any point within support span without diminishing cable tray rated loading capacity.
 - 6. Splice plates for aluminum tray systems shall be aluminum and attached with minimum of 4 rib neck carriage bolts, lock washers.
 - 7. Side rails shall be of sufficient thickness to prevent damage to the tray caused by repeated support of ladders or other equipment and personnel.
 - 8. All surface finishes and section joints shall be smooth to the touch to eliminate cable chafing.
 - 9. Tray system shall not present sharp edges, burrs, or projections injurious to wiring. Upper flanges shall be rolled out and downward for safety.
 - 10. Corners shall have generous **factory-manufactured curved sweeps** (90-degree angles are unacceptable).

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11. Tray system shall be side rail hung.
 12. Trapeze hangers shall be supported by 3/8" or 1/2" minimum diameter rods.
 13. Aluminum and galvanized steel cable trays shall be UL classified as equipment grounding conductors.
 14. Elevation changes shall be made with factory-constructed components matching fabrication and material requirements of straight sections and accessories.
 15. Dropouts shall be made with factory-constructed components matching fabrication and material requirements of accessories and be of the same manufacturer and type as tray.
- B. Size: Cable tray shall be [XXX wide] by 4" deep [as indicated on the Drawings] or in project specific scope of work] with minimum usable load depth 1" less than overall nominal tray depth.
- C. Type/Product:
1. Ladder tray with rounded rungs spaced no farther than 6 inches apart. Mono-Systems ML4A06-XX-XXX, Cooper B-Line 24A06-XX-XXX or approved equal. deep [product size specifics as indicated on the Drawings or in project specific scope of work]
 - a. Cable tray provided under this Section in MDF and IDF Rooms shall be ladder tray.
 2. Solid Bottom Tray shall be interiorly flat (non-corrugated). : Mono-Systems ML4ASB-XX-XXX, Cooper B-Line 24ASB-XX-XXX or approved equal. deep [specific sizes as indicated on the Drawings or in project specific scope of work]
 3. Basket Tray shall be rounded rungs spaced no further than 3 inches apart. Cablofil® CF Series, Cooper B-Line Flextray (FT) series, or approved equal.

2.7 CONDUIT

- A. Conduit types and sizes shall be only as specifically noted on the Drawings and specified herein.
- B. Flexible Metal Conduit: Flexible metal conduit shall not be used without prior approval by Owner.
- C. Outside Plant Conduit Infrastructure: Specific Materials and/or schedule to be called out out in the specific project scope of work.

Outside cable plant infrastructure shall be a minimum 4- inch PVC (heavy wall EPC)
Schedule [40] [80] rigid nonmetallic conduit, provided with metallic pull tape.

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Outside Plant Conduit Infrastructure: Outside cable plant infrastructure shall be a minimum 4-inch hot dipped galvanized rigid steel conduit (GRC), provided with a metallic pull tape.

1. Conduits shall be provided with base and intermediate spacers, which are high impact spacers with horizontal and vertical locking separation of **[3"] [4"] [XXX"]** between ducts.
2. Radius sweeps shall be provided for all transitions in direction of conduit.
 - b. Materials shall match conduit.
 - c. Minimum bend radius of 10 times the diameter for conduits 2" or more.
3. Bushings shall be used on all conduits and shall match the conduit material.
4. All outside plant conduit shall be provided with lubricated pull tape.
5. Underground warning tapes shall be used for all conduit duct banks and shall:
 - a. Be 6" wide by 0.004" thick polyethylene film.
 - b. Have "**CAUTION – COMMUNICATIONS LINE BELOW**" or similar text.

D. INSIDE CABLE PLANT CONDUIT INFRASTRUCTURE

1. Electrical Metallic Tubing (EMT): ANSI C80.3, UL 797; galvanized steel tubing
 - a. Fittings (couplings, conduit bodies, bushings and connectors) shall be: NEMA FB 1, UL 514B; steel, watertight gland compression type [or] [steel concrete-tight set-screw type] connectors with double locknuts and insulated throat and metallic insulating bushings. Indenter, drive-on, die-cast, or pressure-cast fittings not permitted.
 - b. Manufacturers: Cooper Crouse-Hinds, Carlon® Electrical Products, O-Z/Gedney, Appleton®, Hubbell®, or approved equal.
2. Rigid Nonmetallic Conduit (RNC): NEMA TC 2, UL 651; Schedule **[40][80]** PVC
 - a. Fittings: NEMA TC 3, UL 651
3. Spillways: Spillways shall be Bejed BJ – 2049A-001 (2" EMT spillway) or Bejed BJ – 2049B-002 (4" EMT spillway), or approved equal.

2.8 CONDUIT SLEEVES (THROUGH WALLS/FLOORS)

- A. The sleeves shall be no less in in type, internal dimension and wall thickness than the conduit pathway entering and exiting the pathway and meet all governing fire and building codes.

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- B. Use pre-manufactured fire rated assemblies where fire rating is required. Hilti CP 653 or approved equal.

C. RECTANGULAR SLEEVES ASSEMBLIES (THROUGH WALLS/FLOORS)

1. Rectangular Sleeve

- a. For sleeve cross-section rectangular perimeter less than 50" and no side greater than 16", thickness shall be 0.052.
- b. For sleeve cross-section rectangular perimeter equal to or greater than 50" and 1 or more sides equal to or greater than 16", thickness shall be 0.138".
- c. For fire rated application use pre-manufactured assembly provided with fire-rated sleeve. EZ Path series 33 or 44 or approved equal.

2. Supporting/attachment brackets shall:

- a. Be strut channel anchored to **[wall]** **[floor]**. Unistrut or approved equal

2.9 PULL AND JUNCTION BOXES

- A. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1; galvanized steel
- B. Cast-metal Pull, and Junction Boxes: NEMA FB 1; **[cast aluminum]** **[galvanized, cast iron]** with ground flange, gasketed cover and stainless steel cover screws
- C. Minimum size:
 - a. 4" square by 2.125" deep for use with 1" conduit and smaller
 - b. 4-11/16" square by 2.125" deep for use with 1-1/4" conduit and larger
- D. Maximum size:
 - a. 24" square by 8" deep for collecting multiple 1" station conduit. Sheet Metal Boxes larger than 12" in any direction are required to have a hinged cover or a chain installed between box and cover. Pre-approval by Owner required.
- E. Manufacturers: O-Z/Gedney, Raco, Cooper Crouse-Hinds/Hoffman Enclosures or approved equal. (Field-fabricated boxes are not allowed.)

2.8 RACEWAY PENETRATION SEALS

1. Thru Wall and Floor Seals:
2. Manufacturers:

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New construction – O-Z/Gedney FSK Series
Existing construction – O-Z/Gedney CSM Series
Or approved equals

2.9 EXPANSION FITTINGS

- A. Expansion fittings shall be malleable iron, hot dip galvanized allowing 4" (+/- 2") raceway movement.
1. Manufacturers:
O-Z/Gedney AX Series
Or approved equal

2.10 OUTLET BOXES

A. Wall/Ceiling Outlet Boxes

1. All device boxes for communication systems shall be extra-deep designation.
2. Sheet Metal Outlet Boxes: NEMA OS 1, UL 514A; galvanized steel with stamped knockouts.
3. Concrete Ceiling Boxes: concrete type
4. Cast-Metal Outlet Boxes: NEMA FB 1, [ferrous alloy] [aluminum], Type FD with gasketed cover **[and threaded hubs]**
5. Non-metallic Outlet Boxes: NEMA OS 2
6. Wall-mounted/ceiling-mounted communication boxes concealed within the wall/ceiling shall be a 4-inch by 4-inch box with a minimum depth of 2.125 inches with reducer mud ring. At acoustic tile ceilings boxes shall be mounted flush with the tile.
7. Minimum box size shall be 4-inch by 4-inch with a minimum depth of 2.125 inches. Provide mud rings to match the box size where applicable.
8. Manufacturers:
O-Z/Gedney
Raco; Cooper Crouse-Hinds
Hoffman Enclosures
Or approved equal

B. Outdoor WI-FI Boxes

Coordinate with Section 27 17 53 WI-FI Communications for NEMA 4X box with Seal Tight flexible connection to house WI-FI outlet).

C. Specific-use Wall Outlet Boxes

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For situations where oversized conduit is used so a standard 4x4 box is inadequate for the terminations required, use:

Product:

Hubbell Recessed Wall Mounted Gang – WSCS-MMO-X

Or approved equal

D. In-floor Outlet Boxes

All shared utility floor boxes must be approved by Owner

1. Metal Floor Boxes: NEMA OS1; **[cast metal] [sheet metal]; [fully adjustable] [semi-adjustable]; [rectangular]; [moisture-proof, adjustable, with forged blank cover with each box and close-up covers and/or carpet flanges as required for finished floor.]**
2. Above Grade: Stamped steel, approved for use on above-grade floors, with 4 independent wiring compartments and capacity for up to 4 outlets: 4 communications outlets, 4 power outlets, and/or combination of power and communications. Each compartment will be served by a single conduit, dedicated to the service provided to the identified compartment. Box: fully adjustable providing pre-pour and after-pour adjustment, tunnel compartment, and 2 receptacle brackets. Conduit knockouts total one 1/2", three 1", six 3/4", and six 1-1/4". Comply with UL 514A and UL 514C Scrub Water Exclusion Test for tile, terrazzo, carpet, and wood floors.
3. On Grade: Cast iron, watertight design approved for use in on-grade and above-grade concrete floor applications, with independent wiring compartments and capacity for up to 4 outlets: 4 communications outlets, 4 power outlets, and/or combination of power and communications. Each compartment will be served by a single conduit, dedicated to the service provided to the identified compartment. Box: fully adjustable providing pre-pour and after-pour adjustment, tunnel compartment, and 2 receptacle brackets. Conduit knockouts total four 1" and four 1-1/4". Comply with UL 514A and UL 514C Scrub Water Exclusion Test for tile, terrazzo, carpet, and wood floors.
4. Covers: Activation Covers – die-cast aluminum with textured aluminum finish, and **[black] [brass]** powder-coated paint finishes. Cover: flanged or flangeless, as required, with options for tile or carpet inserts, blank covers, or covers with one or two 1" liquid-tight conduit openings for furniture feed applications.
5. Communication Modules Mounting Accessories

Complete line of faceplates and bezels provided by floor box manufacturer to facilitate mounting of UTP, fiber optic, coaxial, and communication devices. Box shall accommodate workstation connectivity outlets and modular inserts and other system devices.

Products:

WireMold (Co-located Power and Communications)

Wiremold Walkerbox – 880CS2

Wiremold Walkerbox – 524-brass (carpet flange)

Wiremold Walkerbox – 828R (duplex cover plate)

Hubbell (Shared Power and Communications)

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HBLCFB301BASE when not in a concrete slab on earth
HBLAFB301BASE with HBL301401PB pour box when in a concrete slab on earth
Box Cover - Hubbell HBLTCGNT

Or approved equals

6. Fittings For In-floor Outlet Boxes

Assembly comprising service fitting, poke-through component, fire stops and smoke barriers, and junction box for conduit termination.

Products:

Walker-Shared Power and Communications Poke-Thru – RC4 Flush Quad
COM50 (adapter) with (2) 2A-42ATT (jack frames)

Hubbell

Shared Power and Communications Poke-Thru – S1PT4X4AL
[Power ((1) $\frac{3}{4}$ " conduit feed) and Communications ((2) $\frac{3}{4}$ " conduit feeds)]
Dedicated Communications Poke-Thru - S1PTFIT.
Hubbell S1TFCBL (tile assembly cover - black)
Hubbell S1CFCBL (carpet cover – black)

For 2 ea 1" conduit feeds, include Hubbell Sub-Plate - S1SP receive approval from Owner prior to ordering or installation.

Or approved equals

7. Podium Floor Boxes

Provide power/communications in one box and dedicated audiovisual in another box side-by-side with concrete pour boxes as required. Boxes shall meet requirements of in-floor outlet boxes.

Products:

Hubbell (for shared Power and Communications)
HBLCFB301BASE when not in a concrete slab on earth,
Box Cover – Hubbell HBLTCGNT

HBLAFB301BASE with HBL301401PB pour box when in a concrete slab on earth. Box
Cover – Hubbell HBLTCGNT

Hubbell (for co-located Audiovisual)

HBLCFB501BASE when not in a concrete slab on earth. Box Cover – Hubbell
HBLTCGNT

HBLAFB501BASE with HBL501PB pour box when in a concrete slab on earth.
Box Cover - Hubbell HBLTCGNT

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Or approved equals

E. Enclosures

1. Hinged Cover Panel Enclosure

See the Outlet Schedule, and details in drawing set for specific locations related to products used and installation information.

Required Products:

Box: Milbank #12126-LC1 (12"x12" x6" enclosure)

Hinged Cover w/Lock: Milbank #A-LKSFMKEXL

2. Outdoor WI-FI Boxes

Coordinate with Section 27 17 53 WI-FI Communications for NEMA 4X box with Seal Tight flexible connection [to house WI-FI electronics provided by WI-FI subcontractor].

2.11 SURFACE MOUNTED RACEWAY (SMR)

A. General

1. Surface raceway shall be **[metallic][non-metallic]** for **[branch circuits and] [copper fiber]** services.
2. Surface raceway system shall consist of:
 - a. Raceways bases
 - b. Fittings
 - c. Device-mounting plates (activation plates)
3. Lengths of raceways shown on the Drawings are illustrative and diagrammatic only and are not accurate. Raceways shall be provided completely installed to match lengths **[of walls] [of the cabinets and shelving as indicated on [laboratory] casework shop Drawings] [indicated on Drawings]**.
4. Sections of SMR that provide less than the equivalent capacity of a 1-inch conduit shall not be used.
5. All inside and outside bends made using SMR shall accommodate optical fiber manufacturer's bend radius specifications, whether or not the fiber has been specified as part of the cable plant.

B. Fabrication

1. **[Steel] [Aluminum] [Non-metallic]**
Approximately **[XXX"]** wide by **[XXX"]** deep **[size as indicated on plans] [Same size as WireMold Isoduct ALA 4800 Series]**.
2. 2-piece with base and snap on cover:

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3. Base **[single compartment] [2 compartments with [fixed] [moveable] dividers]** and cover plate
4. **[2-compartment raceway with separate cover for each compartment]**
5. Covers with cutouts for device plates as shown on the Drawings
6. Provide 12" sections of cover at "corners".

C. Materials

1. Steel Raceways: Galvanized steel, minimum thickness 0.040"
2. Aluminum Raceways: Alloy 6063-T5 extruded aluminum, minimum thickness 0.060"
3. Non-metallic Raceways: Non-flammable self-extinguishing, tested to UL 94, V-0
4. Fittings: Same material and material thickness as linear raceway components

D. Finishes

1. Steel Raceway:
 - a. Manufacturer's standard [gray] [ivory] [XXX] color]
 - b. [Factory-applied base suitable for field-applied finish]
2. Aluminum Raceways: Satin, No. 204 clear anodized 0.004 inch thick, Class R1 Mil-Spec
3. Non-metallic Raceways: [white] [XXX} color
4. Fittings: Color to match linear raceway components

E. Accessories

1. Fittings: Available as standard accessories, including but not limited to external corner units, internal corner units, blank end units, internal and external elbows, coupling for joining raceway sections, and device-mounting brackets and plates.
2. Wire Clips: 1 for every 2 linear feet of indicated raceway configuration
3. Corner and tee fittings to maintain 2" cable bend radius that meets requirements for communications pathways and specifications for fiber optics and Category 5e cabling.
4. Device-Mounting Brackets and Plates: Plastic device-mounting brackets and trim plates allowing installation of indicated wiring devices, and communications outlets horizontally in raceways; trim cover sized to overlap device cut-out in raceway, concealing seams; finished to match linear raceway components; plastic compatible

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with UL 94; brackets and plates to match raceway width, and with device-mounting holes.

F. Products:

Wiremold

Wiremold V2400 (raceway, covers, and device plates)

Wiremold 3000 (raceway, device plates and covers)
bridge mounting extension bracket #G-3046

Wiremold 4000 (raceway [divided where required] and covers)
device plate (cover and bracket) #G-4007C-1

Wiremold 6000 (raceway [divided where required] and covers)
device plate #G-6007C-1

Isoduct

Isoduct 300

Raceway:	Isoduct AL 3000
Cover:	Isoduct DDC-300T Double Duplex (specify 12"/18" length)
Blank Cover:	Isoduct BC AL3000
End Caps:	Isoduct EC 3000
Slide Connectors:	Isoduct SC 3000
Inside Corner:	Isoduct IC 3000
Outside Corner:	Isoduct OC 3000
Flat Elbow:	Isoduct FE 3000

Isoduct 452

Raceway:	Isoduct AL 4520
Cover:	Isoduct DDC-300T Double Duplex (specify 12"/18" length)
Blank Cover:	Isoduct BC AL4520
End Caps:	Isoduct EC 4520
Slide Connectors:	Isoduct SC 4520
Inside Corner:	Isoduct IC 4520
Outside Corner:	Isoduct OC 4520
Flat Elbow:	Isoduct FE 4520

Panduit

TG70	Raceway base, cover, divider, device bracket
TGECIW	End caps
T70PGIW	Single-gang snap-on device plate
TG70BCIW	Base couplers
T70CCIW	Cover couplers
TGTIW	Tee fittings
TGTD	Tee divider
TGBFIW	Backfeed fitting
TGICIW	Inside corner fitting

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TG70HB3-X	Hanging box with divider
TGRAIW	Right angle fitting
TGEEIW	Entrance end fitting

Or approved equals

2.12 INDOOR SERVICE POLES

- A. Description: Freestanding, [single compartment] [two compartments] utility columns with receptacles for [power branch circuits and] provision for communication outlets.
- B. Materials: Main Body: [Steel] [Aluminum]; cover plates: [single] [cover for each compartment]; [steel] [aluminum] [plastic].
- C. The number of receptacles per length of pole as shown on the Drawings.
- D. Pole cover with [hole-cut provisions for communication outlets] [communication outlets factory mounted].
- E. Accessories: Trim plates for closing ceiling opening; fittings available as standard accessories; foot: suitable for [carpet] [hard surface] [floor finish as indicated on the Drawings]; top clamp: concealed, designed to fasten pole to [inverted "T" grid ceiling suspension member] [cable tray] [telco ladder tray].
- F. Finish: Manufacturer's standard [gray] [ivory] [XXX] color
- G. Products
Wiremold; [XXX];
Or approved equal

2.13 INTERDUCT

- A. Interduct shall be:
 - 1. flexible non-metallic
 - 2. corrugated
 - 3. suitable to the environment in which it is installed
 - 4. [flame-retardant riser rated] [flame-retardant plenum rated]
 - 5. Orange in color.
- B. Products:
ENDOT IPR 100 24 17 07-7500 (1" CMP with tape)
ENDOT IRI 100 24 17 02-7500 (1" CMR with tape)
ENDOT ICE 100 32 21 02-7500 (1" CM with tape)
Or approved equal

2.14 Cable Lubricants

- A. Cable lubricants shall be:

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1. non-injurious to cable jacket and other materials used
2. None hardening nor become an adhesive with age

B. Products:

DYNA – Blue American Polywater (for twisted pair cable)

IDEAL – Optic Lube (for optical fiber cable)

Or Approved Equal

2.15 FIRESTOPPING MATERIALS

A. Firestopping materials shall be:

1. Provide Firestopping that meets all applicable Code requirements to assure a system approach
2. a combination of [manufactured sleeves] [muffins] [caulk/putty] [foam]

B. Manufacturers:

1. STI
2. T&B
3. 3M
4. Or approved equal

2.16 PULL STRINGS

A. Pull strings shall be:

1. a minimum of 3/32-inch diameter
2. a minimum of 200-pound strength
3. polyethylene line

B. Product:

Greenlee – 430

Or approved equal

2.17 Location Tape

A. Location tape shall be:

1. metallic
2. lubricated mule tape with sequential footage markers
3. flat braided nylon

B. Products:

Reef Industries – Sentry Line

Or approved equal

END OF PART 2

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PART 3 EXECUTION

3.1 GENERAL

A. Document Interpretation

The locations of the outlet symbols shown in the Drawings represent a close approximation of the exact location where the outlet shall be installed. This location may be shifted left or right eight inches to allow for stud alignment or coordination with electrical outlet locations. Approval by Owner is required for more extensive adjustments of outlet location.

B. Outlet Schedule... Applies to those projects where an outlet schedule is required and/or provided.

1. Refer to the outlet schedule contained [herein] [on the Drawings sheet XXX] for outlet mounting height, device box size, and station conduit size.
2. In order to reference a particular outlet to the Outlet Schedule, each outlet symbol located on the Drawings is labeled with a unique, 2-part ID number indicating the outlet number within that room. (At times, the outlet symbols may be labeled with only the sequential number if the room number is clearly marked on the drawing.) Outlet labels shall reflect full label code when installed in field.
3. Continuity of Pathway
 - a. Vertical pathway shall be continuous from the MDF to IDF(s) and between IDFs.
 - b. Horizontal (station) pathway shall be continuous between station outlets and the IDF.
 - c. Continuous Pathway shall be, cable tray, conduit or surface mounted raceway. J-hooks are not allowed unless specially approved by UWIT.

3.2 SERVICE INTERRUPTIONS

- A. The Vendor shall be responsible for identifying any possible service interruptions. Coordination with Owner shall be required to develop a plan.
- B. The Vendor shall maintain continuity of existing service in the construction area and for building occupants not otherwise affected by the Project throughout the demolition and construction phases, unless prior arrangements have been negotiated.
- C. The Vendor shall notify the Owner in writing of all copper, fiber optic, and coaxial communications cables (which are serving occupied spaces) that must be relocated. The Vendor shall be responsible for relocating existing cables that are to remain in service after consultation with Owner.
- D. The Vendor shall prevent interruption of service by identifying and providing temporary supports and protection of all existing communications cables, cross-connect blocks, and

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equipment throughout demolition and construction. Coordinate requirements for continuity with UWIT.

- E. Upon disruption of service, the Vendor shall notify the Owner immediately so that a repair crew can be assigned to correct the problem.

3.3 Infrastructure

- A. Vendor shall provide permanent infrastructure to elevator machine room and other building system service locations as required for early service/commissioning during construction (including conduit, cable tray, junction boxes, etc.).

- B. Infrastructure shall meet all requirements for products in this section and shall be coordinated with all electrical requirements.

- C. Installation

Install all components per manufacturer's instructions.

- D. Cable Plant

Station cables as shown on Outlet Schedule shall be installed from the elevator equipment room and other building systems service locations as required back to the nearest IDF/MDF.

- E. Cable Installation

1. Provide metallic grounding conduit clamps to attach conduits to cable tray system.
2. Provide metallic bushings on conduit ends where cables enter conduit to protect insulation.
3. Make multiple drops at ends of sections using manufacturer's prefabricated cable tray dropouts.
4. Strap vertical runs as required to prevent sagging of cables.
5. Provide sufficient slack in cables to allow for unequal expansion coefficients of cable tray and cables.

- F. Activation

Vendor shall arrange with the Owner to provide early service ACTIVATION prior to the earliest Authority Having Jurisdiction inspection or commissioning timeframe.

3.4 MDF/IDF PROVISIONING

Specifier – Include for projects requiring new or renovated MDF/IDF rooms.

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A. General Requirements

1. The Vendor shall refer to the placement of elements within the MDF and/or IDF Rooms as shown on floor plans, elevations, and details for bid purposes only. These placements are suggestive of the design and are meant only to account for the elements to be included.
2. NOTE: Prior to installation, Vendor shall schedule a walk-through with the Owner for final determination of the MDF and/or IDF elements placement.

B. Plywood Backboard

1. Install fire-rated plywood backboards on all walls of the room extending from 1-foot AFF to 9-foot AFF using standard 3/4-inch thick, 4-foot x 8-foot sheets. All sheets shall be installed with the 8-foot dimension vertical.
2. Additional plywood may be required based on final location of conduits and sleeves. (All cable shall be supported vertically and horizontally at every four feet along the path.)
3. Secure plywood to wall with "A" side facing outward at a minimum of each corner and 2-foot on center using 5/8-inch bolts and anchors as required.
4. Plywood shall be void-free and treated with two (2) coats of matte white fire-resistant paint on all exposed backboard surfaces. Tape shall be placed over a minimum of one rating-identifying stamp per sheet prior to painting for inspector verification.
5. At Hinged cover Panel Enclosures that house Fiber F.A. Loop location and at surface mounted 4x4 box locations provide internal Plywood Backboard: 3/4" cut to fit on site by contractor

C. Cable Tray

Specifier – If the Cabling is going to be done through UWIT the MDF/IDF Cable Management Trays will be included with the UWIT Cabling contract and will be "by Owner". These should be shown on the Drawings but marked "By Owner"

1. Install cable tray six inches from the wall.
2. Install cable tray at height AFF as indicated in the project specific scope of work.
3. At a minimum provide the following access for cable tray:
 - a. 12" above top edge of tray
 - b. 18" from face side of tray for minimum of 24 inches parallel with tray
4. Provide full-width dropouts where cable(s) exit from cable tray.

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5. Join cable tray system sections at ends using manufacturer prefabricated splice plates.
6. Support cable tray system with unistrut brackets from wall, mounted to unistrut channel. Unistrut bracket shall be sized to provide 6-inch space between tray and wall. Unistrut channel and bracket shall have a safety factor of 2.5. Provide all-thread support from deck above to outside of channel as required.
7. Cross-section segments may be supported using trapeze supports or side rail hung.
8. Size, anchor, and space supports to sustain weight of cable tray system, cable and unistrut that are to be installed into cable tray, and 200 lbs excess on any individual ladder rung or section, with safety factor of [XXX] minimum when supported as simple span and tested per NEMA requirements. Load and safety factors are applicable to both rung or section and side rails.
9. Calculate supports based on 20 lbs/ft load of cables and tubes.
10. Total vertical tray deflection shall not exceed 1-1/2" between supports.
11. Make intersections, bends, and tees using fittings of same type and model series as straight run sections. All corners shall be installed using manufactured 90-degree sweeps.
12. Cable tray systems shall be electrically continuous.
13. Connect each cable tray system subassembly to building ground system using grounding clamps and grounding conductors. Provide 3.0 Ohm maximum resistance to building ground connection.
14. Copper grounding conductors shall not be terminated on aluminum tray systems.
15. Cable tray shall not be connected to instrumentation grounding system.
16. Structural side members shall not be punched or drilled except for splice-plate and fastener bolt holes. Cable tray system components shall not be flame-cut or arc-cut. Make cuts using a saw. Drill or punch holes for splice-plates and fasteners and remove burrs. Screws or bolts securing splice plates must not include any sharp ends or edges on the inside of the tray.

D. Electrical Outlets

1. All electrical work in this space shall conform to requirements of Division 26.
2. A utility outlet should be located 18-inches AFF aligned below the light switch, if possible. This utility outlet shall be independent from any circuits supplying power to equipment.

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3. At wall mounted applications electrical outlets shall not share the same box. In divided raceway, wherever communications and/or electrical outlets are closely located, they shall not be vertically stacked on top of one another in the raceway.
4. Locate electrical outlets at racks with each receptacle being on a dedicated circuit. Provide 208 L-630R and Duplex 110 5-20R receptacles as required by design.
5. For riser rooms without racks, provide 208 L6-30R and Duplex 110 5-20R receptacles as required by design at 18" AFF at the bottom edge of the back board.
6. Electrical outlet boxes and conduit shall not block or restrict use of the backboards and shall be installed flush in the wall in new construction and where renovation allows. Any exposed conduit shall be tightly routed at the intersection of the back wall and the side walls (above the plywood backboard for horizontal transitions). Faceplates shall be flush with the finished surfaces.
7. Locate electrical outlets in equipment rack vertical wire-management bracket **(vertical wire-management bracket installed by the Vendor)**. Conduit shall terminate at box mounted in wire-management bracket 6" to 12" AFF. Outlets shall face back of equipment rack; coordinate on pre-installation walk-through with UWIT.

Specifier – on those projects where it has been agreed that UWIT will install the racks and wire management trays the following shall replace above the statement of installation by the Vendor:

Ladder tray and equipment racks shall be furnished and installed by Owner.

8. Provide a 208Y/120V panelboard rated at 100 amps fed from the building power system in the MDF. Panelboard shall be equipped with a ground bus with a dedicated equipment grounding conductor back to the electrical service ground bus. This panel provides the power for the MDF and the associated IDF's through the system riser. Coordinate with the power system riser diagrams.

Specifier – Include the above paragraph for new projects, major renovations, building communications upgrades and on projects that require additional electrical panels be added to provide the power required for communications needs.

9. All outlets shall be dedicated circuits with isolated ground. Refer to riser room elevations (and electrical drawings) for dedicated outlet locations.

E. Grounding

Specifier – section E. Grounding shall be included for project that include grounding and the following items shall be modified as required to match scope.

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1. The ground bus bar shall be located on the plywood of the main copper wall field. Coordinate exact placement with Owner.
2. When the resistance to ground is 10 Ohms or less, an additional ground is mandated.
3. A communications system main grounding backbone (MGBB) shall be installed in the MDF and continue up through the vertical riser system. It shall be terminated in each IDF on a ground bus bar.
4. The MGBB shall be a minimum 3/0-AWG 4N-insulated wire, continuous and without splices. It shall be connected at a single point to the ground bus end of the building neutral bonding jumper via a readily accessible connection (NEC 250-53a). If splices are necessary, they shall first be approved by the design engineer, then cad welded. The MGBB shall be bolted to the ground bus bar in each MDF/IDF with a pass-through clamp. The connection between the MGBB and the service entrance equipment shall be such that the resistance measures 5 Ohms or less.
5. The location and installation of the MGBB and bus bars shall conform to NEC requirements. They shall be located at least six inches away from any electrical conductors to minimize induced voltages and routed at edges/corners of backboard to provide the shortest, most direct, continuous path to the ground electrode system.

F. Lighting Fixtures

Specifier – Coordinate with division 26 include only on projects that require new communication rooms or upgrades that include lighting in the MDF & IDF.

1. Lighting fixtures in the MDF Room and in each IDF Room shall be located above the 11-foot level or low profile ceiling-mounted in such a manner as not to block cable tray within the room or conduit penetrations or otherwise interfere with cable routing and equipment installation.
2. The light switch shall be located just inside and to the right of the doorway. When access to the MDF or IDF is possible by more than one set of doors, there shall be a 3-way light switch system located by all doorways.

Specifier – Include "WALL MOUNTED IDF" section when used in project.

3.5 WALL MOUNTED IDF

- A. Mount Cabinet on ACX fire-retardant plywood (3/4-inch thick) with no voids. Board shall minimally provide total coverage for back of cabinet. Back Board shall be painted with two coats of fire resistant, low VOCs, matte white paint.

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- B. Bottom of cabinet shall be 48" AFF +/- 6".
- C. To the side of the cabinet there shall be 30" clear wall area to allow for swing of cabinet on rear hinges.

3.6 WALL MOUNTED EXTERIOR IDF

- A. Mount Cabinet on substrate engineered to carry load of cabinet and contents.
- B. Bottom of cabinet shall be 48" AFF +/- 6".
- C. The cabinet shall be installed allowing space for opening of door and access to equipment.

3.7 COMMUNICATIONS PATHWAYS

A. Outside Plant Pathways

Specifier – Include this section only for projects that have outside or Tunnel Communication's pathway... edit to fit project.

1. Utility Trench

- a. Provide buried PVC conduit in utility trench/tunnel for inter-building pathway. Refer to the Drawings for trench pathway size and conduit quantity.
- b. Provide spacers to support multiple conduits in common path.

Specifier – Provide trench routing and cross section on plan sheets and details

2. Utilidor Provisioning

- a. Provide two stacked ladder trays along utilidor wall below power distribution tray. Communication ladder tray shall be 12 inches below power tray and second communication tray shall be a minimum of 10 inches from bottom of tray above, to top of tray below.
- b. Provide a minimum 6-inch clearance between utilidor wall power and communication tray side-rails for vertical communication cable pathway.

3. Maintenance Holes and Handholes

- a. Handholes shall be located flush in ground and at every 270-degrees of bend or 200-feet of conduit run.
- b. Handholes shall be provided with drains, labeled cover, and all installation hardware.

Specifier – Coordinate installation of maintenance holes and handholes with civil engineer and landscape architect, including requirements for sump pumps if any.

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B. COMMUNICATIONS CABLE TRAY PATHWAYS

1. Mounting

- a. Cable tray shall be mounted or hung in a manner that ensures a 12-inch minimum vertical clearance above and a minimum 18-inch continuous perpendicular clearance along at least one face/side of tray for a minimum of 24" parallel to tray.
- b. When above ceiling, there shall be a 6" clearance between the bottom of the cable tray hangers and removable ceiling tiles.

Where other trades must cross over cable tray, these requirements shall be met. Consult with UWIT prior to installation. UWIT reserves the right to transition to conduit between tray segments where multiple interferences occur.

C. Transition

1. Cable trays shall be mounted between 9- and 10-feet AFF.
2. Provide gradual sloping raceway transition sections where changes in horizontal mounting height are unavoidable. Pathway shall remain contiguous. NO 90-DEGREE TRANSITIONS SHALL BE USED.
3. 90-degree corners are not acceptable. Provide manufactured sweeps.
4. Vertical elbows or transitions are not acceptable.

D. Routing

Cable tray shall be routed so as not to interfere with installation of other systems or access to these systems for maintenance. Coordination with other systems shall be maintained so that where these systems traverse above or below the tray, there shall be direct access and unrestricted clearance 12 inches above and 18 inches perpendicular to one face/side of the tray. Further, a minimum of 2 feet of clearance horizontally parallel along the side of the tray shall be provided to allow working access. Additionally, no systems shall be run parallel beneath the tray restricting access to the ladder rungs.

E. Installation

1. Cable tray shall be installed as a continuous system connected to the building ground in compliance with NEC.
2. When assembling tray, rounded heads of fasteners shall be placed in the interior of the tray.
3. Join cable tray system sections at ends using manufacturer prefabricated splice plates.

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4. Provide prefabricated expansion splice plates at intervals of 48 feet in straight runs and where cable tray systems cross building expansion joints.
5. Provide minimum of one expansion splice plate in straight runs that exceed 12 feet for tray installations in exterior areas.
6. Support cable tray system utilizing trapeze hangers from building or other structural steel members, angle brackets from vertical structural steel members, upright angle brackets on pipe racks, or directly upon horizontal structural steel members of the building or pipe racks. Supports provided for cable trays shall be dedicated to cable trays and shall not be used to support other systems, trades, or disciplines.
7. No support systems for other services shall pass through cable tray rungs, i.e., ceiling grids, sprinklers, etc. The area under the cable tray rungs shall remain unobstructed. No other services shall be routed under the ladder rungs.
8. Size, anchor, and space supports to sustain weight of cable tray system, cable and tubes that are to be installed in cable tray, and 200 lbs excess on any individual ladder rung or section, with safety factor of [XX%] minimum when supported as simple span and tested per NEMA requirements. Load and safety factors are applicable to both rung or section and side rails.
9. Calculate supports based on [XXX] lbs/ft load of cables and tubes.
10. Total vertical tray deflection shall not exceed 1-1/2" between supports.
11. Make intersections, bends, and tees using fittings of same type and model series as straight run sections.
12. Cable tray systems shall be electrically continuous.
13. Connect each cable tray system subassembly to building ground system using grounding clamps and grounding conductors. Provide 3.0 Ohm maximum resistance to building ground connection.
14. Copper grounding conductors shall not be terminated on aluminum tray systems.
15. Cable tray shall not be connected to instrumentation grounding system.
16. Structural side members shall not be punched or drilled except for splice-plate and fastener bolt holes.
17. Cable tray system components shall not be flame-cut or arc-cut. Make cuts using a saw.
18. Drill or punch holes for splice-plates and fasteners and remove burrs. Assure no sharp edges from screws or bolts inside of tray.
19. Provide blind end plates for trays that dead end.
20. Conductor Installation:

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- a. Provide metallic grounding conduit clamps to attach conduits to cable tray system.
- b. Provide bushings on conduit ends where cables enter or exit conduit to protect insulation.
- c. Provide color-coded metallic bushings on station conduit ends entering from other floors for future ease of identification by owner.

21. Make multiple drops at ends of sections using manufacturer prefabricated ladder drops.

F. Conduit Pathways

1. General Coordination

- a. All conduits shall terminate flush to the outside face of the nearest side rail of tray between 6 and 12 inches above top of side rail.
- b. Coordinate size and location of required built-in openings.
- c. Coordinate with Owner for the cutting, removing, or piercing general or mechanical insulation, fire-rated walls, ceilings, or steelwork.
- d. Coordinate sleeve selection and application with selection and application of firestopping specified.
- e. Verify that exterior wall or wet location boxes are gasketed type cast boxes with matching cover.
- f. Verify with manufacturer that "touch-up" paint kit and PVC-coating kit are available for use.

2. Inspection

Inspect surfaces to receive raceways and boxes for compliance with installation tolerances and other conditions affecting performance of raceway's installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

3. Conduit Sizing

- a. All building entrance conduits and vertical/horizontal interconnecting riser conduits and sleeves shall be four inches in diameter.
- b. All station drop conduits to outlet device boxes shall be 1-inch diameter minimum except as specifically shown on the Drawings.
- c. All station drop conduit to SMR shall be minimum 1-1/4-inch diameter.

4. Bends

- a. Conduits of less than 2" in diameter shall maintain a minimum bend of 6 times the interior diameter of the conduit. For conduits of 2" or more in diameter, the minimum bend shall be 10 times the internal diameter of the conduit.

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- b. Install continuous radius sweeps of 45" minimum for 90-degree bend in 4" conduit.
 - c. No 90-degree fittings shall be used.
 - d. Maximum of 3 bends allowed without pull box.
 - e. Maximum for any one bend shall not exceed 90 degrees.
 - f. Maximum total bends shall not exceed 270 degrees.
5. Conduit Application
- a. FLEXIBLE CONDUIT is not allowed.
 - b. Raceway uses permitted and not permitted per NFPA 70 requirements and as described below.
 - c. Rigid Metal Conduit (RMC) permitted to be installed as follows:
 - 1) Installations below grade and in or under concrete slabs
 - 2) All locations except corrosive atmospheres
 - 3) Hazardous locations
 - 4) Locations requiring mechanical protection.
 - d. Electrical Metallic Tubing (EMT) permitted to be installed as follows:
 - 1) Interior partitions
 - 2) Above suspended ceilings
 - 3) In concrete slabs
 - 4) Six feet AFF in exposed areas of mechanical equipment rooms
 - 5) Sizes 1" and smaller except as approved.
 - e. PVC-coated Conduit permitted to be installed as follows:
 - 1) In corrosive atmosphere **as noted on plans**
 - 2) In exterior environments needing additional protection
 - 3) Use PVC-coated elbows
 - f. Rigid Non-metallic Conduit (RNC) permitted to be installed as follows:
 - 1) Direct burial, concrete encased.
 - 2) Direct burial, in sand fill on bottom and top
 - 3) Corrosive atmospheres
 - 4) Use steel elbow in concrete-encased runs.
 - g. Stainless Steel Conduit: Use exposed stainless steel conduit in GMP Clean Room or Wash-Down environments.

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6. Installation Requirements

- a. Comply with ANSI/NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on the Drawings or in this Section are stricter.
- b. Raceway routing is shown in approximate locations, unless dimensioned. Complete raceway installation before starting cable installation.
- c. Do not cluster raceway. 3 x 3 patterns or greater are not permitted as this blocks access to interiorly located conduit once cable is pulled.
- d. Keep raceways at least 12" away from parallel runs of flues and steam or hot water pipes or ductwork. Install raceways level and square and at proper elevations. Do not block access to junction boxes, mechanical equipment, or prevent removal of ceiling panels, etc.
- e. Run raceways concealed in construction to avoid adverse conditions such as heat and moisture, to permit drainage, and to avoid materials and equipment of other trades, except where noted otherwise.
- f. Avoid exposed raceway runs. Run raceways exposed where it is impractical or impossible to conceal or where specific approval is obtained. Run exposed raceways grouped and parallel or perpendicular to construction. Do not route exposed raceways over boilers or other high-temperature machinery or in contact with such equipment. Offset exposed raceways at boxes.
- g. Cut raceways square using a saw or pipe cutter.
- h. Use hydraulic one-shot raceway bender or factory elbows for bends in raceway larger than 2", unless sweep elbows are required. Bend raceways according to manufacturer's recommendations. Do not use torches or open flame to aid in bend of PVC conduit.
- i. Use raceway fittings compatible with raceways and suitable for use and environment.
- j. Raceway supports for horizontal or vertical single runs: Hot dipped galvanized heavy-duty sheet steel straps, mineralac clamps, or steel slotted support channel system with appropriate components.
- k. Raceway supports for horizontal and vertical multiple runs:
 - 1) Trapeze-type supports fabricated with steel slotted channel systems with appropriate components
 - 2) Support horizontal runs with appropriately sized rods
 - 3) Anchor vertical runs to structure
 - 4) Vertical raceway runs 2 inches and larger passing through floors shall be supported at each floor with pipe riser clamps.
 - 5) Do not support raceways with wire, perforated pipe straps, or plastic tie-wrap. Remove wires used for temporary support

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- l. Arrange raceway supports to prevent misalignment during wiring installation.
 - m. Ground raceways.
 - n. Install PVC-coated raceways in areas with corrosive atmosphere [as noted on plans].
 - o. Install stainless steel raceway clamps, mounting hardware, supports, hangers, etc., when located in “wet” or wash-down areas, per NFPA 70.
 - p. Minimum station communications raceway size shall be 1 inch unless otherwise noted on the Drawings.
 - q. Install one raceway from each communications box. Horizontal raceway runs between wall boxes are not allowed.
 - r. Install flush two-gang box with 4 x 4 plaster ring for each communications outlet.
 - s. Do not install continuous sections longer than 100 ft without prior approval of UWIT.
 - t. When terminated in a pull box, conduit shall be reamed and bushed. When terminated at the inside of a building wall, the conduit shall have a smooth, bell-shaped finish unless it extends further into the building space or area. The conduit sleeve shall be securely fastened to the building.
7. Penetrations
- a. Vertical riser conduit/sleeves between floors shall be “stacked” (i.e., aligned vertically from floor to floor). Coordinate riser penetrations with UWIT prior to installation. They shall be located on the side wall of the space, most often to the right of the main copper blackboard wall. They shall be clustered as close to the wall as possible and out of the way of foot traffic.
 - b. Conduits not extending to a box or tray shall not extend more than 3” into a room (spare conduits/sleeves).
 - c. Height to Enter: When horizontal conduit/sleeves penetrate into room between 1-1/2 – 3 feet above cable tray, extend conduit no more than 3” into room.
 - d. When horizontal conduit/sleeves penetrate into room higher than 3 feet above cable tray, provide turn down to terminate conduit between 1-1/2 – 3 feet above top edge of tray.
 - e. When vertical conduit/sleeves penetrate into room through ceiling, extend conduits to within 1-1/2 – 3 feet above top edge of tray.
 - f. When vertical conduit/sleeves penetrate vertically up through floor, they shall stop 4” AFF.

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- g. All penetrations shall be fire rated and sealed regardless of building construction code.
 - h. Conduits entering building from the exterior shall be sloped to assure moisture does not drain into building.
8. Conduit Through Wall
- a. Arrange raceways to maintain headroom and present a neat appearance.
 - b. Secure raceways in metal stud walls, to prevent rattling.
9. Conduit Through Ceiling
- a. Route raceways installed above accessible ceilings parallel or perpendicular to construction.
 - b. Independently support or attach raceway system to structural parts of construction. Suspended ceiling systems shall not be considered as structural parts of construction for raceway support. Do not attach raceways to piping system.
10. Conduit In Floor. Do not install raceways in structural or topping floor slabs, except where noted on plans. Install raceway in structural or topping floor slabs, where noted on plans, as follows:

Specifier – Include this section for construction that will have raceways embedded in structural floors or construction with topping slabs.

- a. Center raceways in structural slabs clear of reinforcing steel, except where crossing same, and spaced on centers equal to or exceeding 3 times the raceway diameter. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement. Space raceways laterally to prevent voids in concrete.
- b. Do not install raceways in topping slabs of 2 inches or less.
- c. Outside diameter of raceway shall not exceed 1/3 the structural slab thickness.
- d. Obtain approval from Structural Engineer for each run of raceway 1-1/4 inch or larger in slab.
- e. Locate raceways to avoid conflict with equipment, door bucks, partitions, and other equipment bolted to floor.

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- f. Arrange stub-ups so curved portions of bends are not visible above the finished slab. Install with an adjustable top or coupling threaded inside for plugs. Conduits (including bushing) shall terminate at 4" above finished floor.
- g. Transition from non-metallic conduit to RMC or IMC before rising above floor.
- h. Install watertight seals in interior of raceways passing through building roof, ground floor slab (when raceway does not extend beyond building footprint), or through outside walls of building above or below grade. Seal on end inside building, using raceway sealing fittings manufactured for purpose. Locate fittings at suitable accessible locations. For concealed raceways, install each fitting in flush steel box with blank cover plate to match finish or adjacent plates or surfaces.
- i. Seal raceways entering or passing through areas that are "hazardous (classified) areas" as defined in NFPA 70.

11. Sleeves

- a. Coordinate sleeve selection and application with selection and application of firestopping specified. All sleeves in the MDF and the IDF's shall be fire rated and sealed regardless of building code requirements.
- b. Concrete Slabs and Walls: Install sleeves for all penetrations, where core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- c. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- d. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- e. Size pipe sleeves to provide 1/4" annular clear space between sleeve and raceway unless sleeve seal is to be installed [or unless seismic criteria require different clearance].
- f. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- g. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint.
- h. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with firestopping specification.

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- i. Install listed watertight seals to prevent passage of moisture and water vapor through raceway, where raceway passes from interior to exterior of building, where raceway passes between areas of different temperatures such as into or out of cold rooms or freezers, where raceway enters room that at any time is low or high temperature room and where raceway enters room that at any time is subject to internal air pressures above or below normal.
 - j. Above Ground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve sizes to allow for 1" annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - k. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1" annular clear space between raceway and sleeve for installing mechanical sleeve seals.
12. Unused Sleeves
- Thread and cap.
13. Raceway Seismic Restraints
- a. Avoid raceway runs crossing building seismic joints. Use flexible connections where crossings cannot be avoided.
 - b. Install rigid bracing and lateral restraints for suspended raceway and boxes runs per requirements of seismic anchorage and restraint.
 - c. Install flexible connections for bonding, grounding, and sleeves where crossing seismic restraints.
14. Associated Components
- a. Bushings
 - 1) Provide bushings on all raceways.
 - 2) Provide conduit dropout manufactured bushings for all backbone and horizontal cabling exiting 2- or 4-inch conduits to cable tray.
 - 3) Bushings for in-floor outlets shall be color coded to distinguish the floor the cable is served from (same floor IDF) .
 - b. Bonding

Use UL-listed metallic grounding clamps when terminating raceway to ladder tray.
 - c. Pull Lines

Polyethylene pull line shall be installed in all raceway and conduit runs and secured at each end, prior to installation of cable. Polyethylene pull line shall be

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installed in all raceway and conduit when cable is installed. Secure pull line at each end.

d. Fire Stopping

Specifier – Modify item 1) to include coordination with the general specification section that addresses fire stopping for the project.

- 1) **Coordinate with Specification Section XXXXXX, XXXXXX,** Fire stopping can be a combination of “manufacture sleeves, muffins, caulk/putty foam or other approved methods.
- 2) During the final review and inspection period but prior to substantial completion, all sleeves passing through floors, roofs, and exterior walls shall be filled with approved fire-stop material in accordance with NEC 300-21. All firewall penetrations shall likewise be filled with suitable fire-stop material. Unused sleeves shall be capped or grouted.
- 3) All horizontal and vertical penetrations into MDF or IDF shall be firestopped regardless of building code requirements.
- 4) In situations where cable tray, conduit, or sleeves extend outside the construction area into occupied portions of the building, they shall be firestopped in accordance with NEC throughout the duration of the Project.

e. Labeling

All station drop conduits shall be permanently marked with an outlet ID including room number at the tray, & pull boxes. Conduits entering Communication Closets shall be permanently marked with the destination of the conduit. (i.e. pull box in room xxx, cable tray in corridor xxxx, ect.)

f. Pull Boxes and Junction Boxes

- 1) Install as shown, or as necessary to facilitate pulling of cable and to limit number of bends. Install above accessible ceilings and in unfinished areas.
- 2) Drawings do not necessarily show every pull or junction box required. Requirements for additional boxes shall be approved by UWIT prior to installation.
- 3) Preapproval by Owner and the A&E is required for installation of intermediate junction boxes or pull boxes. These boxes shall be noted on the Vendor’s Field Drawings/Shop Drawings.
- 4) Size pull boxes to NEC. No pull box shall be greater than 24”x24”x8” without prior approval of the owner.

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- 5) Pull boxes shall be installed in public permanently accessible areas 10 feet to center of box AFF. Provide 30-inch clearance in front of the pull box for maintenance and pull space. The location of each box shall be clearly marked on the Field Drawings.
- 6) Do not intermix cable types in same junction box or pull box unless shown or specifically authorized otherwise.
- 7) Install boxes to be permanently accessible.
- 8) For outlet boxes shown in ceiling, faceplate shall be flush below ceiling or removable tile.
- 9) Adjust box location up to [10] [XXXX] ft or within same room whichever is more restrictive prior to rough-in to accommodate intended purpose. For greater variances obtain approval of the Owner.
- 10) Conduits entering or leaving pull boxes or outlet device boxes shall be aligned in the body of the box, unless noted otherwise on the Drawings. Where multiple conduits penetrate into one side of pull box, conduits shall be evenly spaced and centered in the body.

G. Outlet Box Installation

1. Outlet Box Mounting

- a. Station cable boxes shall be double gang regardless of cable count or cable type.
- b. Height: Unless noted otherwise in the Outlet Schedule, all communication outlet boxes shall be installed at the same height as electrical outlets, except wall-mounted telephone outlets, which shall be installed at 48 inches AFF to center of box.
- c. Co-located Spacing: All wall-mounted phone outlets shall have 6" centerline clearance from all adjacencies to provide for mounting phone units.
- d. Install boxes to accommodate device indicated by symbol, in conformance with code requirements and consistent with type of construction.
- e. Install the appropriate cover on all outlet boxes.
- f. Set front edge of device boxes flush with the finished surfaces except on walls of non-combustible materials where the boxes may have maximum set back of 1/4". Secure flush-mounted box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- g. Set outlet boxes parallel to construction and independently attached to same.
- h. Do not install back-to-back and through-the-wall boxes. Install with minimum 6" horizontal separation between closest edges of the boxes. Install with minimum 24" separation in acoustic-rated walls.

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- i. Outlet boxes for communications at walls shall be in a separate box from electrical outlets.
 - j. Box Support:
 - 1) Mount boxes straight.
 - 2) Install stud support one side, with short piece of stud, for up to 2 gang device boxes.
 - 3) Do not support boxes with tie-wire.
 - 4) For one- and two-gang box support, manufactured bracket supports shall be accepted alternate.
 - 5) Support boxes independently of raceways.
 - 6) Install adjustable steel channel fasteners for hung ceiling outlet box.
 - 7) Install stamped steel bridges to fasten flush-mounted outlet box between studs.
 - 8) Do not install boxes to ceiling support wires or other piping systems.
 - k. Mount boxes in block walls at block joint nearest to the indicated height.
 - l. Recessed Boxes in Masonry Walls: Saw cut opening for box in center of cell of masonry block, and install box flush with surface of wall.
 - m. When boxes are installed in fire-resistive walls and partitions, provide 24" horizontal separation between boxes on opposite sides of a wall. In addition, limit penetrations to 16 square inches per penetration and not to exceed a total of 100 square inches per 100 square feet of wall area. **Apply fire stop putty or muffins acceptable to the authority having jurisdiction (AHJ).**
2. Underfloor Outlet Boxes
- a. Position box so closed lid shall be flush with finished surface. Adjust flush-mounted boxes pre-pour and after-pour to be flush with finished materials.
 - b. Allow sufficient clearance between co-located boxes to accommodate installation of box flange and cover plates.
 - c. When boxes are closely co-located, conform to UL spacing requirements.
3. Podium Floor Boxes
- a. Carefully coordinate placement of conduit to both line up with the knockouts dedicated for communications and power versus audiovisual and to function under the custom-built podium.
 - b. Position box so closed lid shall be flush with finished surface. Adjust flush-mounted boxes pre-pour and after-pour to be flush with finished materials.
 - c. Use cast floor pour boxes for installations in slab-on-grade.

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- d. Install floor boxes and fittings to preserve fire-resistant rating of slabs and other elements, using materials and methods specified for fire-stopping.
4. Outlet Boxes and Mudrings – Finish Work
 - a. Care shall be exercised during mounting of outlet boxes to ensure that the mudring face shall be flush with the surface of the finished wall and “square” with the floor. All joint compounds shall be wiped clean while soft so as not to cover mounting holes in the mudring or box.
- H. Enclosures
1. Hinged Cover Panel Enclosure
 - a. Enclosures shall be located in serviceable location within 10’ of data collection controller.
- I. Surface Mounted Raceway (SMR)
1. SMR Feed
 - a. Communications SMR shall NOT be installed through walls.
 - b. In divided SMR, the upper channel is reserved for communications cable and the lower channel for electrical wiring.
 - c. Conduit connections to SMR shall be provided by an intermediate 4-inch by 4-inch junction box installed within the wall aligned horizontally behind the communications channel of the SMR. Install box at center of raceway and as directed on the Drawings.
 - d. No 90-degree junctions may be used. Factory-manufactured curves are required for these transitions.
 - e. Install in accordance with ANSI/NECA 1 and manufacturer’s instructions.
 - f. Install communications outlets of type, quantity, and spacing as indicated on the Drawings.
 - g. Mount raceways on wall [and on casework] parallel to or at right angles to structure [and casework].
 - h. Feed raceways mounted on walls above casework or on modular casework from backbox through wall box connector. Determine point of feed in field.
 2. SMR Device Plates and Covers
 - a. Communication service shall be TOP channel of divided raceway.

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- b. In divided raceway, wherever communications and/or electrical outlets are closely co-located, a minimum of 2 inches of horizontal separation between device plates for electrical service and communications service shall be provided to accommodate faceplates.
 - c. In divided raceway, wherever communications and electrical outlets are closely located, they shall not be vertically stacked on top of one another in the raceway.
 - d. The SMR front cover shall be cut and installed in a manner that provides a short (12-inch) fixed section of cover where the end of an SMR segment abuts a wall, corner, structural deviation, etc.
- J. Indoor Service Poles
- 1. Install wiring devices and communications outlets of type, quantity, and spacing as indicated on the Drawings.
 - 2. Maintain ground continuity throughout entire pole length per grounding requirements.
 - 3. Identify communication outlets per departmental requirements.
 - 4. Neatly cut openings in ceiling panels. Install trim plate.

END OF PART 3