

28 May, 2024

Addendum 5

Columbus County 911 Center

The following addendum shall supersede previous information and does hereby become part of the contract documents.

- Bid Clarification:
UPS-1:
GE Model# TLE 150 UL S1 UNINTERRUPTIBLE POWER SUPPLY
150KW
480/277 3PH INPUT
Unit shall be rated for critical applications.
Install per code/Owner requirements. Provide Owner training or approved equal. Provide full shop drawings for Engineer/Architect approval.
- Doors 108A and 108B are not required to be Level 4 doors. Door 118A is not required to be a Level 4 door. Doors 121A and 121B are required to be Level 4 doors and frames.
- To help clear up some questions see attached spec sections.
 - 271116
 - 270500
 - 270526
 - 270528
 - 271000

End of Addendum 5

SECTION 271116 - EQUIPMENT ROOMS AND FITTINGS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 SUMMARY

- A. The Work of this Section includes all labor, materials, and equipment to provide the communications system components stated below:
 - 1. Cabinets, racks, frames and enclosures
 - 2. Cable-management hardware

1.3 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Section 260500 – Common Work Results – Electrical
- C. Section 270500 – Common Work Results – Communications
- D. Section 270526 – Grounding and Bonding for Communications Systems
- E. Section 271000 – Structured Cable System

1.4 CODES, STANDARDS AND DOCUMENTS

- A. Contractor shall comply with the most recent edition of the (latest revision) referenced Codes and Standards, unless otherwise noted.
 - 1. Motorola R56® – Standards and Guidelines for Communications Sites
 - 2. Harris Site Grounding and Lighting Protection Guidelines
 - 3. National Fire Protection Association (NFPA) 70 – National Electrical Code (NEC)
 - 4. American National Standards Institute/Telecommunications Industry Association (ANSI/TIA)-568-E – Series - Commercial Building Cabling Standards
 - 5. TIA-569-E – Commercial Building Standard for Telecommunications Pathways and Spaces
 - 6. ANSI/TIA-606-C – Administration Standard for the Telecommunications Infrastructure of Commercial Buildings

7. ANSI/TIA-607-D – Generic Telecommunications Grounding (Earthing) and Bonding for Customer Premises
8. ANSI/TIA-942-B – Telecommunications Infrastructure Standard for Data Centers
9. Building Industries Consulting Services, International (BICSI) Telecommunications Distribution Methods Manual (TDMM), latest edition
10. ANSI/BICSI-002-2019 – Data Center Design and Implementation Best Practices

1.5 SUBMITTALS

- A. All submittals shall be submitted for review and approval in accordance with the Division 1 Requirements.
- B. Contractors shall submit data for each product specified in this Section.
- C. Contractor shall submit qualifications for the Contractor's supervisor/foreman responsible for the installation of the structured cabling and grounding systems.

1.6 COORDINATION

- A. Contractor shall coordinate with the General Contractor the exact location of the cabinets, racks and enclosures relative to the system layout in the main equipment room.
- B. Contractor shall coordinate the layout of telecommunications equipment, hardware, and raceways, as well as the work of other trades, in the telecommunications rooms prior to rough-in.

1.7 QUALITY ASSURANCE

- A. The Contractor shall adhere to the quality assurance (QA) requirements as defined in the Division 1 Requirements, as follows:
 1. All products shall be Listed for the specific application intended as part of this Work.
 2. All products shall be Listed and Labeled by Underwriters Laboratories (UL) or another nationally recognized test laboratory (NRTL).
 3. At a minimum, the Contractor's supervisor/foreman responsible for the installation of the Work of this Section, shall be trained by the manufacturer for installation of the products installed as part of the Work.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. All products shall be delivered to the site in the original manufacturer's packaging, distributor's packaging or other packaging suitable for protection of the materials.
- B. All products stored offsite and onsite shall be maintained in a manner to protect the materials from weather, corrosion, or damage.

- C. All products shall be stored in a secure location under the direct control of the Contractor.
- D. All products shall be handled as recommended by the Manufacturer.
- E. Any products exhibiting evidence of damage, corrosion, or defect shall be removed from site and replaced at no additional cost to Owner.

PART 2 – PRODUCTS

2.1 DESIGN BASIS MANUFACTURERS

- A. Products from the following manufacturers generally conform to the specific design basis for the Work. Subject to product compliance with the requirements of the Construction Documents, acceptable manufacturers include, but are not limited to:
 - 1. American Power Conversion (APC)
 - 2. Chatsworth Products Incorporated (CPI)
 - 3. Cooper/B-Line
 - 4. Middle Atlantic Products
 - 5. Great Lakes Case and Cabinet
- B. All products provided as part of this Work shall be Listed for their intended use by a NRTL.
- C. All products shall be Listed for their specific types, sizes, and combinations of conductors and connected items.

2.2 Overhead Cable Runway (Ladder Runway)

- A. Design basis product: Chatsworth Products, Inc., UL Listed cable runway and accessories, or approved equal.
- B. Contractor shall provide cable runway mounted six inches above racks in telecommunications rooms, as indicated on the Drawings and as specified herein.
- C. Dimensions: 18-inches wide x 9 feet 8-1/2-inches long sections.
- D. Material: Steel.
- E. Construction: Tube steel rungs welded to tube steel side rails.
- F. Side rail dimensions: 1-1/2 inch x 3/8 inch x 0.65 inch tube.
- G. Rung dimensions: 1/2 inch x 1 inch x 0.65 inch tube.

- H. Rung spacing: 9 inches.
- I. Color: Black chem film.
- J. UL Classified for use as an equipment grounding conductor.
- K. Install a dedicated support structure for the cable tray and/or ladder runway.
 - 1. Do not attach directly to the cabinets, racks, etc.
 - 2. Do not attach power receptacles directly cable tray or ladder runways. Power required a dedicated means of support, separate from the communications cable support system.
- L. Contractor shall provide all mounting, bonding, and grounding hardware, including, but not limited to:
 - 1. "Waterfall" cable entries into all racks/cabinets
 - 2. Runway mounting turns and corners
 - 3. Runway mounting angles
 - 4. Runway splice kits
 - 5. Grounding system bonding jumpers (with two-hole compression lugs and antioxidant) on both sides of every splice.

2.3 EQUIPMENT CABINETS, FLOOR MOUNT

- A. Design basis product: Middle Atlantic MRK Series enclosure or approved equal.
- B. Cabinet dimensions (min.): 84 inches high x 24 inches wide x 42 inches deep, nominal, use 96 inches high where ceiling height allows. Keep all cabinets from the same manufacturer and product group for consistency.
- C. Frame material: 1/8-inch thick structural steel.
- D. Provide with:
 - 1. Vertical bonding bus bars
 - 2. Vertical cable management, both sides, both front and rear.
 - 3. Horizontal pass-through between cabinets/racks
 - 4. Ganging hardware.
 - 5. Managed and metered power distribution units (PDUs), two per rack/cabinet. Coordinate with electrical contractor for twist-lock UPS power feed into PDUs.
- E. Mounting rails:

1. Two sets of mounting rails per cabinet, front and rear, fully adjustable front to rear.
 2. Additional mid-rack vertical mounting rails for center hung equipment.
 3. Full height of useable space
 4. Mounting holes: #10/32 tapped screws and cage-nuts.
 5. Electronic Industries Alliance (EIA)-310-D universal mounting hole spacing: 5/8-inch, 5/8 inch, 1/2 inch
 6. Material: Tapped rail, 11-gauge steel
- F. Top panel:
1. Solid with knockouts for cable pathways
 2. Material: 18-gauge steel
 3. Color: Black powder or epoxy coat
- G. Side panels:
1. Solid
 2. Material: 20-gauge steel
 3. Color: Black powder or epoxy coat
- H. Front door:
1. Full-width front door
 2. Locking handle
 3. Perforated
 4. Perforated area: 60 percent
 5. Material: 18-gauge steel
 6. Color: Black powder or epoxy coat
- I. Rear door:
1. Half-width split rear doors
 2. Locking handle
 3. Perforated
 4. Perforated area: 60 percent
 5. Material: 18-gauge steel
 6. Color: Black powder or epoxy coat

- J. Provide two (2) vertical patch cord management units, with front and rear channels, from top to bottom of each cabinet/rack.
 - 1. Use standard of 6" on server cabinets (or at end of rows) and 10" on cabling cabinets (or between cabinets mid-row).
 - 2. Color: Black powder or epoxy coat
- K. Provide each cabinet with two (2) vertical power distribution units (power strips).
 - 1. Minimum of 12 National Electrical Manufacturers (NEMA) 5-20R receptacles.
 - 2. Plug strips shall be monitored and controlled by BAS or DCIM system, include network ports and control software for Owner use.
 - 3. Receptacles spaced for installation of wall-mount transformers.
 - 4. Power strips shall be connected to separate UPS circuits using a twist-lock plug NEMA L5-20P with 6-foot cord (min.).
 - 5. Ground PDUs to the single point grounding system.
- L. Provide a cabinet Rack Bonding Bar (RBB) in each cabinet.
 - 1. Material: 110 alloy copper
 - 2. Minimum Dimensions: 3/16 inches thick x 72 inches high x 3/4 inch wide
 - 3. Use two-hole (preferred) or one-hole (acceptable) grounding lugs on all bonding connections.
 - 4. Lug mounting holes:
 - a. Each shall be 1/4-inch tapped lug holes spaced to maximize equipment bonding conductor quantities.
 - b. Two (2) pairs of SS studs or holes sized to accommodate 5/16-inch SS hardware, on 3/4 or 1-inch centers.
- M. Provide bonding jumpers to bond the cabinet frame, doors, side panels, top, mounting rails, cable management, etc., to ground as a single assembly.
- N. Provide keyed locks on all cabinets.
 - 1. All doors and panels shall be keyed alike
 - 2. Coordinate exact requirements for cabinet keying with the Owner's information technology (IT) department prior to placing orders
- O. Finish: Black powder or epoxy coat.
- P. Accessories:
 - 1. Leveling feet (all cabinets)
 - 2. Rack shelves, fixed, one-per cabinet/ rack.

3. #10-32 mounting screws, 100 pieces

2.4 EQUIPMENT CABINETS, WALL MOUNT

- A. Design basis product: Middle Atlantic CWR Series cabling wall-mount rack or approved equal.
- B. Three-section wall-mount cabinet.
- C. Solid front door.
- D. Solid center section with louvered/vented side panels.
- E. Solid rear section with knock outs for conduits.
- F. Locking front door and center cabinet section.
- G. Left- or right-hand swing.
- H. Cabinet dimensions: 48 inches high (min.) x 24 inches wide x 32 inches deep, nominal.
- I. Material: 16-gauge steel.
- J. Solid front door.
- K. Ventilated sides.
- L. Mounting rails:
 1. 11-gauge steel
 2. Tapped 12-24 mounting holes
 3. Universal EIA-310 spacing
- M. Weight Capacity: 250 pounds.
- N. Provide with:
 1. Bonding bus bars
 2. Vertical cable management, front and rear.
 3. Horizontal managed and metered power distribution units (PDUs), two per rack/cabinet. Coordinate with electrical contractor for twist-lock UPS power feed into PDUs.
- O. Provide a cabinet horizontal RBB in each cabinet.
 1. Material: 110 alloy copper

2. Dimensions: 3/16 inch thick x 3/4-inch high x 19 inches wide, minimum.
3. Provide isolation mounts for the ground bus
4. Lug mounting holes:
 - a. ¼-inch tapped lug holes spaced to maximize equipment bonding conductor quantities.
 - b. Two (2) pairs of 5/16-inch diameter holes, on 3/4-inch centers. SS studs or holes sized to accommodate 5/16-inch SS hardware, on ¾ or 1-inch centers.
 - c. The RBB shall be mounted on insulators to provide separation between dissimilar metals.

- P. Provide each cabinet with two (2) horizontal power distribution units (power strips).
- Q. Minimum of six (6) NEMA 5-20R receptacles per power strip.
- R. Power strips shall be connected to separate UPS circuits using a twist-lock plug NEMA L5-20P with 6 foot cord (min.).
- S. Receptacles spaced for installation of wall-mount transformers.
- T. Provide bonding jumpers to bond the cabinet frame, doors, etc. to the grounding system as a single assembly.
- U. Provide keyed locks on all cabinets.
 1. All doors and panels shall be keyed alike
- V. Finish: Black powder or epoxy coat.
- W. Accessories: #12-24 mounting screws, 24 pieces minimum.

2.5 EQUIPMENT 4-POST RELAY RACKS, FLOOR MOUNT

- A. Design basis product: CPI Adjustable Rail QuadraRack and ServerRack or approved equal.
- B. Rack dimensions (min.): 84 inches high x 35.4 inches wide x 41.3 inches deep, nominally use 96 inches high where ceiling height allows. Keep all racks from the same manufacturer and product group for consistency.
- C. Frame material: Steel.
 1. Mounting holes: #10/32 tapped screws and cage-nuts.
 2. Electronic Industries Alliance (EIA)-310-D universal mounting hole spacing: 5/8 inch, 5/8 inch, 1/2 inch
- D. Color: Black

- E. Provide with:
 - 1. Vertical bonding bus bars
 - 2. Vertical cable management, both sides, both front and rear.
 - 3. Horizontal pass-through between cabinets/racks
 - 4. Ganging hardware.
 - 5. Managed and metered power distribution units (PDUs), two per rack/cabinet.
- F. Top rails: Two sets of vertical mounting rails, front and rear, plus an additional vertical set of adjustable rails for mid mounted equipment.
- G. Provide two (2) vertical patch cord management units, with front and rear channels, from top to bottom of each rack.
 - 1. Use standard of 6" on server cabinets (or at end of rows) and 10" on cabling cabinets (or between cabinets mid-row).
 - 2. Color: Black powder or epoxy coat
 - 3. Rack shelves, fixed, one-per rack
 - 4. #10-32 mounting screws and cage-nuts, 100 pieces of each
- H. Provide each rack with two (2) vertical power distribution units (power strips).
 - 1. Minimum of 12 National Electrical Manufacturers (NEMA) 5-20R receptacles
 - 2. Plug strips shall be monitored and controlled by BAS or DCIM system.
 - 3. Receptacles spaced for installation of wall-mount transformers.
 - 4. Power strips shall be connected to separate UPS circuits using a twist-lock plug NEMA L5-20P with 6-foot cord (min.). Provide mounting hardware for power strips that does not block any of the rack mounting space or threaded holes.
- I. Provide a cabinet Rack Bonding Bar (RBB) in each rack.
 - 1. Material: 110 alloy copper
 - 2. Minimum Dimensions: 3/16 inches thick x 72 inches high x 3/4 inch wide
 - 3. Use two-hole (preferred) or one-hole (acceptable) grounding lugs on all bonding connections.
 - 4. Lug mounting holes:
 - d. Each shall be 1/4-inch tapped lug holes spaced to maximize equipment bonding conductor quantities.
 - e. Two (2) pairs of SS studs or holes sized to accommodate 5/16-inch SS hardware, on 3/4 or 1-inch centers.
- J. Provide bonding jumper to bond the rack frame to ground as a single assembly.

2.6 EQUIPMENT RELAY RACKS, FLOOR MOUNT

- K. Design basis product: CPI Standard 6" D 2-post Relay Rack or approved equal.
- L. Rack dimensions (min.): 84 inches high (min.) x 20.5 inches wide x 18 inches deep, nominal, use 96 inches high where ceiling height allows. Keep all racks from the same manufacturer and product group for consistency.
- M. Frame material: High Strength Aluminum.
 - 1. Mounting holes: #10/32 tapped
 - 2. Electronic Industries Alliance (EIA)-310-D universal mounting hole spacing: 5/8 inch, 5/8 inch, 1/2 inch
- N. Color: Black
- O. Provide with:
 - 1. Bonding bus bars
 - 2. Front and rear vertical cable management, on both sides
 - 3. Managed and metered power distribution units (PDUs), two per rack.
- P. Top rails: Two sets of top angles rails per rack, front and rear.
- Q. Provide two (2) vertical patch cord management units, with front and rear channels, from top to bottom of each rack.
 - 1. Use standard of 6" on server cabinets (or at end of rows) and 10" on cabling cabinets (or between cabinets mid-row).
 - 2. Color: Black powder or epoxy coat
 - 3. Rack shelves, fixed, one-per rack
 - 4. #10-32 mounting screws, 100 pieces
- R. Provide each rack with two (2) vertical power distribution units (power strips).
 - 1. Minimum of 12 National Electrical Manufacturers (NEMA) 5-20R receptacles
 - 2. Plug strips shall be monitored and controlled by BAS or DCIM system.
 - 3. Receptacles spaced for installation of wall-mount transformers.
 - 4. Power strips shall be connected to separate UPS circuits using a twist-lock plug NEMA L5-20P with 6-foot cord (min.). Provide mounting hardware for power strips that does not block any of the rack mounting space or threaded holes.

- S. Provide a cabinet Rack Bonding Bar (RBB) in each rack.
 - 1. Material: 110 alloy copper
 - 2. Minimum Dimensions: 3/16 inches thick x 72 inches high x 3/4 inch wide
 - 3. Use two-hole (preferred) or one-hole (acceptable) grounding lugs on all bonding connections.
 - 4. Lug mounting holes:
 - f. Each shall be ¼-inch tapped lug holes spaced to maximize equipment bonding conductor quantities.
 - g. Two (2) pairs of SS studs or holes sized to accommodate 5/16-inch SS hardware, on ¾ or 1-inch centers.
- T. Provide bonding jumper to bond the rack frame to ground as a single assembly.

2.7 HORIZONTAL CABLE MANAGERS

- A. Design basis product: CPI Universal Horizontal Cable Manager or approved equal.
- B. Provide 1RU and 2RU horizontal cable managers above, below, and between patch panels and equipment, and as indicated on the drawings.
- C. Dimensions:
 - 1. 1RU: 19 inches x 1.75 inches x 21.23 inches
 - 2. 2RU: 19 inches x 3.5 inches x 21.23 inches
- D. 1.75-inch management finger spacing.
- E. Removable 180-degree hinged covers.
- F. Materials: UL 94V-O plastic.
- G. Color: Black.

2.8 TOP AND BOTTOM JUMPER CABLE MANAGERS

- A. Design basis product: CPI upper and lower jumper trays, or approved equal.
- B. Provide upper and lower jumper trays at the top and bottom of each rack, and as indicated on the drawings.
- C. Dimensions:
 - 1. Upper tray: 19 inches x 4 inches x 6 inches
 - 2. Lower tray: 19 inches x 4 inches x 3.5 inches

D. Material: Aluminum or steel.

E. Color: Black.

2.9 BACKBOARDS

A. Contractor shall provide plywood backboards on all walls of telecommunications rooms, and as otherwise indicated on the drawings.

B. Material: 8-foot x 4-foot x 3/4-inch, fire-retardant plywood.

C. Grade: C or better.

D. Construction: 3-5 layer, alternating grain, laminated.

E. Contractor shall paint all sides of plywood with white fire-retardant paint prior to installation.

F. Contractor shall paint the exposed faces of the plywood with one additional coat of white fire-retardant paint after plywood is installed.

PART 3 – EXECUTION

3.1 INSTALLATION – GENERAL

A. All products and materials shall be installed as recommended by the manufacturer.

B. All work shall be installed as shown on the drawings and as specified herein, unless otherwise approved by the System Designer.

C. The Contractor shall bond all metal and metallic materials in each space to the telecommunications ground bus bar in the respective telecommunications and equipment rooms.

1. Remove any paint, coatings, or finishes in the areas of grounding and bonding connections as required to make and maintain a ground connection. Apply the proper antioxidant between all metal to metal bonds.

2. Where possible, order equipment with designated grounding connections, masked to avoid any paint, coating, or finish material.

3.2 CABLE RUNWAY

A. A cable runway shall be installed over all racks and to provide a pathway from the racks to the conduits and conduit sleeves exiting the telecommunications room.

- B. Vertical sections of cable runway shall be installed from the conduit sleeves through the floor up to the overhead cable runway.
- C. Cable runway shall be supported to the top of each rack with a 6-inch stand-off bracket. Coordinate with power, HVAC, fire suppression, and lighting.
- D. The Contractor shall coordinate placement of the cable runway with lighting, sprinkler heads, smoke detectors, access panels, HVAC duct work, and like equipment and maintenance accesses in each telecommunications room.
- E. The cable ladder shall be attached to walls and floors with mounting feet with 3/8-inch mounting hardware.

3.3 EQUIPMENT CABINETS/ RACKS

- A. Equipment cabinets/ racks shall be assembled using all of the hardware provided by the manufacturer. Cable entry points shall be provided with plinths, grommets, etc. to maintain proper air flow and physically protect cables.
- B. Equipment cabinets/ racks shall be set and leveled with leveling feet.
- C. The Contractor shall attach each equipment cabinet/ rack to the floor using 3/8-inch hardware, minimum.
- D. The Contractor shall coordinate the quantity and placement of floor access for each cabinet with the floor installer.
- E. All accessories shall be installed in accordance with the manufacturer's installation and assembly instructions.
- F. Vertical cable managers shall be installed at the front and rear, and on both sides, of each cabinet/ rack.
- G. The Contractor shall coordinate the placement of the mounting rails with the depth of the equipment, cable management, and equipment to be provided by the Owner. Adjust the mounting rails as required to accommodate cable and cord installation, routing, and management in each cabinet.
- H. The Contractor shall provide knock outs and grommets for cable pathways between cabinets, with separator panels, as coordinated with the Owner.
- I. A cabinet ground bus shall be installed on each equipment cabinet/ rack. Equipment cabinets/ racks served from overhead shall have the vertical RBB.
- J. Each cabinet/ rack shall be bonded to the telecommunications ground bus in the telecommunications room with #2 AWG (American wire gauge) green insulated

stranded copper wire (minimum), size per Motorola R56, Table 5-3, based on distance.

- K. All metal and metallic components of each rack/cabinet shall be bonded to form a single grounded assembly for connection to the ground bus and telecommunications room ground.
- L. The Contractor shall turn over all keys to all cabinets to the Owner.
- M. All airflow management equipment and devices shall be installed in coordination with, and in cooperation with, the installation of equipment by the Owner.
- N. The Contractor may, at its option, stage the racks/cabinets at its facility for the purpose of installing and configuring equipment. The Contractor shall assume full responsibility for all furnished materials from the time the Contractor takes possession until the time that the work is accepted by the Owner.

3.4 VERTICAL CABLE-MANAGEMENT HARDWARE

- A. The Contractor shall attach vertical cable-management hardware to cabinets and racks through all mounting holes provided on the hardware.
- B. Cable spools, guides, and brackets shall be installed as required to properly support the installed cables.
- C. The Contractor shall dress and attach installed cables to vertical cable-management hardware with 1/2-inch-wide, hook-and-loop-style fasteners (e.g., Velcro) or other approved material.
- D. Patch cords and equipment cords in the vertical cable managers shall be dressed in a neat and orderly manner.
 - 1. Provide drip loops where appropriate
 - 2. Store cable slack throughout the vertical cable managers to avoid congestion and unmanageable cable bundles
 - 3. Do not tie or secure patch cords in vertical cable managers
- E. Cables and cord slack shall be dressed and stored in vertical cable managers in a manner that allows the covers to be closed without forcing the cover closed or pinching protruding cable/cord.

3.5 BACKBOARDS

- A. The Contractor shall attach plywood backboards over gypsum wall board, concrete, or masonry structure with mounting hardware suitable to the mounting surface, without causing cracking or damage to the plywood edges.

- B. Plywood backboards shall be installed corner to corner on specified walls of each telecommunications room.
- C. Plywood backboards shall be installed at the locations shown on the walls of equipment rooms.
- D. Plywood shall be installed starting at 12-inch AFF and extending up to 108-inch AFF.
- E. Plywood may be installed vertically or horizontally.
- F. For installation on gypsum wall board, each full sheet of plywood shall be attached to a minimum of three studs, and at a maximum of 24-inch intervals in the horizontal and vertical directions, and along the edges.
- G. For installation on masonry or concrete walls, each full sheet of plywood shall be attached at a maximum of 24-inch intervals in the horizontal and vertical directions, and along the edges.

END OF SECTION

SECTION 270500 - COMMON WORK RESULTS – COMMUNICATIONS

PART 1 - GENERAL

1.1. GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2. SUMMARY

- A. The Work of this Section includes all labor, materials and equipment to provide the following Communications System components:
 - 1. Utility Services Coordination
 - 2. Interior Pathways and Interior Pathway Coordination
 - 3. Exterior Pathways and Exterior Pathway Coordination
 - 4. Testing
 - 5. Vibration and Seismic Controls
 - 6. Identification and Documentation

1.3. RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Contractor shall comply with the most recent edition of the referenced Codes and Standards, unless noted otherwise.
- C. Harris Site Grounding and Lightning Protection Guidelines
- D. Motorola R56 – Standards and Guidelines for Communications Sites, latest issue
- E. NFPA 70 National Electrical Code
- F. ANSI/TIA-568-E - Series - Generic Telecommunications Cabling for Customer Premises
- G. ANSI/TIA 569-E Telecommunications Pathways and Spaces
- H. ANSI/TIA-606-C Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
- I. ANSI/TIA-607-D Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.
- J. ANSI/TIA-942-B Telecommunications Infrastructure Standard for Data Centers
- K. ANSI/BICSI-002-2019 – Data Center Design and Implementation Best Practices

- L. BICSI Telecommunications Distribution Methods Manual (TDMM), most recent issue.
- M. Section 260500 Common Work Results for Electrical Work
- N. Section 260526 Grounding and Bonding
- O. Section 260533 Raceways and Boxes for Electrical Systems
- P. Section 262726 Wiring Devices and Wall Plates
- Q. Section 270526 Grounding and Bonding for Communications Systems
- R. Section 270508 Pathway for Communications Systems
- S. Section 271000 Structured Cable System
- T. Section 271116 Equipment Rooms and Fittings - Communications

1.4. SUBMITTALS

- A. Submit product specification sheets for review and approval in accordance with the Division 01 Requirements.
- B. Submit product data for each product specified in this Section.
- C. Submit qualifications for the Contractor's Supervisor/Foreman responsible for installation of the communications cable system.
- D. Submit samples for review and approval in accordance with Division 1 Requirements.
- E. Submit certificates of calibration for all test equipment.

1.5. COORDINATION

- A. Coordinate exact requirements for Utility raceway and hand-hole installation with all Service Providers prior to start of installation.
- B. Coordinate all raceway locations at utility poles and utility vaults with all Service Providers prior to start of installation.
- C. Coordinate specific marking and tagging requirements for utility service entrance raceways with all Service Providers prior to start of installation.
- D. Coordinate the location of all building entrance raceways with the General Contractor prior to start of installation.
- E. Coordinate the location of all outlets with the Architect, End Users and the work of other trades prior to the start of rough-in.
 - 1. Contractor shall be especially careful in coordinating rough-ins for outlets and boxes feeding modular furniture systems.
 - 2. Outlets and boxes feeding modular furniture systems shall not be blocked by the modular furniture system after furniture installation.

- F. Coordinate the location and elevation of the transmission line entry port system(s) with the General Contractor prior to the General Contractor ordering precast structures for the MDF / Server Room (Radio Room) or prior to the start of masonry work, as applicable.
- G. Coordinate final labeling and identification system with End Users prior to start of rough-in.

1.6. QUALITY ASSURANCE

- A. Quality assurance requirements as defined in Division 01 requirements and as follows:
 - 1. All products shall be Listed for the specific application intended as part of this Work.
 - 2. All products shall be Listed and Labeled by UL or another Nationally Recognized Test Laboratory (NRTL).
- B. At a minimum, the Contractor's Supervisor/Foreman, responsible for this installation of the Work of this Section shall be trained by the manufacturer for installation of the products installed as part of the Work.
- C. Installations shall comply with the requirements of the standards listed above.

1.7. DELIVERY, STORAGE AND HANDLING

- A. All products shall be delivered to site in the original manufacturer's packaging, distributors packaging or other packaging suitable for protection of the materials.
- B. All products stored off-site and on-site shall be maintained in manner to protect the materials from weather, corrosion or damage.
- C. All products shall be stored in a secure location under the direct control of the Contractor.
- D. All products shall be handled as recommended by the Manufacturer.
- E. Any products exhibiting evidence of damage, corrosion or defect shall be removed from site and replaced at no additional cost to the End Users.

1.8. TRAINING (NOT USED)

1.9. AS-BUILT RECORD DOCUMENTS

- A. Following completion of the installation and as otherwise noted, provide a complete set of as-built documents including, but not limited to the following:
 - 1. Complete Record Drawings: Showing locations, size, length, pathway, and configuration of all components, devices and equipment.
 - a. Detailed as-built locations of outlets and equipment
 - b. Detailed labeling of all outlets, patch panels, and cables
 - c. Detailed wiring diagrams of all installed systems
 - d. Typical wiring diagrams of Category Rated cable system components
 - e. Detail fire rating and weatherproof rating for each cable type

2. Final Inspection and Test Report:
 - a. Detail test procedure used.
 - b. Test equipment calibration report
 - c. Record of any failed tests and corrective action taken.
 - d. Final test reports

1.10. WARRANTY

- A. Provide a warranty as required by Division 01 and as indicated herein.
- B. Provide a minimum 20-year extended performance warranty on all Category Rated cable infrastructure provided as part of this project.
- C. Provide a minimum 15-year extended component warranty on all structured cable system components not covered under the system performance warranty.

1.11. MAINTENANCE SERVICES (NOT USED)

1.12. SPARE PARTS (NOT USED)

1.13. DESIGN BASIS MANUFACTURERS

- A. Products from the following manufacturers generally conform to the specific design basis for the Work. Subject to product compliance with the requirements of the Construction Documents, acceptable Manufacturer's include, but are not limited to:
 1. Hubbell Electrical
 2. Leviton
 3. Panduit
 4. Carlon Industries
 5. DuraLine
 6. Endot Industries
 7. Chatsworth Products, Inc. (CPI)
 8. Rittal
 9. Cooper/B-Line
 10. Hoffman Enclosures
 11. Hammond Manufacturing
 12. Brady
 13. Tech Products, Inc.

- B. All products provided as part of this Work shall be Listed for their intended use by a Nationally Recognized Testing Laboratory (NRTL).

1.14. UTILITY SERVICE ENTRANCE PATHWAYS

- A. Contractor shall provide Schedule 40 raceways from the utility pole to the building entrance facility as indicated on the Drawings.
- B. Contractor shall provide raceways and hand-holes for utility service entrances as indicated on the Drawings, as required to maintain bends between pull points to 270 degrees or less, and as required to maintain a maximum pull length of 600 feet.
- C. All PVC raceways shall be provided with RMC conduit and swept 90 degree bends at utility poles, building entrance locations and where entering the building through the slab.
- D. All bends in metal conduits shall be made with the largest bending shoe available.
- E. All bends in non-metallic conduit shall be made with a box heater and swept to as large a radius as possible for the bend.
- F. Factory made elbows shall not be used.
- G. Conduit bodies (such as LBs) shall not be used.
- H. Conduits under paved parking, driveway, and roadway surfaces shall be concrete encased.

1.15. EXTERIOR PATHWAYS

- A. Conduit
 - 1. Contractor shall provide Schedule 40 raceways for exterior pathways as indicated on the Drawings.
 - 2. Raceways shall be provided as required in this Section.
 - 3. Contractor shall provide raceways and hand-holes for exterior pathways as indicated on the Drawings, as required to maintain bends between pull points to 180 degrees or less, and as required to maintain a maximum pull length of 600 feet.
 - 4. All PVC raceways shall be provided with RMC conduit and swept 90 degree bends at utility poles, building entrance locations and where entering the building through the slab.
 - 5. All bends in metal conduits shall be made with the largest bending shoe available.
 - 6. All bends in non-metallic conduit shall be made with a box heater and swept to as large a radius as possible for the bend.
 - 7. Factory made elbows shall not be used.
 - 8. Conduit bodies (such as LBs) shall not be used.

9. Conduits under paved parking, driveways, and roadway surfaces shall be concrete encased.

B. Innerduct

1. Design Basis Product: Carlon Industries or approved equal.
2. Contractor shall provide outside plant rated innerduct in exterior conduits as shown on the Drawings and as otherwise indicated in the Documents.
3. Material: High density polyethylene (HDPE)
4. Dimensions: Sizes indicated on the drawings indicate the minimum inside diameter of the innerduct to be provided.
5. Construction:
6. Exterior Wall: Smooth
7. Interior Wall: Ribbed
8. Provide factory installed 1200 lb. tensile braided pull tape in each innerduct, tie off at both ends of innerduct for future use.
9. Provide factory installed permanent silicone lubricant in all innerducts.
10. Innerduct sizes and quantities shall be as indicated on drawings.

C. Exterior Pedestal Enclosure

1. Design Basis Product: Hoffman ComLine NEMA Type 4x enclosure or approved equal.
2. For installation on a pipe/pole mount pedestal support.
3. Material:
4. Body: 0.080 in. thick Type 5052-H32 aluminum
5. Cover: 0.080 in. thick Type 5052-H32 aluminum
6. Dimensions: 24 inches high x 24 inches wide x 8 inches deep, nominal
7. Construction: Welded joints, ground smooth.
8. Solid cover, hinged along the side edge.
9. NEMA 4X rating
10. Weather tight gasketed cover.
11. Color: Light gray
12. Provide with key lock latching cover.
13. Provide with padlock kit.
14. Provide with internal panel.
15. Motorola R56 compliant secondary ground bus (SBB)

16. Provide with a solar shield top.
17. Provide with pole mount bracket
18. Provide a concrete embedded, concrete filled 4" RMC base mounting pole.
19. Provide the enclosure with a heater and thermostat
 - a. Design Basis Products:
 - i. Heater: Hoffman/McLean Semiconductor Heater or approved equal.
 - b. 30 Watt, 1.2A, 120VAC
 - i. Thermostat: Hoffman Electronic Hygrotherm, or approved equal.
 - c. Low temperature set point at 50 degrees Fahrenheit
 - d. High humidity set point at 65 percent Relative Humidity
20. Provide with other accessories as required and as indicated on the Drawings.
21. Provide with electrical receptacles as shown on the Drawings.
22. Provide with a custom wire or metal bracket to support optical fiber converters and fiber splice trays as shown on the Drawings. Optical fiber converters will be furnished by the End Users.
 - a. The custom bracket shall be fabricated to mount the optical fiber converters as indicated on the drawings.
 - b. The design basis optical fiber converter has the following dimensions: 3-7/8 inch wide x 3-1/2 inch wide x 1 inch deep as shown on the drawings.
 - c. Sufficient space shall be included in the box to house a End Users provided power strip and four power supplies.
 - i. The individual power supplies are: 1-3/4 inches wide x 2-3/4 inches high x 1-1/4" deep.
23. Modify the enclosure to accept a NEMA 4X connector access panel mounted to the face of the box.
24. Coordinate exact placement of boxes and conduits with the General contractor prior to rough-in.
25. Provide with other accessories as required and as indicated on the Drawings.

1.16. INTERIOR PATHWAYS

- A. Conduit raceways for telecommunications outlets shall be as specified in Section 260533.13 Conduits, Section 260533.16 Boxes, and as specified in this Section. Unless noted otherwise:
 1. Conduit raceways for telecommunications outlets to receive Category 6A cables shall be 1-1/4"C minimum.

2. Conduit raceways for telecommunications outlets to receive Category 6 or lower cable shall be 1”C minimum.
3. Conduit raceways for A/V outlets shall be 1-1/4”C minimum.
4. Conduit raceways for CATV outlets shall be 1”C minimum.

B. Cable Tray

1. Design Basis Product: Cooper B-Line FlexTray Series or approved equal.
2. For installation as the primary telecommunications cable support system above accessible ceilings and below accessible floors.
3. Material: 0.196” (5mm) minimum diameter steel wire.
4. Construction: Welded on 2” x 4” intersections.
5. Finish: Zinc plated.
6. Provide in 4-inch tray depths as indicated on the Drawings.
7. Provide in 22-inch cable tray widths as indicated on the Drawings.
8. Provide with trapeze type hanger bars for installation above accessible ceilings. Center hung supports will not be accepted.
9. Provide with stands, cantilever stands, under-floor stands and pedestal clamp support systems for installation below accessible floors.
10. Provide with minimum 3/8” threaded rods, bolts and hardware for attaching overhead cable tray to building structure.
11. Provide with u-channel supports as required to span supports under duct work and similar obstructions. Cable tray supported from duct work or the work of other trades will not be accepted.
12. Make all field cuts, bends, transitions and junctions to maintain:
 - a. A 24” minimum inside bend radius at changes in direction for cable trays 12” wide and wider above accessible ceiling.
 - b. A 12” minimum inside bend radius at changes in direction for 6-inch cable trays above accessible ceiling.
13. Cable trays below access floor shall be installed with square corners and flexible radius shields to maintain minimum cable bend radius around corners.
14. Provide with all tray section splices, mounting hardware, fasteners, anchors, etc. for a complete installation.
15. Provide with radius cable dropouts (waterfalls) between non-continuous sections of cable tray at vertical transitions, and at each communications cabinet or rack.
16. Provide with bonding straps between non continuous sections of cable tray.
17. Provide with cable tray label holder for mounting warning labels on cable tray.

18. Provide each cable tray wall penetration with acoustic batting, completely filling all voids and gaps in the penetration.

C. J-Hooks

1. Not for use for communications and signaling wiring in Communications Center, per NFPA 1221, Section 5.5.
2. Design Basis Product: Erico Caddy CatLinks Wide Base J-Hooks, or approved equal
3. Designed for support of both Category 6 and Category 6A and higher cables.
4. Construction: Galvanized steel
5. Provide 1-inch, 2-inch, 3-inch and 4-inch J-hooks as required by cable quantity.
6. Wire bail to hold cables in J-hooks after installation.
7. Provide with hook trees, mounting brackets, threaded rod, and accessories for a complete installation.
8. J-Hooks shall be installed at random intervals approximately 48" apart.
9. Do not bundle more than 24 UTP cables together when PoE will be used.
10. Provide J-hooks as required to maintain the maximum cable fill as follows:
 - a. 1" J-hook: 7 cables
 - b. 2" J-hook: 24 cables

D. Telecommunications Outlet Boxes

1. Boxes for telecommunications outlets shall be as specified in this section.
2. Unless noted otherwise, boxes for telecommunications wall, ceiling and above ceiling outlets to receive Category 6A cables shall be 5" x 5" x 2-3/4", minimum.
3. Unless noted otherwise, boxes for telecommunications wall, ceiling and above ceiling outlets to receive only Category 6 or lower cable shall be 4-11/16" x 4-11/16" x 2-1/8", minimum.
4. Unless noted otherwise, boxes for audio/video (A/V) devices shall be 6" x 6" x 3-1/2", minimum.
5. Masonry boxes shall not be used for telecommunications and A/V outlets unless approved in advance by the Design Team.
6. The termination chamber for telecommunications outlets in in-slab boxes, poke-through boxes and raised access floor boxes shall provide a minimum of 50 cubic inches of space behind the device plate for every four telecommunications cables to be installed in the box.

7. Above ceiling mount outlet boxes shall be mounted to building structure with angle brackets and beam clamps or other demountable attachment method to allow for relocation of outlet.
8. Ceiling mount outlet boxes shall be mounted to accessible ceiling grid or GWB ceiling supports with tile bridges or as approved for box, device and equipment support.

E. Interior Wall Mount Enclosures

1. Design Basis Product: Hoffman or approved equal.
2. For housing optical fiber converters, fiber cable terminations, media connections and audio multi-box connections.
3. Material:
 - a. Body: 16 gauge steel
 - b. Cover; 16 gauge steel
4. Dimensions: 36 inches high x 24 inches wide x 8 inches deep, nominal
5. Solid cover, modified to mount front panel audio and video connectors
6. NEMA 1 rated
7. Color: As directed by Architect.
 - a. Baked powder coat or epoxy paint.
 - b. Enclosure cover shall be painted after all front panel modifications.
8. Provide with key lock, hinged latching cover.
9. Provide with internal panel.
10. Motorola R56 compliant secondary ground bus (SBB)
11. Provide with other accessories as required and as indicated on the Drawings.
12. Provide with electrical receptacles as shown on the Drawings.
13. Provide with a custom wire or metal brackets to support optical fiber converters and fiber splice trays as shown on the Drawings. Optical fiber converters will be furnished by the End Users.
 - a. The custom brackets shall be fabricated to mount the optical fiber converters as indicated on the drawings.
 - b. The design basis optical fiber converter has the following dimensions: 3-7/8 inch wide x 3-1/2 inch wide x 1 inch deep as shown on the drawings.
 - c. Sufficient space shall be included in the box to house a End Users provided power strip and four power supplies.

- i. The individual power supplies are: 1-3/4 inches wide x 2-3/4 inches high x 1-1/4" deep.
14. Provide single mode angled polished fiber connectors spliced to the installed fiber cables.
15. Coordinate exact placement of boxes and conduits with the General contractor prior to rough-in.
16. Coordinate exact configuration of panel mount connectors, mounting brackets, power supplies and equipment with the End Users prior to fabrication and assembly.

1.17. SEISMIC AND VIBRATION CONTROLS

- A. Contractor shall provide bracing and support structures for telecommunications cabinets, racks, raceways and equipment in accordance with Section addressing Seismic Controls for Electrical Work.

1.18. IDENTIFICATION AND DOCUMENTATION

A. Detectable Warning Tape

1. Contractor shall provide detectable warning tape at 12 inches below finished grade above all conduits for telecommunications cables and direct buried telecommunications cables.
2. Provide warning tape as specified in Telecommunications Outside Plant, and as specified in this Section.
3. Warning tape installed above communications cables and conduits shall be orange.
4. Text: "Warning: Underground Communications Lines", or as approved.

B. Cable Labels

1. Interior Cable Labels

- a. Contractor shall provide permanent machine printed labels on all interior cables.
- b. Material: Polyester
- c. Configuration: Self laminating, white field, clear laminate.
- d. Size: One inch wide field, minimum
- e. Lettering: 1/8" high, Arial or similar non-serif font.
- f. Text: Cable identification as indicated on Drawings and as coordinated with End Users.

2. Exterior Cable Labels

- a. Provide permanent embossed or molded labels on all exterior cables.

- b. Material: UV stabilized polyolefin plastic or as approved
- c. Size: 1.5 inch high individual alpha-numeric symbols
- d. Lettering: 1 inch high, injection molded
- e. Color:
 - i. Black on orange field – general communications
 - ii. Black on orange field - multimode fiber
 - iii. Black on yellow field – single mode fiber
- f. Text: Cable identification as indicated on Drawings and as coordinated with End Users.
- g. Provide with poly tag holders of sufficient length to hold all identification characters.
- h. Attach to cables with UV stabilized cable ties rated for use in outside plant applications or stainless-steel straps.

C. Cable Warning Labels

1. Provide cable warning labels at building entrances and in all hand holes.

2. Communications Cable Labels

- a. Material: UV stabilized polyolefin plastic or as approved
- b. Size: 2 inch x 4 inch, minimum
- c. Lettering: ½ inch high, injected molded or embossed
- d. Color: Black on orange field
- e. Text: “Caution: Telecommunications Cable”, or as approved

3. Fiber Optic Cable Labels

- a. Material: UV stabilized polyolefin plastic or as approved
- b. Size: 2 inch x 4 inch, minimum
- c. Lettering: ½ inch high, injected molded or embossed
- d. Color:
 - i. Multimode Fiber Cable: Black on orange field
 - ii. Singlemode Fiber Cable: Black on yellow field
- e. Text: “Caution: Fiber Optic Cable”, or as approved
- f. Attach to cables with UV stabilized cable ties rated for use in outside plant applications or stainless-steel straps

D. Cabinet and Rack Labels

1. Provide non-conductive laminated plastic engraved labels to identify all cabinets, racks, consolidation points and wireless access point locations.
2. Material: Two layer laminate, white lettering on black field, unless noted otherwise.
3. Size: 1" high x 4" wide, minimum
4. Lettering: ½" engraved, unless noted otherwise.
5. Text: In accordance with the approved labeling scheme, as indicated on Drawings and as coordinated with End Users.
6. Label Location: Upper left hand corner of front face of cabinet or rack as coordinated with End Users, and as otherwise noted.
7. Attach to cabinet or rack with screws or permanent double sided transfer adhesive suitable for the mounting surface.
8. Refer to Section 271000, Structured Cable System for label placement for consolidation points and wireless access point outlets.

E. Cable Tray Labels

1. Provide machine printed cable tray labels at 10 foot intervals on all cable tray and runway.
2. Material: Adhesive backed poly or embossed poly material.
3. Size: Two inches high x 12" inch length, minimum
4. Lettering: Minimum ½" high lettering, machine printed or embossed
5. Text: "Warning: Do not use as walkway, ladder or support for personnel. Use only as mechanical support for cables, tubing and raceways."
6. Attach to cable tray and runway with permanent adhesive, cable ties or stainless-steel straps.

F. Outlet Labels

1. Contractor shall provide machine printed labels on the faceplates of all telecommunications outlets.
2. Material: Adhesive backed polyester, or as approved.
3. Size: ¾ inch high x 1 inch wide, nominal, as required by outlet type.
4. Lettering: 1/8" high, Arial or similar non-serif font.
5. Text: Outlet identification as indicated on Drawings and as coordinated with End Users.
6. Label Location: As indicated on the Drawings.
7. Attach to faceplate with adhesive backing.

8. Legibly write the outlet identification inside the faceplate with indelible permanent marker.

G. Conduit Labels

1. Contractor shall clearly mark all conduits with the respective outlet number or from/to designation within six inches of the conduit termination or connection point.
2. Conduits above accessible ceilings and in equipment rooms shall be clearly marked with an indelible permanent marker or machine printed label.
3. Conduits in exposed areas shall be marked with a machine printed label.

PART 2. - PRODUCTS

2.1. UTILITY SERVICES ENTRANCE RACEWAYS

- A. Utility service entrance raceways, hand holes, manholes, etc. shall be installed in strict compliance to the Service Provider's requirements.
- B. Coordinate exact requirements for utility service entrance raceways with individual service providers.
- C. Installation shall be as specified as follows:
 1. Conduit bodies shall not be installed in conduit runs for telecommunications utility service entrance cables. Provide properly sized pull boxes at locations require the use of a conduit body for pulling cable. Pull boxes shall be sized to support cable minimum bend radius in accordance with the telecommunications service provider requirements.
 2. Conduits for telecommunications utility service cables shall be installed so that not more than 2 quarter bends (180 degrees) between pull points.
 3. Conduits for telecommunications utility service entrance conduits shall be turned up at utility pole locations in rigid steel conduit (RGS) to a minimum of three feet above finished grade.
 4. Rod, swab and perform a mandrel test on all exterior conduits following backfill and concrete encasement to verify that the conduit has not been damaged during installation. Remove and replace any conduits exhibiting damage at no additional cost to the Owner or End Users.
 5. Install temporary caps on all exterior conduits to prevent ingress of water and foreign materials after mandrel testing and before installation of innerducts and cables.
 6. Provide a 1200 lb. test pull tape in each telecommunications conduit and innerduct.
 - a. Pull tapes shall not be installed with cables.

- b. Contractor shall remove pull tapes from conduits after cable installation, fish or rod the conduit/duct and install a new pull tape after all cables are installed.
7. Seal all conduits and raceways penetrations with duct seal (outside conduits) and mechanical duct plugs (inside conduits).
 - a. Size duct plugs for proper seal around installed cables.
 - b. Coordinate installed cable sizes with service providers.
8. Provide firestop systems around all pathways through and floor wall penetrations in all fire rated structures.
9. Provide sealed fire stop systems at all pathways through wall and floor penetrations in the equipment room and all spaces equipped with a clean agent fire suppression system.
 - a. All penetrations entering or exiting a space with a clean agent fire suppression system shall be through conduit or a conduit sleeve.
 - b. All penetrations shall be sealed with a UL listed fire stop system.
 - c. Conduits and sleeves exiting the space shall be sealed externally at the penetration and internally at the conduit termination.
 - d. All innerducts and sub-ducts shall be sealed externally at the penetration and internally at the cable exit.
 - e. Conduit, conduit sleeve and innerduct seals shall form a cold smoke seal as well as a fire-resistant seal.
 - f. Coordinate the exact requirements for sealing conduit and cable penetrations with the Contractor responsible for the clean agent fire suppression system.
10. Bond all metal raceways to ground at utility poles, hand holes, manholes and at building entrances and other locations as required by Code and Sections 260526 and 270526 for Grounding and Bonding.

2.2. EXTERIOR PATHWAYS

- A. Installation shall be as specified as follows:
 1. Conduit bodies shall not be installed in conduits to contain telecommunications cables (fiber, category rated, coax). Provide properly sized pull boxes at locations require the use of a conduit body for pulling cable. Pull boxes shall be sized to support cable minimum bend radius of the largest cable to be installed.
 2. Conduits for telecommunications cables shall be installed so that not more than 2 quarter bends (180 degrees) between pull points.

3. Conduits for telecommunications utility service entrance conduits shall be turned up at utility pole locations in rigid steel conduit (RGS) to a minimum of three feet above finished grade.
4. Rod, swab and perform a mandrel test on all exterior conduits following backfill and concrete encasement to verify that the conduit has not been damaged during installation. Remove and replace any conduits exhibiting damage at no additional cost to the Owner or End Users.
5. Install temporary caps on all exterior conduits to prevent ingress of water and foreign materials after mandrel testing and before installation of innerducts and cables.
6. Provide a 1200 lb. test pull tape in each telecommunications conduit and innerduct.
 - a. Pull tapes shall not be installed with cables.
 - b. Contractor shall remove pull tapes from conduits after cable installation, fish-tape or rod the conduit/duct and install a new pull tape after all cables are installed.
7. Seal all conduits and raceways penetrations with duct seal (outside conduits) and mechanical duct plugs (inside conduits).
 - a. Size duct plugs for proper seal around installed cables.
8. Provide firestop systems around all pathways through floor and wall penetrations in all fire rated structures.
9. Provide sealed fire stop systems at all pathways through wall and floor penetrations in the equipment room and all spaces equipped with a clean agent fire suppression system.
 - a. All penetrations entering or exiting a space with a clean agent fire suppression system shall be through conduit or a conduit sleeve.
 - b. All penetrations shall be sealed with a UL listed fire stop system.
 - c. Conduits and sleeves exiting the space shall be sealed externally at the penetration and internally at the conduit termination.
 - d. All innerducts and sub-ducts shall be sealed externally at the penetration and internally at the cable exit.
 - e. Conduit, conduit sleeve and innerduct seals shall form a cold smoke seal as well as a fire-resistant seal.
 - f. Coordinate the exact requirements for sealing conduit and cable penetrations with the Contractor responsible for the clean agent fire suppression system.

10. Bond all metal raceways to ground at hand holes, manholes and at building entrances and other locations as required by Code and Sections 260526 and 270526 for Grounding and Bonding.

2.3. INTERIOR PATHWAYS

- A. Installation shall be as specified as follows:
- B. Conduit bodies shall not be installed in conduits to contain telecommunications cables (fiber, category rated, coax). Provide properly sized pull boxes at locations require the use of a conduit body for pulling cable. Pull boxes shall be sized to support cable minimum bend radius of the largest cable to be installed.
- C. Conduits for interior telecommunications cables shall be installed with not more than 3 quarter bends (270 degrees) between pull points, if the final bend is within 12" of the end of the conduit, if not the fill must be de-rated, per BICSI TDMM.
- D. Rod, swab and perform a mandrel test on all interior conduits (2 inches and larger) installed in slab or below slab following concrete encasement to verify that the conduit has not been damaged during installation. Remove and replace any conduits exhibiting damage at no additional cost to the Owner or End Users.
- E. All penetrations through rated walls and all floors shall be sleeved with 4" conduit.
 1. Conduit sleeves shall extend beyond the surface of the finished wall a minimum of 12", to above an accessible ceiling.
 2. Extend conduits and conduit sleeves as required to terminate the end of the conduits above an area of accessible ceiling.
 3. Terminate all conduit sleeves with conduit connectors and plastic or phenolic bushings.
 4. Install a UL listed or approved firestop system for each penetration in a fire or smoke rated structure.
- F. All penetrations through non-rated walls shall be sleeved and filled with acoustic batting to minimize sound transmission through the wall penetration. Provide conduit sleeves, sized as required (minimum 2"C) for non-rated wall penetrations. Cable tray penetrations through walls shall be framed with sheet metal studs and insulated as shown on the Drawings.
- G. Provide a 600 lb. test pull cord in each telecommunications conduit and innerduct.
 1. Pull tapes shall not be installed with cables.
 2. Contractor shall remove pull tapes from conduits after cable installation, fish-tape or rod the conduit/duct and install a new pull tape after all cables are installed.
- H. Provide through penetration firestop systems around all pathways through floor and wall penetrations in all fire rated structures.

- I. Provide membrane fire stop systems for all raceways and boxes installed through one side of a rated structure.
- J. Provide sealed fire stop systems at all pathways through wall and floor penetrations in the equipment room and all spaces equipped with a clean agent fire suppression system.
 - 1. All penetrations entering or exiting a space with a clean agent fire suppression system shall be through conduit or a conduit sleeve.
 - 2. All penetrations shall be sealed with a UL listed fire stop system.
 - 3. Conduits and sleeves exiting the space shall be sealed externally at the penetration and internally at the conduit termination.
 - 4. All innerducts and sub-ducts shall be sealed externally at the penetration and internally at the cable exit.
 - 5. Conduit, conduit sleeve and innerduct seals shall form a cold smoke seal as well as a fire-resistant seal.
 - 6. Coordinate the exact requirements for sealing conduit and cable penetrations with the Contractor responsible for the clean agent fire suppression system.
- K. Bond all metal raceways to ground in the telecommunications rooms, equipment rooms and other locations as required by Code and Sections 260526 and 270526 for Grounding and Bonding.

2.4. SEISMIC AND VIBRATION CONTROLS

- A. Installation shall be as specified in Section regarding Seismic Controls for Electrical Work.

2.5. IDENTIFICATION AND DOCUMENTATION

A. Utility Documentation

- 1. The Contractor shall document the cable types, pair counts, strand counts and cable identification of all utility service entrance cables on the Record Drawings.
- 2. The Contractor shall identify the conduits used by the utility service providers and the remaining spare conduits on the Record Drawings.

B. Grounding and Bonding Identification

- 1. Label each ground bus bar and all telecommunications bonding backbone wires.
 - a. Provide a non-conductive engraved plastic laminate label plate in the upper left hand corner of the bus bar.
 - b. Label each ground wire with the location of origin and destination location in the same manner as backbone cables.
 - c. Provide a non-metallic tag shall be used at each connection of the telecommunications bonding backbone wires. The brass tag shall have the legend "Telecommunications Ground - Do Not Disconnect". The brass tag

shall be tied to the ground wire within six inches of the termination with a brass wire or stainless-steel strap.

2. Label each bonding conductor in each telecommunications space and in the consolidation points with the location of origin (bus bar) and destination location (cabinet, rack, enclosure, etc.)

C. Interior Identification

1. All cables, devices, jacks, faceplates, cabinets, termination hardware, cable tray, etc. shall be labeled as indicated herein, on the Drawings and as coordinated with the End Users.
2. Labeling and identification shall include, but is not limited to the following:
 - a. Horizontal distribution cables
 - b. Backbone cables
 - c. Conduits
 - d. Cable trays and ladders
 - e. Cabinets and racks
 - f. Patch Panels
 - g. Fiber termination enclosures
 - h. Termination hardware
 - i. Wireless access point locations
 - j. Consolidation points
 - k. Consolidation point locations
 - l. Outlet plates
 - m. Jacks
 - n. Connectors
3. Coordinate final labeling and identification system with End Users prior to start of rough-in.
 - a. Preliminary label schemes are shown on the Drawings.
 - b. Contractor shall use these preliminary label schemes to develop a detailed cable running list and a detailed device and equipment identification list.
 - c. Contractor shall coordinate the detailed lists with the End Users prior to cable rough-in.
4. Apply all labels plumb and square to the cable, device and equipment.
5. All flexible cable, faceplate and equipment labels shall be adhesive backed.
6. Label each outlet conduit above accessible ceiling.

- a. Each outlet conduit shall be identified with the respective outlet number.
 - b. Outlet conduits shall be marked legibly with indelible marker or machine printed label approximately six inches from the end of the conduit.
 - c. Conduits shall be identified after painting is complete; or mask the identification location prior to painting and remove the masking after painting is complete.
7. Label each backbone conduit pathway with its location of origin and destination location.
 - a. Backbone conduits shall be marked legibly with indelible marker or machine printed label approximately six inches from the end of the conduit.
 - b. Conduits shall be identified after painting is complete; or mask the identification location prior to painting and remove the masking after painting is complete.
8. Label each cabinet and rack with a non-conductive engraved laminated plastic label plate.
 - a. The label plates shall be installed in the upper left hand corner on the face of the cabinets and racks.
9. Label each cable tray with cable tray warning labels at 10 foot intervals or as otherwise recommended by the manufacturer.
10. Label each patch panel with an adhesive backed label in the upper left hand corner of the face of each patch panel.
11. Label each fiber termination enclosure with an adhesive backed label on the upper left hand corner on the face of each fiber termination enclosure.
 - a. Label each connector group with the location of origin and destination location information associated with the respective fiber cable.
 - b. Label each fiber port with individual fiber strand numbers 1 through N (where N= strand count).
 - c. Label individual ports for horizontal distribution fibers with the outlet jack identification number.
12. Label termination hardware (e.g. 110 style termination blocks) shall be labeled using designation strips and designation strip holders as recommended by the hardware manufacturer.
 - a. Copper backbone termination hardware shall be labeled with the location of origin and destination locations associated with the respective copper backbone cable.
 - b. For backbone copper cables, label the first and last pair number on each termination row (e.g. 1 → 25).

- c. For horizontal distribution copper cables at consolidation points, label each four pair group with its respective jack number.
13. Label wireless access point outlet locations on the ceiling grid below the wireless access point outlet in addition to the faceplate and jack labels.
 - a. Provide a non-conductive engraved laminated plastic label plate.
 - b. Affix the label to the ceiling grid with a releasable double sided tape to allow relocation of the label plate if required.
14. Label consolidation outlets and consolidation outlet locations.
 - a. Provide a non-conductive engraved laminated plastic label plate affixed to the lower left hand corner of the consolidation point enclosure.
 - b. Provide a non-conductive engraved laminated plastic label plate affixed to the ceiling grid below the consolidation point location.
15. Label individual outlet plates with an adhesive backed label.
 - a. A single outlet plate label is sufficient for labeling two or more plates for floor boxes containing multiple outlet plates.
16. Label individual jacks and connectors with individual port numbers and cable category ratings (where applicable).
17. Unless noted otherwise, apply non-conductive laminated plastic engraved labels with transfer adhesive on smooth surfaces in environmentally conditioned spaces.
18. Apply non-conductive laminated plastic engraved labels with #4 sheet metal screws or #4 machine screws and nuts on textured surfaces and outside of environmentally conditioned spaces.

D. Exterior Identification

1. All cables, devices, jacks, faceplates, cabinets, termination hardware, cable tray, etc. shall be labeled as indicated herein, on the Drawings and as coordinated with the End Users.
2. Labeling and identification shall include, but is not limited to the following:
 - a. Horizontal distribution cables
 - b. Backbone cables
 - c. Conduits
 - d. Fiber termination enclosures
 - e. Media van parking area outlet enclosures
 - f. Outlet plates
 - g. Jacks
3. Connectors

- a. Coordinate final labeling and identification system with End Users prior to start of rough-in.
 - b. Preliminary label schemes are shown on the Drawings.
 - c. Contractor shall use these preliminary label schemes to develop a detailed cable running list and a detailed device and equipment identification list. Refer to Appendix A of this Section for an example of the cable running list to be developed and completed by the Contractor.
 - d. Contractor shall coordinate the detailed lists with the End Users prior to cable rough-in.
4. Apply all labels plumb and square to the cable, device and equipment.
 5. All flexible cable, faceplate and equipment labels shall be adhesive backed.
 6. Label each backbone conduit pathway with its location of origin and destination location.
 - a. Provide an embossed or molded plastic label strip on each conduit at the utility service pole.
 - b. Provide an embossed or molded plastic label strip on each entrance conduit. Install the label with nylon cable ties or stainless-steel straps. Label strips shall be installed vertically on the side of each conduit so the identification is visible.
 - c. Provide an embossed or molded plastic label strip for each conduit in each handhole. Where the conduits protrude into the handhole, the label strips shall be applied directly to the conduit. Where the conduits do not extend into the handhole, affix the label to the handhole wall adjacent to the conduit.
 7. Label media van connection enclosures with a non-conductive engraved laminated plastic label plate affixed to the lower left hand corner of the enclosure.
 - a. Label fiber cables in the same manner as outlet plates
 - b. Label individual fiber strands in the same manner as individual jacks.
 8. Label individual coaxial connections in the same manner as individual jacks.
 9. Apply non-conductive laminated plastic engraved labels with #4 sheet metal screws or #4 machine screws and nuts.
- E. Test Documentation
1. Provide summary and detailed test reports of all testing performed.
 2. Provide test reports in electronic format and provide a software reader to display the summary and detailed test report.

3. Provide a letter of certification from the Contractor verifying that all of the tests performed are in accordance with the requirements of this document, industry standards as specified, and that all installed cables and components meet or exceed the requirements of these documents.

F. As-Built Record Documents

1. Operation and Maintenance Manuals (for active equipment and systems)
2. Product information (Approved submittals)
3. Record Drawings
4. Cable Identification Records
5. Test Records
6. Seismic and Vibration Control

G. Provide Record Drawings detailing the location and identification of all components installed as part of this Work. The Record Drawings shall include, but are not limited to showing the following:

1. Telecommunications Room locations and identification
2. Telecommunications outlet locations and identification
3. Telecommunications riser with identification of each backbone cable.
4. Telecommunications cabinet and rack identification.
5. Telecommunications grounding and bonding backbone and bus bar locations and identification.
6. Telecommunications raceway locations and routing
 - a. Exterior conduits, location of origin, destination location and route.
 - b. Cable trays and ladders
 - c. Interior conduits, backbone conduit runs only.
 - d. Interior and exterior conduit identification.
7. A draft copy of the project Record Drawings shall be provided to the End Users' Information Technology Department a minimum of 30 days prior to the project acceptance or turn over for the End Users' beneficial use.
 - a. At a minimum, the draft copy of the Record Drawings shall show all outlets installed with cable/jack identification clearly marked.
 - b. The draft copy may be used by the Owner to begin patching, connection and testing of network equipment.
 - c. The Contractor shall notify the End Users of any changes in the labeling scheme and any requirements to test cables that are patched or connected after delivery of the draft Record Drawings.

H. Seismic and Vibration Controls Documentation

1. Document seismic and vibration controls and measures installed on the Record Drawings.
2. Show location and details for seismic and vibration controls and measures installed.

2.6. TESTING

A. Copper Cable Testing - All Copper Cables

1. Inspect all terminations to verify that all conductors are properly seated in the connection.
2. Inspect all cables for evidence of stretching, over bending, cuts, or damage during installation. Replace any damaged cables.
3. Test all copper cables for the following:
 - a. DC loop resistance
 - b. Polarity between conductors
 - c. Shorts
 - d. Opens
 - e. Intermittent faults
4. Test all cables prior to patching and cross-connecting.
5. Test all voice circuits for the parameters above from end to end.
6. Document all tests as pass/fail. Any test that are '* pass' shall be considered a failed test.
7. Contractor shall repair or replace all cables not passing these tests at no additional cost to the project.

B. Copper Cable Testing - Performance Testing

1. Test all Category Rated cables for the following:
 - a. Wire map
 - b. Length
 - c. Insertion loss
 - d. Near-end cross-talk (NEXT)
 - e. Power sum near-end cross-talk (PSNEXT)
 - f. Equal-level far-end cross-talk (ELFEXT)
 - g. Power sum equal-level far-end cross-talk (PSELFEXT)
 - h. Return Loss

- i. Propagation delay
 - j. Delay Skew
- 2. Test all cables prior to patching.
- 3. Performance test equipment shall meet or exceed the requirements of TIA/EIA-568 C.2.
- 4. Document all tests as pass/fail and include worst cast test measurements for each test parameter.
- 5. Contractor shall repair or replace all cables not passing these tests at no cost to the End Users or Department.

C. Fiber Cable Testing

- 1. Each fiber shall be tested for insertion loss (attenuation) and continuity with an optical loss test set comprised of an optical power meter and stabilized light source. Optical time domain reflectometer (OTDR) testing will not be accepted for insertion loss testing.
- 2. The maximum link loss for each cable segment shall be calculated and submitted for approval prior to the start of testing.
- 3. The maximum link loss shall be calculated for both primary wavelengths of each type of fiber.
 - a. Backbone single mode fibers shall be less than 1.5 dB attenuation at both wavelengths.
- 4. The maximum link loss shall be calculated using the connector and cabled fiber loss values from the TIA 568C.3 optical cable standards or the manufacturer's specified guaranteed maximum insertion loss values, whichever is more stringent.
- 5. Document the values used in the calculations.
- 6. Test results shall be evaluated based on the calculated maximum link loss for each cable segment.
- 7. Test each backbone fiber in both directions at both wavelengths
- 8. Test each horizontal distribution fiber in one direction at one wavelength.
- 9. Multimode fiber shall be tested in accordance with TIA 526-14A, Method B, one jumper reference, two jumper test.
 - a. Backbone multimode fibers shall be tested at 850 and 1300 nm wavelengths.
 - b. Horizontal distribution multimode fibers shall be tested at 850 nm wavelength.
- 10. Single mode fibers shall be tested in accordance with TIA 526-7, Method A, one jumper reference, two jumper test.

- a. Backbone single mode fibers shall be tested at 1310 and 1550 wavelengths.
 - b. Horizontal distribution single mode fibers shall be tested at 1310 nm wavelength.
11. Document all tests as the actual dB insertion loss of each fiber, at both wavelengths, in both directions.
 12. Contractor shall repair or replace all cables not passing these tests at no additional cost to the project.

D. Test Equipment Requirements

1. All test equipment shall be under current calibration.
2. Test equipment calibration shall be traceable to National Institute of Standards and Technology (NIST) or a Nationally Recognized Testing Laboratory (NRTL).
3. Submit calibration certificates for all test equipment as part of the project submittals.
4. Include calibration certificates for all test equipment as part of the test As-Built Record Documents.

E. As-Built Record Documents shall be provided in hard copy and electronic formats.

1. Hard copy documents may be requested on 8-1/2" x 11" paper, 11" x 17" paper, full-size plotted drawings and half size plotted drawings.
2. Hard copy documents may be requested in three ring binders or bound format.
3. All binders and bound copies shall include the official project name, Department's project number, Contractor name and Contractor's contact information on the project cover.
4. All binders and bound copies shall include an index, tabbed sections and volume numbers where applicable.
5. All hard copy drawings shall be bound and stapled.
6. Electronic files shall be provided in the original native file format of the program used to create the files.
7. Electronic files shall not be password protected or otherwise protected to prevent the Department and End Users full access and use of the information.
8. Electronic document files may be requested in Microsoft Word, Microsoft Excel, Microsoft Visio, AutoCAD or other software formats.
9. The Contractor shall coordinate the requirements for hard and electronic format deliverables with the Department and the End Users prior to delivery of the As-Built Record Documents.

10. In addition to the As-Built Record Documents to be delivered to the Department as required by the Division 1 Specifications, the Contractor shall provide two hard copy sets of the Drawings, an electronic copy of the drawings and an electronic copy of the cable system test reports to the End Users's Information Technology (IT) Department for their use. These documents shall be delivered directly to the Owner's IT Department point of contact. Coordinate this requirement with the Architect prior to delivery of the As-Built Record Documents.

END OF SECTION

APPENDIX A

Sample Cable Identification Record - Horizontal Distribution

Telecom Room ID	Outlet Box #	Cable/Jack #	Rack #	Patch Panel #	Port #	Cable Type	Notes
A	A-001	AD220401	D22	04	01	Cat6A	
A	A-001	AD220801	D22	08	01	Cat6	
A	A-001	AD220802	D22	08	02	Cat6	
A	A-001	AD220803	D22	08	03	Cat6	
A	A-002	AD220402	D22	04	02	Cat6A	
A	A-002	AD220804	D22	08	04	Cat6	
A	A-002	AD220805	D22	08	05	Cat6	
A	A-002	AD220806	D22	08	06	Cat6	
A	A-003	AD220403	D22	04	03	Cat6A	
A	A-003	AD220807	D22	08	07	Cat6	
A	A-003	AD220808	D22	08	08	Cat6	
A	A-003	AD220809	D22	08	09	Cat6	
A	A-004	AD220404	D22	04	04	Cat6A	
A	A-004	AD220810	D22	08	10	Cat6	
A	A-004	AD220811	D22	08	11	Cat6	
A	A-004	AD220812	D22	08	12	Cat6	
A	A-005	AD220405	D22	04	05	Cat6A	
A	A-005	AD220813	D22	08	13	Cat6	
A	A-005	AD220814	D22	08	14	Cat6	
A	A-005	AD220815	D22	08	15	Cat6	
A	A-006	AD220406	D22	04	06	Cat6A	
A	A-006	AD220816	D22	08	16	Cat6	
A	A-007						Spare
A	A-008	AD220407	D22	04	07	Cat6A	
A	A-008	AD220817	D22	08	17	Cat6	
A	A-009						Spare
A	A-010	AD220408	D22	04	08	Cat6A	
A	A-010	AD220818	D22	08	18	Cat6	
A	A-011	AD220409	D22	04	09	Cat6A	
A	A-011	AD220819	D22	08	19	Cat6	
A	A-012	AD220410	D22	04	10	Cat6A	
A	A-012	AD220820	D22	08	20	Cat6	
A	A-013	AD220411	D22	04	11	Cat6A	
A	A-013	AD220821	D22	08	21	Cat6	

**Sample
Cable Identification Record – Backbone Distribution**

Telecom Room ID Origin	Rack #	FTE/Patch Panel #	Port #s	Telecom Room ID Destination	Rack #	FTE/Patch Panel #	Port #s	Cable Type
A	D24	01	01-12	B	A01	01	01-12	FM
A	D24	01	13-24	B	A01	01	13-24	SM
A	D25	06	01-24	B	A01	02	01-24	CU
A	B18	N/A	N/A	B	A02	N/A	N/A	CO
A	D24	01	25-36	C	A01	01	01-12	FM
A	D24	01	37-48	C	A01	01	13-24	SM
A	D25	06	25-48	C	A01	02	01-24	CU
A	B18	N/A	N/A	C	A02	N/A	N/A	CO
A	D24	01	49-60	D	A01	01	01-12	FM
A	D24	01	61-72	D	A01	01	13-24	SM
A	D24	07	01-24	D	A01	02	01-24	CU
A	B18	N/A	N/A	D	A02	N/A	N/A	CO
A	D24	02	01-12	E	A01	01	01-12	FM
A	D24	02	13-18	E	A01	01	13-24	SM
A	D25	07	25-48	E	A01	02	01-24	CU
A	B18	N/A	N/A	E	A02	N/A	N/A	CO

SECTION 270526 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 – GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 WORK INCLUDED

- A. Provide all labor, materials, and equipment for the complete installation of work called for in the Contract Documents.

1.3 SCOPE OF WORK

- A. This section includes the minimum requirements for the equipment and cable installations in communications equipment rooms; e.g., main distribution frame (MDF), intermediate distribution frame (IDF), radio equipment rooms, audio/media equipment and related areas, emergency operations (EOC) rooms, and any other areas deemed by the authority having jurisdiction (AHJ).
- B. Included in this section are the minimum composition requirements and installation methods for the following:
 - 1. Interior grounding systems which include the following, but not limited to items:
 - a) Busbars
 - b) Grounding/bonding conductors
 - c) Bonding accessories
 - d) Raised floor bonding grid

1.3 QUALITY ASSURANCE

- A. All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner or Owner Representative. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufactures listed. Where “approved equal” is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.
- B. Strictly adhere to all project drawing and specifications, Motorola R56®, Standards and Guidelines for Communication Sites, Building Industry Consulting Service International (BICSI), Electronic Industries Alliance (EIA) and Telecommunications Industry

Association (TIA) recommended installation practices when installing communications/data cabling, the more stringent shall apply.

- C. Material and work specified herein shall comply with the applicable requirements of the following standards and the Authority Having Jurisdiction (AHJ). The more stringent shall apply.
1. Motorola R56® (R56) - *Standards and Guidelines for Communication Sites*
 2. ANSI/TIA/EIA – 568 *Commercial Building Telecommunications Cabling Standard* – latest edition
 3. TIA – 569 *Commercial Building Standard for Telecommunications Pathways and Spaces*– latest edition
 4. ANSI/TIA/EIA – 606 *Administration Standard for the Telecommunications Infrastructure of Commercial Buildings*– latest edition
 5. ANSI-J-STD – 607 *Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications*– latest edition
 6. NFPA 70 – *National Electric Code*
 7. BICSI – *Telecommunications Distribution Methods Manual, 14th Edition*,

1.4 SUBMITTALS

- A. Provide product data for the following:
- a) Provide with bid submittal the intent for compliance for grounding and bonding per these specifications.
 - b) Provide manufacturer's cut sheets, specifications, and installation instructions for all products, before installation.

PART 2 – PRODUCTS

2.1 WALL/FLOOR-MOUNT BUSBARS

- A. Primary Bonding Bar (PBB)
1. Primary bonding bar (PBB) shall be constructed of .25" (6.4 mm) thick solid copper bar. The bar may be tin-plated and is required in damp/wet or when mounted to galvanized surfaces.
 2. The busbar shall be 4"H x 20"L (100 mm x 510 mm) and shall have attachment points for two-hole grounding lugs, with 20% future growth.
 3. The hole pattern for attaching grounding lugs shall meet the requirements of R56 and should accept lugs with ¾ (19 mm) or 1" (24.5 mm) hole centers.
 4. The busbar shall include wall-mount stand-off brackets, assembly screws and 2kV minimum voltage rating insulators.

5. The busbar shall be UL Listed as grounding and bonding equipment.

B. Secondary Bus Bar (SBB)

1. Secondary bonding bar (SBB) shall be constructed of .25" (6.4 mm) thick solid copper bar. The bar may be tin-plated and is required in damp/wet or when mounted to galvanized surfaces.
2. The busbar shall be, minimally, 4"H x 12"L (100 mm x 300 mm), and shall be properly sized to accommodate two-hole grounding lugs, with 20% future growth.
3. The hole pattern for attaching grounding lugs shall meet the requirements of R56 and should accept lugs with ¾ (19 mm) or 1" (24.5 mm) hole centers.
4. The busbar shall include wall-mount stand-off brackets, assembly screws and 2kV minimum voltage rating insulators.
5. The busbar shall be UL Listed as grounding and bonding equipment.

C. Operator Station Secondary Bonding Bar (OSBB)

1. Operator Station Secondary Bonding Bar (OSBB) shall be constructed of .25" (6.4 mm) thick solid copper bar. The bar may be tin-plated and is required in damp/wet or when mounted to galvanized surfaces.
2. The busbar shall be 2"H x 12"L (50 mm x 300 mm) and shall be properly sized to accommodate two-hole grounding lugs, with 20% future growth.
3. The hole pattern for attaching grounding lugs shall meet the requirements of R56 and should accept lugs with ¾ (19 mm) or 1" (24.5 mm) hole centers.
4. The busbar shall include wall-mount stand-off brackets, assembly screws and 2kV minimum voltage rating insulators.
5. The busbar shall be UL Listed as grounding and bonding equipment.

2.2 RACK BONDING BAR (RBB)

A. Horizontal Rack Bonding Bar (RBB)

1. Horizontal rack-mount busbar shall be constructed of minimally 3/16" (4.76 mm) thick by 1/2"H (12.7 mm) alloy copper or tin-plated copper bar. The bar may be tin-plated and is required in damp/wet or when mounted to galvanized surfaces.
2. Bar shall be 19" EIA or 23" rack mounting width as best fit for mounting on relay racks or in cabinets.
3. Bar shall have 10-32 tapped (1/4" preferred), minimally, ground mounting holes on 1" (25.4 mm) holes spaced to maximize equipment bonding conductor quantities.
4. Stainless-steel (300-series) studs or holes sized to accommodate 5/16-inch SS hardware, on ¾ or 1-inch centers shall be provided on each end for attachment of a double-hole bonding lug.
5. Bar shall be UL Listed as grounding and bonding equipment.

B. Vertical Rack Bonding Bar (RBB)

1. Vertical rack-mount busbar shall be constructed of minimally 3/16" (4.76 mm) thick by 1/2"H (12.7 mm) alloy copper or tin-plated copper bar. The bar may be tin-plated and is required in damp/wet or when mounted to galvanized surfaces.
2. Bar shall be 72"H (1830 mm) or 36"H (910 mm) as required for best fit for coverage of the rack height.
3. 72"H (1830 mm) bar shall have 13 threaded 1/4-20 attachment points for two-hole lugs with 5/8" (15.8 mm) hole centers and two pairs of threaded studs (one at top, one at bottom) for two-hole lugs with 1" (25.4 mm) hole centers.
4. Bar shall have 10-32 tapped (1/4" preferred), minimally, ground mounting holes on 1" (25.4 mm) holes spaced to maximize equipment bonding conductor quantities.
5. Stainless-steel (300-series) studs or holes sized to accommodate 5/16-inch SS hardware, on 3/4 or 1-inch centers shall be provided on each end for attachment of a double-hole bonding lug.
6. Bar shall be UL Listed as grounding and bonding equipment.

2.3 BONDING ACCESSORIES

A. Compression Lugs

1. Compression lugs shall be manufactured from tinned-plated copper.
2. Compression lugs shall have two holes spaced properly to secure to the bus bar.
3. Compression lugs shall be sized to fit its specific size conductor.
4. Compression lugs shall be UL Listed as wire connectors.
5. Two-hole compression lugs shall be installed on the PBB and SBB for bonding all grounding conductors.
6. One-hole compression lugs are allowed to be used on rack/cabinet-mounted equipment bonding conductors attached to equipment and the RBB.
7. Interior lug connections shall be irreversibly crimp connectors, crimped to 2-ton force, minimally.

B. Antioxidant Joint Compound

1. Oxide inhibiting joint compound for copper-to-copper and tin-plated copper to copper, shall be a copper-based ointment.
2. Oxide inhibiting joint compound for copper or tin-copper to other metallic surfaces or other metallic bonding shall be a zinc-based ointment.
3. All mechanical connections shall have an antioxidant joint compound applied.

C. C-Type, Compression Taps

1. Compression taps shall be manufactured from copper alloy.
2. Compression taps shall be C-shaped connectors that wrap around two conductors forming an irreversible splice around the conductors; installation requires a hydraulic crimping tool
3. Compression taps shall be sized to fit specific size conductors.
4. Compression taps shall be UL Listed.

5. Compression taps shall be insulated to inhibit incidental contact with other metallic media.
6. Interior lug connections shall be irreversibly crimp connectors, crimped to 2-ton force, minimally.
7. Exterior lug connections shall be exothermically welded or irreversibly crimp connectors rated and installed for 12-ton force, minimally.

D. Pedestal Clamp with Grounding Connector

1. Pedestal clamp shall be made from electroplated tinned copper or bronze. Installation hardware will be 300-series stainless steel.
2. Pedestal clamps shall be sized to fit a specific size conductor.
3. Pedestal clamp installation hardware shall be sized to attach to round and/or square raised access floor pedestals that are 1-1/8" to 1-3/4" in diameter, as stated below.
4. Pedestal clamp shall provide straight (in-line) or cross (intersection) support for up to two conductors.
5. Pedestal clamp shall be UL Listed as grounding and bonding equipment.

E. Pipe Clamp with Grounding Connector

1. Pipe clamp shall be made from electroplated tinned bronze. Installation hardware will be stainless steel.
2. Pipe clamp shall be sized to fit up to two conductors ranging in size from #6 to 250 MCM; conductors must be the same size.
3. Pipe clamp installation hardware shall be sized to attach to pipes, sizes 1" to 6" (.75" to 6.63" in diameter), as stated below.
4. Pipe clamp shall be UL Listed as grounding and bonding equipment.

2.4 BONDING GRID

1. The bonding grid shall be prefabricated.
2. The grid shall be made of 26 gauge (0.4 mm) by 2" (50 mm) wide copper strap.
3. The grid shall cross at 90-degree angles and exothermically welded together at 2' intervals, thus making a 2' by 2' grid pattern.

2.5 GROUNDING AND BONDING CONDUTORS

1. Shall be properly sized according to job specifications and drawings, Motorola R56 and TIA-607, the more stringent shall apply.
2. Minimally one bonding backbone conductor shall be installed to provide connection of the PBB to all other area SBBs. The size shall be maintained throughout the run.
3. The PBB shall bond to the electrical service common electrode bus via the same size conductor as the bonding backbone conductor.
4. All bus bars shall bond to the grounding system via conductors sized appropriately by their total length. Reference Motorola R56 table 5-3.
5. No. 2 AWG is the minimal sized conductor to be used for bus bar to system connections and for bonding multiple items (reference R56 for exceptions).

PART 3 – EXECUTION

3.1

INSTALLATION

A. Wall/Floor-Mount Busbars

1. Attach busbars to the substrate with appropriate hardware according to the manufacturer's installation instructions.
2. Conductor connections to the PBB or SBB shall be made with two-hole bolt-on compression lugs sized to fit the busbar and the conductors.
3. Each lug shall be attached with 300-series stainless steel hardware after preparing the bond according to manufacturer recommendations and treating the bonding surface on the busbar with antioxidant to help prevent corrosion at the bond.
4. The wall/floor-mount busbar shall be bonded to ground as part of the overall Telecommunications Bonding and Grounding System.

B. Rack-Mount Busbars and Ground Bars

1. When a rack or cabinet supports active equipment or any type of shielded cable or cable termination device requiring a ground connection, add a rack-mount horizontal or vertical busbar to the rack or cabinet. The rack-mount busbar provides multiple bonding points on the rack for rack and rack-mount equipment.
2. Attach rack-mount busbars to racks or cabinets according to the manufacturer's installation instructions.
3. Bond the rack-mount busbar to the room's PBB, main SSB, or bonding grid with appropriately sized hardware and conductor.

C. Operator Station Secondary Bonding Bar

1. An operator station secondary bonding bar (OSBB) shall be installed within each operator's furniture, in a location as determined by the owner and design team.
2. The OSBB shall bond to the area's PBB, main SBB, or bonding grid via a No. 2 AWG conductor, minimally.
3. All metallic media at the operator's station shall be properly bonded to the OSBB using methods described in this section. Items that shall bond to the OSBB, but not limited to are:
 - a) AC power
 - b) Cable shields
 - c) Power distribution units (PDUs)
 - d) Metallic furniture parts
 - e) Surge protection devices (SPDs)
 - f) An addition floor pedestal located under the operator's seating area

D. Bonding Grid

1. The grid shall bond to the areas PBB or main SBB with two conductors sized per the backbone bonding conductor. The conductors shall bond on opposing extremes of the bus bar and radiate away from another. Attach the other end of the conductors to the grid via exothermic weld.
2. The grid shall lay flat on the floor with the floor pedestals centered within the open area of the 2'x2' grid pattern.
3. The operator's station SBB and equipment area racks shall bond to the grid via minimally a No. 2 AWG conductor.

E. Pedestal Clamp

1. At minimum, bond every fourth raised access floor pedestal, around the perimeter and within the field, with a minimum #6 AWG conductor to the bonding grid, via exothermic weld, and to the pedestal using a pedestal clamp sized to fit the pedestal and the conductor and installed according to the manufacturer's recommendations.
2. Bond each rack and/or cabinet to the bonding grid via minimally a No. 2 conductor exothermically welded to the grid. Attach the conductor to the PBB or SBB via two-hole lug.
3. Remove paint between the pedestal and pedestal clamp, clean surface and use antioxidant between the pedestal and the clamp to help prevent corrosion at the bond.
4. Remove insulation from conductors where wires attach to the pedestal clamp.
5. Bare conductors may be used in plenum areas but shall be installed to inhibit incidental contact with other metallic media.

F. Pipe Clamp

1. Bond metal pipes located inside the communication/equipment rooms with a minimum #6 AWG conductor to the PBB, SBB, or bonding grid using a pipe clamp sized to fit the pipe and the conductor and installed according to the manufacturer's recommendations.
2. Remove paint between the pipe and pipe clamp, clean surface and use antioxidant between the pipe and the clamp to help prevent corrosion at the bond.
3. Remove insulation from conductors where wires attach to the pipe clamp.

G. Equipment Ground Jumper Kit

1. Bond equipment to a rack-mount busbar using ground jumper according to Motorola R56 or the manufacturer's recommendations. The more stringent shall apply.
2. Clean the surface and use antioxidant between the compression lugs on the jumper and the rack-mount bus bar to help prevent corrosion at the bond.
3. The ground jumper shall be attached to the bus bar by using 300-series stainless-steel hardware.

END OF DOCUMENT

SECTION 270528 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 SUMMARY

- A. Section Includes:
 1. Cable Tray (wire rod)
 2. Fire Stops
 3. J-Hooks (Not for use for communications and signaling wiring in Communications Center, per NFPA 1221, Section 5.5.)

1.3 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section. Refer to the following sections:
 1. Division 01 Section "Construction Waste Management"
 2. Section 260536 "Cable Trays for Electrical Systems", for cable trays and accessories

1.4 RELATED REQUIREMENTS

- A. Systems, design, equipment, components, cabling materials, installation, labeling and testing shall comply with these (latest edition of each) specifications and associated reference documents, including but not limited to the following:
 1. Motorola R56® – Standards and Guidelines for Communications Sites
 2. Harris Site Grounding and Lighting Protection Guidelines
 3. National Fire Protection Association (NFPA) 70 – National Electrical Code (NEC)
 4. American National Standards Institute/Telecommunications Industry Association (ANSI/TIA)-568-E – Commercial Building Cabling Standards
 5. ANSI/TIA-569-E – Commercial Building Standard for Telecommunications Pathways and Spaces
 6. ANSI/TIA-606-C – Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
 7. ANSI/TIA-607-D – Generic Telecommunications Grounding (Earthing) and Bonding for Customer Premises
 8. ANSI/TIA-942-B – Telecommunications Infrastructure Standard for Data Centers
 9. Building Industries Consulting Services, International (BICSI) Telecommunications Distribution Methods Manual (TDMM), latest edition

10. ANSI/BICSI-002-2019 – Data Center Design and Implementation Best Practices,
11. All other applicable electrical and building codes.

1.5 SUBMITTALS

- A. Shop drawings shall be submitted and organized by specification section.
- B. Shop Drawings:
 1. Complete bill of materials
 2. Product cut sheets indicating materials, finish, dimensions, and all accessories.

PART 2 - PRODUCTS

2.1 CABLE TRAY (WIRE ROD)

- A. Provide cable trays in quantities, locations, and layouts per the plan drawings. Provide all necessary accessories and mounting equipment for a complete and first-class installation.
- B. Description:
 1. Welded wire mesh cable management system
- C. Material:
 1. Carbon Steel
- D. Finish:
 1. Electro-plated Zinc Galvanizing: ASTM B 633
- E. Construction:
 1. Cable trays shall be constructed with high strength welded steel wire mesh. Wire rod tray is to have a continuous safety edge wire lip. Wire rod tray sections shall be mechanically connected with ends finished to protect installers and cables.
- F. Inside Width:
 1. Products should be available in 6 inch, 8 inch, 12 inch and 22 inch widths.
 - a. Provide cable tray in 18 inch widths (per Motorola R56) unless otherwise noted on the project drawings.
- G. Inside Depth:
 1. Products should be available in 1- ½ inch, 2 inch and 4 inch depths.
 - b. Provide cable tray in 4 inch depths unless otherwise noted on the project drawings.
- H. Support:
 1. Provide all necessary accessories for cantilever bracket, trapeze support, or single rod suspension support.
- I. Tray sections shall be supplied in nominal 10 foot lengths.

- J. Mesh Spacing:
 1. 4 inches x 2 inches.
- K. All tray section splices shall use connectors designed for that purpose from the same manufacturer. Connectors must protect cables from sharp edges to prevent damage.
- L. Provide manufacturer's standard clamps, hangers, brackets, splice plates, blind ends, barrier strips, connectors, grounding straps, and all other apparatus is required.
- M. Hardware used to connect tray sections must be by same manufacturer and insure grounding continuity.
- N. When tray makes up to a 90-degree change in direction none of the inside corners shall be at 90 degrees. The contractor shall provide radial and or angled inserts to protect the min. bend radius of the cables.
- O. Grounding and Bonding
 1. All cable trays shall be electrically continuous and bonded to the telecommunications grounding system.
 2. Adjacent trays shall be bonded using UL listed splices or bonding jumpers on both sides.
 3. An electrical grounding conductor shall be used at all discontinuous joints (i.e. conduit sleeves or EZ paths). Size conductor per NEC and Motorola R56, the more stringent shall apply.
- P. Manufacturers:
 1. Cooper B-Line - FlexTray
 2. Legrand - Cablofil
 3. Or approved equal

2.2 UL LISTED FIRESTOPS

- A. Provide firestops in types, quantities, and locations per the Contract drawings.
- B. Provide re-enterable, non-hardening, intumescent putty, rated for floor or wall rating, UL approved assembly, with approved packing material for firestopping all inside building cable penetrations.
- C. See drawings for cable tray through-wall firestop assembly.
- D. Manufacturers:
 1. STI - EZ-Path
 2. Nelson Equal
 3. 3M Equal

2.3 J-HOOKS

- A. J-Hooks shall be used to support all data/voice/video/CATV/fiber cable not in conduit, wire rod tray, cable runway, or other approved pathway. J-hooks shall be sized appropriately for supporting cables. J-hooks shall be suspended using all thread.

Acoustic ceiling support wires shall not be used for J-hook suspension; all J-hooks must be rigidly supported with all thread and/or slick-rod to meet NEC 300-22 requirements (note that separate support wires, that only support the J-Hook and are connected at least two locations, above and to the t-bar ceiling or above twice are acceptable support means to meet NEC 300-22 requirements). All J-hooks minimum size of 2" unless larger sizes are needed; provide all accessories and appurtenances to completely fasten support, and install the J-hooks, whether or not shown on the drawings or called out herein.

- B. Provide all necessary appurtenances for complete installation.
- C. Manufacturers:
 - 1. Erico Caddy-Cat32
 - 2. Or Equal

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install metallic cable runway in accordance with NEMA VE-2 Application Information Section.
- B. Wire-rod type cable trays to be installed and supported using manufacturer's suggested loads and support spacing. Center hung cable trays are not acceptable.
- C. Install products in accordance with the Manufacturer's instructions.
- D. All innerduct and conduit traversing through a wall or floor shall be firestopped on both sides using intumescent putty.
- E. Provide supports at each connection point, at the end of each run, and at other points to maintain a maximum spacing between supports of 5 feet.
- F. Install cable runway and cable tray in such a manner that joints are not made at support brackets.
- G. Install horizontal section support brackets at a maximum of 2.5 feet from any junction or splice in the cable runway.
- H. Install support brackets for each cable runway and cable tray fitting, junction, or elbow.
- I. Provide ceiling trapeze or wall mount for all horizontal cable tray as required.
- J. Install support within 2 feet on each side of expansion joints and within 2 feet of fitting extremity.

- K. Provide expansion joints in accordance with NEMA VE-2 for 25 degrees Fahrenheit maximum temperature variation.
- L. Install without exposed raw edges.
- M. Provide firestopping to sustain ratings when passing cable tray through fire-rated elements.
- N. Bond cable tray/runway to provide grounding continuity with manufacture's grounding straps over the entire length. Provide mechanical connectors for tray/runway connection to the nearest Telecommunications busbar, Provide bonding jumper at each expansion joint and adjustable connection. Bonding of the cable tray sections and to the interior grounding system shall be per Motorola R56.
- O. Cable tray and/or cable runway without separation shall only support data and voice cabling. Install other low voltage cabling in separate raceway(s) or provide dividers in the cable tray/runway.
- P. Provide separate raceways for different cable systems as indicated on the drawings. Separate low voltage systems may require separate raceway systems.
- Q. Power cable shall not be installed in the same cable tray as low voltage signal cables.

3.2 SLEEVES

- A. The Contractor shall provide sleeves at all wall and floor to protect cabling and/or raceways installed as part of the telecommunications system. Each sleeve shall extend through the respective wall, floor or partition and shall be furnished with a connector and protective bushing.
- B. Sleeves through floor and wall penetrations shall extend a minimum of 3 inches above the finished floor or as indicated on drawings.
- C. Sleeves through fire rated structures shall have an appropriate (UL Listed or ETL equal) fire stop system installed as indicated in - Chases and Openings.
 - 1. Conduits, innerducts or other raceways that are not part of a fully enclosed raceway system shall be considered sleeves for this requirement.
- D. Where conduits pass through waterproofed floors or walls, design of sleeves shall be such that waterproofing can be flashed into and around the sleeves.
- E. Space between floor sleeves and passing conduit shall be caulked with graphite packing and waterproof caulking compound as required for a waterproof installation.

- F. Sleeves through exterior walls below grade shall have the spaces between conduit and sleeve caulked watertight.
- G. Sleeves in bearing and masonry walls, floors, and partitions shall be of standard weight steel pipe finished with smooth edges. For other masonry partitions, through suspended ceilings and for concealed vertical piping, sleeves shall be No. 22 U.S.G. galvanized iron.
- H. All sleeves through exterior walls shall be:
 - 1. Properly installed at a slope sufficient to limit water ingress.
 - 2. Securely cemented in place.
- I. All spaces between the sleeve and cable(s), innerduct(s) or other items entering the building shall be packed and caulked with a re-enterable material to prevent water from entering the building.

3.3 CHASES AND OPENINGS

- A. All openings or chases required for the installation of the telecommunications work in the building shall be coordinated with and provided by the General Electrical Telecommunications Contractor.
- B. The Contractor shall seal all openings made in fire rated floors, ceilings or partitions after the work has been installed. The material used for sealing the openings shall have a fire rating equal to or greater than the rating of the floor, ceiling or partition material. All fire stop material installed shall be U.L. classified. The fire stop materials shall be installed as part of a U.L. listed system approved for the type of structure, penetration and penetrating item(s).
- C. This Contractor shall patch and repair any openings, penetrations and/or damage caused by his work, to the satisfaction of the Owner. The patch and/or repair shall be restored in like-kind of the structure and finish surrounding the penetrated or damaged area to a scratch coat to be finished by others.

END OF SECTION

SECTION 271000 - STRUCTURED CABLE SYSTEM

PART 1 - GENERAL

1.1. GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2. SUMMARY

- A. The Work of this Section includes all labor, materials and equipment to provide a complete, turn-key the Structured Cabling System components stated below:
 - 1. Backbone Cable
 - 2. Horizontal Cable
 - 3. Termination Hardware
 - 4. Faceplates and Connectors
 - 5. Connecting Cords, Devices and Adapters

1.3. RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
 - B. Contractor shall comply with the most recent edition of the (latest revision) referenced Codes and Standards, unless otherwise noted.
 - C. NFPA 70 National Electrical Code
 - D. Harris Site Grounding and Lightning Protection Guidelines
 - E. Motorola R56 – Standards and Guidelines for Communications Sites, latest issue
 - F. NFPA 70 National Electrical Code
 - G. ANSI/TIA-568-E - Series - Generic Telecommunications Cabling for Customer Premises
 - H. ANSI/TIA 569-E Telecommunications Pathways and Spaces
 - I. ANSI/TIA-606-C Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
 - J. ANSI/TIA-607-D Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.
 - K. ANSI/TIA-942-B Telecommunications Infrastructure Standard for Data Centers
- Columbus County 911 Center 22001

- L. ANSI/BICSI-002-2019 – Data Center Design and Implementation Best Practices
- M. BICSI Telecommunications Distribution Methods Manual (TDMM)
- N. Section 270500 Common Work Results - Communications Systems
- O. Section 270508 Pathway for Communications Systems
- P. Section 271116 Equipment Rooms and Fittings - Communications

1.4. DEFINITIONS

- A. Consolidation Point - an assembly consisting of a NEMA 1 rated enclosure and Category Rated 100-style termination block(s) for interconnecting and outside plant Category Rated Cable to inside plant Category Rated cable. The consolidation point is installed above the ceiling in the area of slab on grade floor boxes. Conduits are installed from the slab on grade floor boxes to the consolidation point. The cables are interconnected on the 110-style termination blocks. Cable testing is performed using the inside plant rated cable performance characteristics.
- B. Equipment Cords – flexible cords with like or dissimilar connectors at either end for connecting between a work area or equipment outlet to installed equipment (e.g.: wireless access point; fire alarm control panel; security control panel; building automation panel, etc.).
- C. Equipment Outlets - telecommunications outlets installed inside or adjacent to equipment to be installed by this Contractor or by another trade (e.g.: wireless access point, fire alarm control panel, security control panel; building automation panel, elevator telephone, etc.).
- D. Patch Cords – flexible cords with like or dissimilar connectors at either end for connecting between patch panels and from patch panels to rack mount equipment in communications spaces (e.g. network switches, routers, etc.)
- E. Work Area Cords – flexible cords with like or dissimilar connectors at either end for connecting between work area outlets and End Users provided equipment in the work area (e.g.: computers, printers, copiers, telephones, etc.)
- F. Work Area Outlet - telecommunications outlets installed in offices, modular furniture, floor boxes, etc. for connection of computers and equipment to be installed by the End Users (e.g.: computers, printers, copiers, telephones, etc.). Work area outlet plates include wall mount outlets, wireless access point outlets, furniture mount outlets, floor mount outlets (all types), wall-phone outlets, wet/damp location outlets and similar outlet locations.

1.5. SUBMITTALS

- A. All submittals shall be submitted for review and approval in accordance with the Division 1 Requirements.
 - 1. Submit product data in accordance with Division 1 Requirements.
 - 2. Submit product data for each product specified in this Section.
 - 3. Submit samples in accordance with Division 1 Requirements.

- a. Submit samples of the following for review and approval:
 - b. Connectors
 - c. Work Area Outlet Plates with affixed labels.
- B. Qualifications: Submit qualifications for the Contractor's Supervisor/Foreman responsible for installation of the system.
- C. Submit proof of Contractor's Manufacturer Certification for installation and extended warranty of the proposed cable system immediately following issuance of notice to proceed.
- D. As-Built Record Documents: Following completion of the system installation, provide a complete set of as-built documents including, but not limited to the following:
- E. Complete Record Drawings: Showing locations, size and configuration of all components, devices and equipment.
 - 1. As-built one-line schematic diagrams.
 - 2. Detailed as-built drawings.
 - 3. Final Inspection and Test Report:
 - a. Test procedure used.
 - b. Record of any failed tests and corrective action taken, resulting in compliant test results.

1.6. COORDINATION

- A. Coordinate exact location of all outlets with End Users, and the work of other trades prior to rough-in.
- B. Coordinate the location of all floor outlets, modular furniture feed outlets and wall outlets with the Architect and furniture plans prior to rough-in.
- C. Coordinate connections between patch panels with End Users prior to installation of patch cords.
- D. Coordinate connections between patch panels and equipment with the End Users prior to installation of patch cords.
- E. Coordinate exact location rough-ins for modular furniture systems with the Architect and End Users prior to rough-in.
- F. Coordinate location of and connection to equipment of other trades with Contractor responsible for equipment installation prior to rough-in of equipment outlets.
- G. Coordinate cross-connect and telephone circuit requirements with the End Users and the equipment installers prior to rough-in.

1.7. QUALITY ASSURANCE

- A. Quality assurance requirements as defined in Division 1 requirements and as follows:
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- B. All products shall be Listed for the specific application intended as part of this Work.
- C. All products shall be Listed and Labeled by UL or another Nationally Recognized Test Laboratory (NRTL).
- D. At a minimum, the Contractor's Supervisor/Foreman, responsible for this installation of the Work of this Section, shall be trained by the manufacturer for installation of the products installed as part of the Work.

1.8. DELIVERY, STORAGE AND HANDLING

- A. All products shall be delivered to site in the original manufacturer's packaging, distributors packaging or other packaging suitable for protection of the materials.
- B. All products stored off-site and on-site shall be maintained in a manner to protect the materials from weather, corrosion or damage.
- C. All products shall be stored in a secure location under the direct control of the Contractor.
- D. All products shall be handled as recommended by the Manufacturer.
- E. Any products exhibiting evidence of damage, corrosion or defect shall be removed from site and replaced at no additional cost to the End Users.

1.9. TRAINING

- A. After completion of the system installation, the Contractor shall provide training to the End Users on proper methods to inspect, test and maintain the installed system.
- B. The training shall include recommendations for an inspection, testing and maintenance program to be performed by the End Users over the expected lifetime of the system.

1.10. WARRANTY

- A. Provide a warranty as required by Division 1 and as indicated herein.
- B. Structured cable system components from separate manufacturers (e.g. cables and termination hardware) shall be manufacturer tested as an end-to-end solution and verified as an end-to-end solution by a Nationally Recognized Testing Laboratory (NRTL) to meet or exceed all performance requirements as specified in the Standards listed.
- C. Provide a minimum 20-year cable system link performance warranty for the backbone and horizontal distribution cable systems installed as part of the Work. Provide a minimum 15-year warranty on all cable, connectors and termination hardware included as part of the Work, and not otherwise covered by the system performance warranty. Contractor shall be a Manufacturer Certified Contractor for the cable system(s) proposed at the time bids are submitted. Submit proof of Contractor's Manufacturer Certification for installation and extended warranty of the proposed cable system immediately following issuance of notice to proceed.

PART 2. – PRODUCTS

2.1. DESIGN BASIS MANUFACTURERS

- A. Products from the following manufacturers generally conform to the specific design basis for the Work. Subject to product compliance with the requirements of the Construction Documents, acceptable Manufacturer's include, but are not limited to:
1. Corning Cable Systems
 2. Superior Essex
 3. General Cable
 4. Berk-Tek
 5. CommScope
 6. Mohawk
 7. Hubbell
 8. Leviton
 9. Panduit
 10. Ortronics
 11. The Siemon Company
- B. All products provided as part of this Work shall be Listed for their intended use by a Nationally Recognized Testing Laboratory (NRTL).
- C. All products shall be Listed for their specific types, sizes and combinations of conductors and connected items.
- D. Contractor shall be responsible for selection of cable, connectors and termination hardware as required to provide extended warranties as required by the Construction Documents.
- E. All fiber connectors installed or on patch / equipment cords provided shall have ceramic ferrules, and be provided with matching performance rating.
- F. All copper connectors (patch panel ports, jacks, plugs, outlets, patch cords, etc.) shall be provided with matching performance rating.

2.2. SINGLE MODE OPTICAL FIBER

- A. Design Basis Product: Corning SMF-28e+ Optical Fiber or approved equal.
- B. Mode Field Diameter:
1. 1310 nm: 9.2 +/- 0.4 micron
 2. 1550 nm: 10.4 +/- 0.5 micron
- C. Dispersion:

1. 1550 nm: ≤ 18.0 ps/(nm²-km)
2. 1625 nm: ≤ 22.0 ps/(nm²-km)

D. Point Discontinuity:

1. 1310 nm: ≤ 0.05 dB
2. 1550 nm: ≤ 0.05 dB

E. Attenuation:

1. 1310 nm: 0.35 dB/km, maximum
2. 1383 nm: 0.35 dB/km, maximum
3. 1490 nm: 0.24 dB/km, maximum
4. 1550 nm: 0.20 dB/km, maximum
5. 1625 nm: 0.23 dB/km, maximum

F. Macrobend Loss:

Mandrel Radius (mm)	Number of Turns	Wavelength (nm)	Induced Attenuation (dB)
32	1	1550	≤ 0.03
50	100	1310	≤ 0.03
50	100	1550	≤ 0.03
60	100	1625	≤ 0.03

G. Glass Geometry:

1. Core Diameter: 8.2 micron
2. Cladding Diameter: 125.0 \pm 0.7 micron
3. Core-Clad Concentricity: ≤ 0.5 micron
4. Cladding Non-Circularity: $\geq 0.7\%$

H. Coating Geometry:

1. Coating Diameter: 242 \pm 5 micron
2. Coating-Cladding Concentricity: < 12 micron

I. Environmental:

Environmental Test	Test Condition	Induced Attenuation 1310nm, 1550nm and 1625nm (dB/km)
Temperature Dependence	-60 degrees C to +85 degrees C	≤ 0.05

Temperature Humidity Cycling	-10 degrees C to +85 degrees C and up to 98% RH	</= 0.05
Water Immersion	23 degrees C +/- 2 degrees C	</= 0.05
Heat Aging	85 degrees C +/- 2 degrees C	</= 0.05

J. Operating Temperature Range: -60 degrees C to 85 degrees C.

K. Proof Test: >= 100 kpsi, minimum

2.3. MULTIMODE OPTICAL FIBER

A. Design Basis Product: Corning ClearCurve OM4 Multi-mode Optical Fiber, or approved equal

B. Optimized Data Rates and Supported Distances:

1. 1 Gbps - >1000 m
2. 10 Gbps - >300 m
3. 40/100 Gbps - >140m

C. Fiber Type: 50/125, OM4 (ISO/IEC 60793-1-49), ITA/EIA 455-220A

D. Effective Modal Bandwidth:

1. 850 nm: 3500 MHz/km
2. 1300 nm: 500 MHz/km

E. Attenuation:

1. 850 nm: </= 2.3 dB/km, maximum
2. 1300 nm: </= 0.6 dB/km, maximum

F. Macrobend Loss:

Mandrel Radius (mm)	Number of Turns	Induced Attenuation (dB) @ 850nm	Induced Attenuation (dB) @ 1300nm
15	2	</= 0.1	</= 0.3
7.5	2	</= 0.2	</= 0.5

G. Glass Geometry:

1. Core Diameter: 50.0 +/- 2.5 micron
2. Cladding Diameter: 125.0 +/- 1.0 micron
3. Core-Clad Concentricity: </= 1.5 micron
4. Cladding Non-Circularity: >= 1.0%
5. Core Non-Circularity: </= 5%

H. Coating Geometry:

1. Coating Diameter: 242 +/- 5 micron
2. Coating-Cladding Concentricity: <12 micron

I. Environmental:

Environmental Test	Test Condition	Induced Attenuation 850nm & 1300 nm (dB/km)
Temperature Dependence	-60 degrees C to +85 degrees C	</= 0.10
Temperature Humidity Cycling	-10 degrees C to +85 degrees C and 4% to 98% RH	</= 0.10
Water Immersion	23 degrees C +/- 2 degrees C	</= 0.20
Heat Aging	85 degrees C +/- 2 degrees C	</= 0.20
Damp Heat	85 degrees C at 85% RH	</= 0.20

J. Operating Temperature Range: -60 degrees C to 85 degrees C.

K. Proof Test: >/= 100 kpsi, minimum

2.4. OUTSIDE PLANT OPTICAL FIBER BACKBONE CABLE - ISP/OSP DIELECTRIC

- A. For installation in outside plant duct, conduit applications and plenum rated spaces.
- B. Design Basis Product: Corning Cable Systems - FREEDM Gel-Free Cable, or approved equal
- C. Cable Construction: Tight buffer, all dielectric
- D. Fiber Type: As indicated on drawings
- E. Fiber Count: As indicated on drawings
- F. Buffer Tube Diameter: 2.5 mm
- G. Water Blocking Material: Water-swellable tape
- H. Strength Member: Dielectric, aramid fiber or epoxy glass rod
- I. Outer jacket Material: Flame retardant, UV resistant, plenum rated OFNP
- J. Cable Tensile Strength
 1. Short-term: 2700 N (600 lbf)
 2. Long-term: 890N (200 lbf)
- K. Weight: 49 pounds/1000 ft
- L. Outer Diameter: 0.5", maximum
- M. Minimum Bend Radius:

1. Installation: 6.2"

2. Operation: 4.1"

N. Temperature Range:

1. Storage: -40 degrees F to 158 degrees F

2. Installation: -22 degrees F to 158 degrees F

3. Operation: -40 degrees F to 158 degrees F

O. Compliance:

1. ANSI/ICEA S-87-640

2. RoHS

2.5. INSIDE PLANT OPTICAL FIBER BACKBONE CABLE

A. Design Basis Product: Corning Cable Systems – Plenum Rated MIC Distribution Cable, or approved equal

B. For installation between cabinets in the main equipment room.

C. Cable Construction: Tight buffered, all dielectric

D. Fiber Type: As indicated on drawings

E. Fiber Count: As indicated on drawings

F. Strength Member: Aramid yarn

G. Outer jacket Material: Flame retardant PVC

H. UL Listed Flame Rating: OFNP

I. Outer Jacket Color:

1. Multimode: Aqua

2. Single mode: Yellow

3. Composite (SM/MM): Orange

J. Cable Tensile Strength

1. Short-term: 440 N (100 lbf)

2. Long-term: 132N (30 lbf)

K. Minimum Bend Radius:

1. Installation: 20 times cable outside diameter

2. Operation: 10 times cable outside diameter

L. Temperature Range:

1. Storage: -40 degrees F to 158 degrees F

2. Installation: 32 degrees F to 140 degrees F
3. Operation: 32 degrees F to 158 degrees F

M. Compliance:

1. NEC OFNP
2. ICEA S-83-5960
3. RoHS

2.6. INSIDE PLANT OPTICAL FIBER BACKBONE CABLE, ARMORED

- A. Design Basis Product: Corning Cable Systems – Plenum Rated MIC Armored Cable, or approved equal
- B. For installation in cable trays from the main distribution frame to the intermediate distribution frames.
- C. Cable Construction: Tight buffered, interlocking armor
- D. Fiber Type: As indicated on drawings
- E. Fiber Count: As indicated on drawings
- F. Strength Member: Aramid yarn
- G. Outer jacket Material: Flame retardant PVC
- H. UL Listed Flame Rating: OFCP
- I. Outer Jacket Color:
 1. Multimode: Aqua
 2. Single mode: Yellow
 3. Composite (SM/MM): Orange
- J. Cable Tensile Strength
 1. Short-term: 440 N (100 lbf)
 2. Long-term: 132N (30 lbf)
- K. Minimum Bend Radius:
 1. Installation: 20 times cable outside diameter
 2. Operation: 10 times cable outside diameter
- L. Temperature Range:
 1. Storage: -40 degrees F to 158 degrees F
 2. Installation: 32 degrees F to 140 degrees F
 3. Operation: 32 degrees F to 158 degrees F

M. Compliance:

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1. NEC OFCP
2. ICEA S-83-5960
3. RoHS

2.7. INSIDE PLANT MULTI-PAIR UTP COPPER BACKBONE CABLE

- A. Design Basis Product: Superior Essex – Category 5 Plenum, or approved equal
- B. Conductors: 24 AWG, solid, annealed copper
- C. Pair Count: As indicated on drawings
- D. Insulation: Flame retardant PVC
- E. Insulation Color Code: In accordance with telephone industry standards
- F. Core Assembly:
 1. 25 Pairs and Less: Single group
 2. > 25 Pairs: 25 pair groups, color coded unit binder
- G. Jacket: Flame retardant PVC
- H. Weight: 1142 pounds/1000 ft., maximum (25-pair)
- I. Outer Diameter: 0.43", nominal (25-pair)
- J. Minimum Bend Radius:
 1. Installation: 10 times cable outside diameter
 2. Operation: 4 times cable outside diameter
- K. Temperature Range:
 1. Installation: 0 degrees C to 60 degrees C
 2. Operation: -20 degrees C to 75 degrees C
- L. Compliance:
 1. NEC CMP
 2. ANSI/TIA 568-C.2
 3. RoHS

2.8. INSIDE PLANT COAXIAL FLEXIBLE BACKBONE CABLE

- A. Design Basis Product: Commscope 2287V, Series-11 Quad Shield, Plenum Rated Cable, or equal
- B. Center Conductor: Copper-clad steel
- C. Dielectric Material: Foamed FEP
- D. Quad Shield Construction:

1. Bonded aluminum poly tape
 2. 60% tinned copper, 36 AWG wire
 3. Non-bonded aluminum poly tape
 4. 50% tinned copper, 36 AWG wire
- E. Jacket Material: Fire retardant PVC (CMP rated)
- F. Center Conductor Gauge: 14 AWG
- G. Center Conductor Diameter: 0.0641 inch
- H. Dielectric Diameter: 0.278 inch
- I. Inner Shield Tape Diameter: 0.284 inch
- J. Outer Jacket Diameter: 0.356 inch
- K. DC Resistance:
1. Center Conductor: 11.0 ohms/kft
 2. Quad Shield: 1.70 ohms/kft
- L. Nominal Velocity of Propagation: 86%
- M. Characteristic Impedance: 75 ohm
- N. Operating Frequency: 5-2200 MHz
- O. Structural Return Loss: 15 dB @ 1000-3000 MHz, 20 dB @ 5-1000 MHz, 100% sweep tested
- P. Minimum Bend Radius:
1. Loaded: 20 times outside diameter
 2. Unloaded: 10 times outside diameter
- Q. UL Listed: CATVP/CMP
- R. Compliance: RoHS
- S. Electrical Performance:

Frequency (MHz)	Attenuation (dB/100 ft)
1	0.15
10	0.45
50	0.90
100	1.28
200	1.85
400	2.75
700	3.92
900	4.72
1000	5.04

1450	6.67
1800	7.71
2200	8.50
3000	988

2.9. CATEGORY 6A RATED UTP COPPER HORIZONTAL DISTRIBUTION CABLE

- A. Design Basis Product: Superior Essex – 10Gain XP Category 6A CMP, or approved equal
- B. Cable Construction:
 - 1. Four-pair unshielded twisted pair
 - 2. Cross-web separator
 - 3. Non-conductive isolation wrap
- C. Conductors: 23 AWG solid annealed copper
- D. Insulation Material: FEP (CMP rated)
- E. Jacket Material: Fire retardant, low-smoke PVC
- F. Outside Diameter: 0.295”, nominal
- G. Characteristic Impedance: 100 ohms +/- 15 ohms
- H. Velocity of Propagation: 69%, nominal
- I. Alien Cross-talk Isolation: 3 dB greater than ANSI/TIA-568-E requirements
- J. Performance Compliance: ANSI/TIA-568-E
- K. Performance tested to 500 MHz
- L. Minimum Bend Radius: 1.2”
- M. Compliance:
 - 1. NEC CMP
 - 2. ANSI/TIA 568-C.2
 - 3. RoHS
- N. NRTL Programs:
 - 1. UL Verified Cat 6A

2.10. CATEGORY 6A RATED STP (U/FTP) COPPER HORIZONTAL DISTRIBUTION CABLE

- A. Design Basis Product: Superior Essex – 10Gain XP Category 6A CMP, or approved equal
- B. Cable Construction:
 - 1. Four-pair unshielded twisted pair
 - 2. Cross-web separator

- 3. Drain wire, tri-coated
 - 4. Non-conductive isolation wrap
 - C. Conductors: 23 AWG solid annealed copper
 - D. Insulation Material: FEP (CMP rated)
 - E. Jacket Material: Fire retardant, low-smoke PVC
 - F. Outside Diameter: 0.32", nominal
 - G. Characteristic Impedance: 100 ohms +/- 15 ohms
 - H. Velocity of Propagation: 77%, nominal
 - I. Alien Cross-talk Isolation: 3 dB greater than ANSI/TIA-568-E requirements
 - J. Performance Compliance: ANSI/TIA-568-E
 - K. Performance tested to 500 MHz
 - L. Minimum Bend Radius: 1.2"
 - M. Compliance:
 - 1. NEC CMP
 - 2. ANSI/TIA 568-C.2
 - 3. RoHS
 - N. NRTL Programs:
 - 1. UL Verified Cat 6A
- 2.11. CATEGORY 6A RATED UTP COPPER HORIZONTAL DISTRIBUTION CABLE – WET/DAMP LOCATION
- A. Design Basis Product: Superior Essex – OSP Broadband Category 6A, or approved equal
 - B. For use in slab on grade outlets and cables installed in slab-on grade raceways.
 - C. Cables shall be transitioned to plenum rated cables in a consolidation point above accessible ceiling
 - D. Contractor shall bond the cable screen to ground in the outlet box and in the consolidation point.
 - E. Contractor shall extend an insulated ground conductor from the consolidation point to the serving telecommunications room for this purpose, size conductor per Motorola R56.
 - F. Cable Construction:
 - 1. Four-pair screened twisted pair
 - 2. Cross-web separator
 - 3. Gel-filled, water repellent core

- 4. Polyethylene inner jacket
- 5. Powder or yarn dry water block
- 6. Aluminum tape shield
- 7. Polyethylene outer jacket
- G. Conductors: 23 AWG solid annealed copper
- H. Insulation Material: Polyolefin
- I. Jacket Material: Sunlight and weather resistant polyethylene
- J. Outside Diameter: 0.39", nominal
- K. Characteristic Impedance: 100 ohms +/- 15 ohms
- L. Velocity of Propagation: 68%, nominal
- M. Performance Compliance: ANSI/TIA-568-E
- N. Performance tested to 500 MHz
- O. Compliance:
 - 1. NEC CMP
 - 2. ANSI/TIA 568-E
 - 3. RoHS
- P. NRTL Programs:
 - 1. UL Verified Cat 6A

2.12. CATEGORY 6 RATED UTP COPPER HORIZONTAL DISTRIBUTION CABLE

- A. Design Basis Product: Superior Essex – NextGain Category 6eX CMP, or approved equal
- B. Cable Construction:
 - 1. Four-pair unshielded twisted pair
 - 2. Cross-web separator
- C. Conductors: 23 AWG solid annealed copper
- D. Insulation Material: FEP (CMP rated)
- E. Jacket Material: Fire retardant, low-smoke PVC
- F. Outside Diameter: 0.295", nominal
- G. Characteristic Impedance: 100 ohms +/- 15 ohms
- H. Velocity of Propagation: 75%, nominal
- I. Near-end Cross-talk Isolation: 6 dB greater than ANSI/TIA-568-C.2 requirements
- J. Attenuation to Cross-talk Ratio:

1. 30 dB at 100 MHz
 2. 11.7 dB at 250 MHz
- K. Performance Compliance: ANSI/TIA-568-E
- L. Performance tested to 250 MHz
- M. Minimum Bend Radius: 1.2”
- N. Compliance:
1. NEC CMP
 2. ANSI/TIA 568-E
 3. RoHS
- O. NRTL Programs:
1. UL Verified Cat 6
- 2.13. CATEGORY 6 RATED UTP COPPER HORIZONTAL DISTRIBUTION CABLE – WET/DAMP LOCATION
- A. Design Basis Product: Superior Essex – OSP Broadband Category 6, or approved equal
 - B. For use in slab on grade outlets and cables installed in slab-on grade raceways.
 - C. Cables shall be transitioned to plenum rated cables in a consolidation point above accessible ceiling
 - D. Contractor shall bond the cable screen to ground in the outlet box and in the consolidation point.
 - E. Contractor shall extend an insulated ground conductor from the consolidation point to the serving telecommunications room for this purpose, conductor size per Motorola R56.
 - F. Cable Construction:
 1. Four-pair screened twisted pair
 2. Cross-web separator
 3. Gel-filled, water repellent core
 4. Polyethylene jacket
 - G. Conductors: 23 AWG solid annealed copper
 - H. Insulation Material: Polyolefin
 - I. Jacket Material: Sunlight and weather resistant polyethylene
 - J. Outside Diameter: 0.30”, nominal
 - K. Characteristic Impedance: 100 ohms +/- 15 ohms
 - L. Velocity of Propagation: 68%, nominal

M. Performance Compliance: ANSI/TIA-568-E

N. Performance tested to 250 MHz

O. Compliance:

1. NEC CMP
2. ANSI/TIA 568-E
3. RoHS

P. NRTL Programs:

1. UL Verified Cat 6

2.14. OPTICAL FIBER CONNECTORS

A. Design Basis Product:

1. Corning Cable Systems – UniCam Connectors, or approved equal
2. Corning Cable Systems – Epoxy Polish Connectors, or approved equal

B. Contractor may provide no-epoxy type connectors for field termination of fibers to 900 micron buffered multimode fiber strands in fiber termination enclosures and outlet boxes.

C. Termination of 250 micron coated fiber strands shall be made with epoxy type connectors or fusion splicing to factory assembled pigtails.

D. No-epoxy connectors shall have a factory assembled and polished fiber stub in the connector ferrule.

E. Termination of angle polished connectors shall be by fusion splicing to factory assembled pigtails.

F. Connectors for factory assembled pigtails shall meet or exceed the connector requirements as specified herein.

G. Connector Type:

1. Duplex LC/UPC: for multimode connections.
2. Simplex LC/APC: for single mode fiber connections.

H. Connector Ferrule: Ceramic

I. Fiber Type:

1. Multimode: OM3/OM4 50 micron core
2. Single mode: 8.2 micron core

J. Insertion Loss (mated pair):

1. Multi-mode Fiber: 0.1 dB, typical; 0.5 dB, maximum
2. Single mode Fiber: 0.2 dB, typical; 0.5 dB, maximum

3. Angle Polished Connector: 0.2 dB, typical; 0.5 dB, maximum

K. Reflectance:

1. Multimode: ≤ -20 dB
2. Single mode: ≤ -55 dB
3. Angle Polished Connector: ≥ -65 dB

L. Housing Color:

1. Multimode: Aqua
2. Single mode: Blue
3. Angle Polished Connector: Green

M. Connector Tensile Strength:

1. Jacketed Cable: 10 lb, change ≤ 0.2 dB, FOTP-6
2. 900 micron Buffered Fiber: 0.5 lb, change ≤ 0.2 dB, FOTP-6

N. Operating Temperature: -40 degrees F to 167 degrees F

O. Compliance:

1. ANSI/TIA 568-E
2. RoHS

P. Contractor shall provide cable furcation kits for direct termination of 250 micron fibers.

Q. Contractor shall provide cable furcation kits for direct termination of 900 micron fibers terminated in outlet boxes.

1. Furcation kits shall build up the fiber to a minimum of 2 mm.
2. Fiber connectors shall be sized to crimp to furcation kit jacket material

2.15. CATEGORY 6A RATED COPPER CONNECTORS

A. Design Basis Product: Leviton eXtreme 6a Cat 6A UTP Connectors, or approved equal

B. Contact Configuration: 8 position, 8 contact (8p8c / RJ-45), non-keyed

C. Contact Material: Copper based alloy plated with 50 microinches of gold over 100 microinches of nickel.

D. Connection Type: 110 Style, insulation displacement contacts

E. Connector Body: Keystone type

F. Connector Body Material: High-impact, fire retardant plastic, UL 94V-0

G. Color: As indicated on Drawings

H. Performance Compliance: ANSI/TIA/EIA 568-E up to 500 MHz

I. Compliance: RoHS

2.16. CATEGORY 6A RATED STP COPPER CONNECTORS

- A. Design Basis Product: Leviton Atlas-X1 Cat 6A STP Connectors, or approved equal
- B. Contact Configuration: 8 position, 8 contact (8p8c / RJ-45), non-keyed
- C. Contact Material: Copper based alloy plated with 50 microinches of gold over 100 micro-inches of nickel.
- D. Connection Type: 110 Style, insulation displacement contacts
- E. Connector Body: Keystone type
- F. Connector Body Material: High-impact, fire retardant plastic, UL 94V-0
- G. Color: As indicated on Drawings
- H. Performance Compliance: ANSI/TIA/EIA 568-E up to 500 MHz
- I. Compliance: RoHS

2.17. CATEGORY 6 RATED COPPER CONNECTORS

- A. Design Basis Product: Leviton eXtreme 6+ Cat 6 UTP Connectors, or approved equal
- B. Contact Configuration: 8 position, 8 contact (8p8c / RJ-45), non-keyed
- C. Contact Material: Copper based alloy plated with 50 micro-inches of gold over 100 micro-inches of nickel.
- D. Connection Type: 110 Style, insulation displacement contacts
- E. Connector Body: Keystone type
- F. Connector Body Material: High-impact, fire retardant plastic, UL 94V-0
- G. Color: As indicated on Drawings
- H. Performance Compliance: ANSI/TIA/EIA 568-E up to 250 MHz
- I. Compliance: RoHS

2.18. WALL MOUNT AND WIRELESS ACCESS POINT OUTLET PLATES

- A. Design Basis Product: Leviton QuickPort Stainless Steel Wall-plates, or approved equal
- B. For wall mount outlets and wireless access point outlets.
- C. Faceplate Configuration: Single gang, 4-port
- D. Material:
 - 1. Faceplate: 304 stainless steel
 - 2. Connector Carrier: ABS plastic, UL 94V-O
- E. Port Count: As indicated on Drawings
- F. Port Configuration: As indicated on Drawings.

- G. Dimensions: Single Gang: 4.5" x 2.75", nominal
- H. Compliance: RoHS

2.19. WALL PHONE OUTLET PLATES

- A. Design Basis Product: Leviton QuickPort Stainless Steel Wall-plates, or approved equal
- B. Faceplate Configuration: Single gang
- C. Single port
- D. Flush mount connector
- E. Wall-phone mounting studs
- F. Material:
 - 1. Faceplate: 302 stainless steel
 - 2. Connector Carrier: ABS plastic, UL 94V-O
- G. Dimensions: Single Gang: 4.50" x 2.75", nominal
- H. Compliance: RoHS

2.20. MODULAR FURNITURE OUTLET PLATES

- A. Design Basis Product: Leviton QuickPort Modular Furniture Plates, or approved equal
- B. Faceplate Configuration: 4-port, horizontal (when used in PSAP Console Systems Furniture, provide 10-ports terminated on a patch panel)
- C. Material: ABS plastic, UL94V-0 rated.
- D. Port Count: As indicated on Drawings
- E. Port Configuration: As indicated on Drawings.
- F. Dimensions:
 - 1. Extended Depth: 3.25" x 1.76" x 0.75"
 - 2. Herman Miller: 3.65" x 2.18" x 0.25"
- G. The End Users will be using existing modular furniture from a variety of manufacturers. Contractor shall coordinate specific size of modular furniture baseplate knockouts and appropriate quantities of each size prior to ordering modular furniture faceplates.
- H. Compliance: RoHS

2.21. FURNITURE FEED OUTLET PLATES – WALL MOUNT

- A. Design Basis Product: Leviton Wallplates, or approved equal
- B. Material: 302 stainless steel
- C. Dimensions: double gang, 4.5" x 4.6"

- D. Contractor shall provide punched faceplates with liquid tight connectors and raceway to transition from wall mount furniture feed to modular furniture.
- E. Provide double gang faceplate with a 1-1/4" liquid tight flex conduit for a single furniture unit feed of up to six (6) Category rated cables.
- F. Provide double gang faceplate with a 1-1/2" liquid tight flex conduit for multiple furniture fees for up to eight (8) Category rated cables.
- G. Liquid tight conduits shall be of sufficient length to minimize stress on the connectors, wall boxes or cables.
- H. Provide multiple furniture feeds at locations exceeding the cable quantities indicated above or where furniture configuration will not support larger liquid tight conduit sizes.
- I. Configuration:
 - 1. Punched for liquid tight connector.
 - 2. Provide liquid tight conduit from faceplate to modular furniture base plates for cable feed to furniture.
 - 3. Provide liquid tight conduit connectors at the faceplate and modular furniture baseplate.
 - 4. Provide 180 degree and 45 degree liquid tight connectors as required by furniture and outlet configuration. 90 degree liquid tight connectors shall not be used.

2.22. EQUIPMENT OUTLET BOXES

- A. Design Basis Manufacturer: Leviton QuickPort Surface Mount Housing
- B. For connections to equipment requiring network or telephone connections.
- C. For installation in equipment enclosures or in a NEMA 1 box adjacent to equipment enclosures.
- D. Material: High impact ABS plastic, UL94V-0 rated.
- E. Port Count: One or two port, as required by cable count.
- F. Labeling window.
- G. Color: White.
- H. Dimensions:
 - 1. 1-Port: 1.5" x 2.25" x 1.0", nominal
 - 2. 2-Port: 2.5" x 2.25" x 1.0", nominal
- I. Provide 6" x 6" x 4" NEMA 1 enclosures and conduit where equipment outlet box cannot be installed inside the equipment enclosure as described in Part 3, Execution.

2.23. RAISED FLOOR BOX OUTLET PLATES

- A. Design Basis Manufacturer: As required for installation in raised floor boxes.

2.24. CAST-IN-PLACE FLOOR BOX OUTLET PLATES

- A. Design Basis Manufacturer: As required for installation in cast-in place floor boxes as specified in Section 16130. Coordinate with Architect and other trades for cable pathways and penetrations.
- B. Slab on grade outlets shall be installed with wet/damp location cable, however wet/damp location connectors and faceplates are not required in slab on grade outlets unless otherwise noted.

2.25. POKE-THROUGH FLOOR BOX OUTLET PLATES

- A. Design Basis Manufacturer: As required for installation in poke-through floor boxes. Coordinate with Architect and other trades for cable termination spaces.

2.26. WET/DAMP LOCATION OUTLET PLATES

- A. Design Basis Product: Leviton DuraPort Stainless Steel Wallplates, or approved equal
- B. For use where weatherproof or wet/damp location outlet (WP) is indicated on Drawings.
- C. Provide with connectors as indicated by outlet type.
- D. Faceplate Configuration:
 - 1. Single gang: 1-port and 2-port
 - 2. Double gang: 2-port and 4-port
- E. Material:
 - 1. Faceplate: 304 stainless steel
 - 2. Connector Carrier: ABS plastic, UL 94V-O
- F. Port Count: As indicated on Drawings
- G. Port Configuration: As indicated on Drawings.
- H. Over-molded faceplate gasket
- I. Captive connector cap
- J. Dimensions:
 - 1. Single Gang: 4.5" x 2.75"
 - 2. Double Gang: 4.5" x 4.60"
- K. Environmental: IP67, dust-tight, temporary water immersion
- L. Compliance: RoHS

2.27. FIBER TERMINATION ENCLOSURES, RACK MOUNT

- A. Design Basis Product: Corning Cable Systems – Closet Connector Housing (CCH), or approved equal

- B. 19" cabinet/rack mount fiber termination enclosure
- C. Dimensions:
 - 1. Up to 24 Strands fiber: 3.5" x 17" x 17"
 - 2. Over 24 strands fiber: 7" x 17" x 17"
- D. Capacity:
 - 1. Two Rack Unit Enclosure: Four connector panels
 - 2. Four Rack Unit Enclosure: Eight connector panels
- E. Connector Panels:
 - 1. Duplex LC: 12 strands per panel
 - 2. Simplex LC: 12 strands per panel
- F. Locking front and rear access
- G. Material:
 - 1. Housing: White powder coated steel
 - 2. Covers: Tinted polycarbonate
- H. Compliance: RoHS
- I. Provide with splice trays/cassettes when used with fusion spliced pigtails.
- J. Provide with slack management cassettes when used with field terminated connectors.
- K. Provide with cable strain relieve and fiber management devices.
- L. Provide with blank filler panels in all unused panel spaces.

2.28. FIBER TERMINATION ENCLOSURES, WALL MOUNT

- A. Design Basis Product: Corning Cable Systems – Industrial Connector Housing (ICH), or approved equal
- B. Wall-mount fiber termination enclosure.
- C. Dimensions: 10-1/2" high x 13" wide x 5-1/2" deep, nominal.
- D. Capacity: Two connector panels.
- E. Connector Panels: Duplex LC, 12 strands per panel.
- F. Locking termination cover.
- G. Padlock hasp on enclosure cover.
- H. Material: White powder coated steel
- I. Compliance: RoHS
- J. Provide with splice trays and splice tray holders when used with fusion spliced pigtails.

- K. Provide with cable strain relieve and fiber management devices.
- L. Provide with blank filler panels in all unused panel spaces.

2.29. FIBER TERMINATION ENCLOSURES, VERTICAL MOUNT

- A. Design Basis Product: Leviton Vertigo Series, or approved equal
- B. For terminating six to twelve strands of multimode fiber inside vertical wall mount equipment cabinets.
- C. Dimensions: 10-1/2" high x 2-1/2" wide x 2-1/2" deep, nominal.
- D. Capacity: One connector panels.
- E. Connector Panels: Duplex LC, 12 strands per panel.
- F. Material: Black powder coated steel
- G. Compliance: RoHS
- H. Provide with cable strain relieve and fiber management devices.
- I. Provide with blank filler panels in all unused panel spaces.

2.30. SPLICE TRAYS

- A. Design Basis Product: Corning M67 Series Splice Trays, or approved equal.
- B. For housing fusion splices in fiber termination enclosures and outdoor enclosures.
- C. Material: Aluminum body and cover
- D. Splice Chip: for housing 12 or 6 heat shrink protected fusion splices, as required
- E. Designed to support the bend radius of single-mode and multimode fiber at all wavelengths.
- F. Mounting hole for stud mounting in enclosures.
- G. Dimensions:
 - 1. 12 fiber: 11.7" x 3.9" x 0.2:
 - 2. 6 fiber: 7.3" x 3.5" x 0.2"
- H. Provide with heat shrink fusion splice protectors, quantity as required.

2.31. TERMINATION BLOCKS - TELEPHONE

- A. Design Basis Product: Leviton: Cat. 6, 110-Style Cross-Connect Blocks, or approved equal
- B. For use as cross connect at telephone service provider demarcation point only.
- C. Configuration:
 - 1. Wall-mount wiring blocks with legs

- 2. 50-pair, 100-pair or 300-pair as required
- D. Connector Blocks: 5-pair connector blocks
- E. Dimensions:
 - 1. 50-pair: 1.81" x 10.7" x 3.3"
 - 2. 100-pair: 3.62" x 10.7" x 3.3"
 - 3. 300-pair: 10.83" x 10.7" x 3.3"
- F. Materials:
 - 1. Fire retardant plastic, UL 94V-O
 - 2. Insulation displacement contacts: Solder plated
- G. Provide with labels and label holders

2.32. TERMINATION BLOCKS - CATEGORY RATED

- A. Design Basis Product: Leviton: Cat. 6 or Cat 6A (match cable performance and construction type) 110-Style Connecting Blocks or approved equal. Do not mix different performance cables on the same termination field.
- B. For use as interconnect between outside plant rated and inside plant rated cables at Consolidation Points only.
- C. Configuration:
 - 1. Wall-mount wiring blocks with legs
 - 2. 96-pair
- D. Connector Blocks: 4-pair connector blocks
- E. Dimensions: 3.62" x 10.7" x 3.3"
- F. Materials:
 - 1. Fire retardant plastic, UL 94V-O
 - 2. Insulation displacement contacts: Solder plated
- G. Provide with labels and label holders

2.33. CROSS-CONNECT WIRE

- A. Single-pair 24-AWG plastic insulated cross-connect wire.
- B. Category 3 or higher rated performance.
- C. Blue/white color-coded wires.

2.34. CLOCK AND CONTROL CIRCUIT WIRE

- A. Design Basis Manufacturer: West Penn

- B. For synchronized clock RS-485 2-wire circuit and door release dry contact circuits.
- C. Cable Construction: Two conductor, twisted, unshielded
- D. Conductors: 18 AWG stranded
- E. Insulation Material: Polymer Alloy
- F. Jacket Material: Fire retardant, low-smoke PVC
- G. Outside Diameter: 0.154", nominal
- H. Jacket Color: Gray
- I. Compliance:
 - 1. NEC CMP
 - 2. RoHS
- J. Color: White.

2.35. CATEGORY 6A RATED COPPER PATCH PANELS

- A. Design Basis Product: Leviton eXtreme CAT 6A Patch Panels, or approved equal
- B. For termination of Category 6A cables in telecommunications spaces
- C. Match cable construction (UTP or STP), do not mix different performance or cable construction types on the same patch panel.
- D. Panel Configuration: Angled
- E. Contact Configuration: 8 position, 8 contact (8p8c / RJ-45), non-keyed
- F. Contact Material: Copper based alloy plated with 50 micro-inches of gold over 100 micro-inches of nickel
- G. Connection Type: 110 Style, insulation displacement contacts
- H. Connector Configuration: Printed circuit board modules
- I. Panel Material: 16 gauge steel, black powder coat
- J. Printed Circuit Board and Plastics: UL 94V-O
- K. Dimensions:
 - 1. 24-Port: 1.75" x 19" x 4.82"
 - 2. 48-port: 3.5" x 19" x 4.82"
- L. Performance Compliance:
 - 1. ANSI/TIA/EIA-568-C.2 up to 500 MHz
 - 2. IEEE 802.3an, 10GBaseT
 - 3. NRTL (ETL) Verified Category 6A component performance

- M. Compliance:

1. RoHS
2. UL Listed

2.36. CATEGORY 6 RATED COPPER PATCH PANELS

- A. Design Basis Product: Leviton eXtreme CAT 6+ Patch Panels, or approved equal
- B. For termination of telecommunications and Audio/Video outlet Category 6 cables in telecommunications spaces.
- C. Match cable construction (UTP or STP), do not mix different performance or cable construction types on the same patch panel.
- D. Panel Configuration: Angled
- E. Contact Configuration: 8 position, 8 contact (8p8c / RJ-45), non-keyed
- F. Contact Material: Copper based alloy plated with 50 micro-inches of gold over 100 micro-inches of nickel
- G. Connection Type: 110 Style, insulation displacement contacts
- H. Connector Configuration: Printed circuit board modules
- I. Panel Material: 16 gauge steel, black powder coat
- J. Printed Circuit Board and Plastics: UL 94V-O
- K. Dimensions:
 1. 24-Port: 1.75" x 19" x 4.82"
 2. 48-port: 3.5" x 19" x 4.85"
- L. Performance Compliance:
 1. ANSI/TIA/EIA-568-C.2 up to 250 MHz
 2. IEEE 802.3ab, 1000BaseT
 3. NRTL (ETL) Verified Category 6 component performance
- M. Compliance:
 1. RoHS
 2. UL Listed

2.37. CATEGORY 6A RATED COPPER PATCH PANELS

- A. Design Basis Product: Leviton eXtreme CAT 6A Patch Panels, or approved equal
- B. For termination of Security Network and Facility Network Category 6A cables in telecommunications spaces.
- C. Match cable construction (UTP or STP), do not mix different performance or cable construction types on the same patch panel.

- D. Panel Configuration: Flat
- E. Provide horizontal cable management above and below each flat patch panel.
- F. Contact Configuration: 8 position, 8 contact (8p8c / RJ-45), non-keyed
- G. Contact Material: Copper based alloy plated with 50 micro-inches of gold over 100 micro-inches of nickel
- H. Connection Type: 110 Style, insulation displacement contacts
- I. Connector Configuration: Printed circuit board modules
- J. Panel Material: 16 gauge steel, black powder coat
- K. Printed Circuit Board and Plastics: UL 94V-O
- L. Dimensions:
 - 1. 24-Port: 1.75" x 19" x 1.48"
 - 2. 48-port: 3.5" x 19" x 1.48"
- M. Performance Compliance:
 - 1. ANSI/TIA/EIA-568-C.2 up to 250 MHz
 - 2. IEEE 802.3ab, 1000BaseT
 - 3. NRTL (ETL) Verified Category 6A component performance
- N. Compliance:
 - 1. RoHS
 - 2. UL Listed

2.38. CATEGORY 6 RATED COPPER PATCH PANELS

- O. Design Basis Product: Leviton eXtreme CAT 6+ Patch Panels, or approved equal
- P. For termination of Security Network and Facility Network Category 6 cables in telecommunications spaces.
- Q. Match cable construction (UTP or STP), do not mix different performance or cable construction types on the same patch panel.
- R. Panel Configuration: Flat
- S. Provide horizontal cable management above and below each flat patch panel.
- T. Contact Configuration: 8 position, 8 contact (8p8c / RJ-45), non-keyed
- U. Contact Material: Copper based alloy plated with 50 micro-inches of gold over 100 micro-inches of nickel
- V. Connection Type: 110 Style, insulation displacement contacts
- W. Connector Configuration: Printed circuit board modules

X. Panel Material: 16 gauge steel, black powder coat

Y. Printed Circuit Board and Plastics: UL 94V-O

Z. Dimensions:

1. 24-Port: 1.75" x 19" x 1.48"

2. 48-port: 3.5" x 19" x 1.48"

AA. Performance Compliance:

1. ANSI/TIA/EIA-568-C.2 up to 250 MHz

2. IEEE 802.3ab, 1000BaseT

3. NRTL (ETL) Verified Category 6 component performance

BB. Compliance:

1. RoHS

2. UL Listed

2.39. CATEGORY 5E RATED COPPER PATCH PANELS

A. Design Basis Product: Leviton Voice Grade Patch Panels, or approved equal

B. For termination of telephone backbone telecommunications spaces

C. Match cable construction (UTP or STP), do not mix different performance or cable construction types on the same patch panel.

D. Panel Configuration: Flat

E. Provide horizontal cable management above and below each flat patch panel.

F. Contact Configuration: 8 position, 8 contact (8p8c / RJ-45), non-keyed

G. Contact Material: Copper based alloy plated with 50 micro-inches of gold over 100 micro-inches of nickel

H. Connection Type: 110 Style, insulation displacement contacts

I. Connector Configuration: Printed circuit board modules

J. Panel Material: 16 gauge steel, black powder coat

K. Printed Circuit Board and Plastics: UL 94V-O

L. Dimensions:

1. 24-Port: 1.75" x 19" x 1.48"

2. 48-port: 3.5" x 19" x 1.48"

M. Performance Compliance:

1. ANSI/TIA/EIA-568-E

2. IEEE 802.3, 10BaseT

3. NRTL (ETL) Verified Category 5e component performance

N. Compliance:

1. RoHS
2. UL Listed

2.40. PRIMARY PROTECTORS - DATA GRADE

- A. Design Basis Manufacturer: ITW/Linx Category 6 Building Entrance Surge Protector, or approved equal.
- B. Wall mount 4-pair building entrance protector.
- C. 110-style input connection.
- D. 110-style output connection.
- E. Solid state protectors
- F. Clamping Level: 16V
- G. Response Time: 1-5 nanoseconds
- H. Capacitance: < 5 pF
- I. Dimensions: 4.25" x 4.25" x 1.5"
- J. Compliance: UL 497 Listed for Primary Protection

2.41. OPTICAL FIBER CORDS

- A. Design Basis Product: Corning Cable Systems – Fiber Cable Assemblies, or approved equal
- B. Contractor shall provide single fiber cable assemblies for connection and patching of single channel video system equipment and other equipment as indicated.
- C. Contractor shall provide two fiber cable assemblies for connection and patching of telecommunications equipment, servers, network switch uplinks, audio/video equipment and other equipment as indicated.
- D. All jumper cords shall be factory made.
- E. Single-mode fibers and connectors shall meet or exceed the requirements specified herein.
- F. Multimode fibers and connectors shall meet or exceed the requirements specified herein.
- G. Contractor shall coordinate exact requirements for equipment cords and work area cords with the End Users prior to ordering products.
- H. Contractor shall coordinate exact lengths for patch cords, equipment cords and work area cords with End Users prior to ordering products.
- I. Single Fiber Cable Assemblies

1. Single fiber cable
2. Single mode: Yellow cable jacket
3. Multimode: Aqua cable jacket
4. LC to LC connectors
5. LC to other connectors as required by terminal equipment

J. Two Fiber Cable Assemblies

1. Two fiber cable
2. Single mode: Yellow cable jacket
3. Multimode: Aqua cable jacket
4. Duplex LC to duplex LC connectors
5. Duplex LC to other connectors as required by terminal equipment

K. Patch Cords

1. Cord Length: 1 meter, 3 meter, 5 meter, 7 meter cable assemblies as required and as coordinated with End Users
2. Quantity:
 - a. Provide one patch cord and one equipment cord for each fiber equipment outlet and fiber work area outlet provided as part of this project.
 - b. Provide ten (10) 3 meter patch cords for connecting to servers, network equipment and other equipment.

L. Equipment Cords

1. Cord Length: 1 meter and 3 meter cable assemblies as required and as coordinated with End Users.
2. Quantity: One equipment cord for each fiber equipment outlet provided as part of this project.

M. Work Area Cords

1. Cord Length: 1 meter and 3 meter cable assemblies as required and as coordinated with End Users.
2. Quantity: One work area cord for each fiber work area outlet provided as part of this project.

2.42. CATEGORY 6A RATED COPPER CORDS

- A. Design Basis Product: Leviton eXtreme Category 6A Patch Cords, or approved equal
- B. Contractor shall provide Category 6A patch cords and work area cords for each Category 6A outlet provided as part of this project.

- C. Contractor shall coordinate exact requirements for equipment cords and work area cords with the End Users prior to ordering products.
- D. Contractor shall coordinate exact lengths for patch cords, equipment cords and work area cords with End Users prior to ordering products.
- E. Contractor shall coordinate colors of cords with End Users prior to ordering products.
- F. All patch cords shall be factory made.
- G. Copper cords shall meet or exceed the requirements for copper cable systems specified herein.
- H. Conductors: 26 AWG stranded copper
- I. Connector: 8P8C male plug
- J. Snag-less connector or snag-less boot
- K. Patch Cords:
 - 1. Cord Length: 3 foot, 5 foot, 7 foot, 10 foot, 15 foot and 20 foot cable assemblies as required and as coordinated with End Users
 - 2. Quantity:
 - a. Provide one patch cord for each Category 6A work area outlet jack provided as part of this project.
 - b. Provide twenty (20) 10 foot patch cords for connecting to servers, network equipment and other equipment.
- L. Equipment Cords
 - 1. Cord Length: 15 foot and 20 foot cable assemblies as coordinated with End Users.
 - 2. Quantity: One work area cord for each Category 6A work area outlet provided as part of this project.

2.43. CATEGORY 6 RATED COPPER CORDS

- A. Design Basis Product: Leviton eXtreme Category 6+ Patch Cords, or approved equal
- B. Contractor shall provide Category 6 patch cords, equipment cords and work area cords for each Category 6 outlet provided as part of this project.
- C. Contractor shall coordinate exact requirements for equipment cords and work area cords with the End Users prior to ordering products.
- D. Contractor shall coordinate exact lengths for patch cords, equipment cords and work area cords with End Users prior to ordering products.
- E. All patch cords shall be factory made.
- F. Contractor shall coordinate colors of cords with End Users prior to ordering products.

- G. Copper cords shall meet or exceed the respective requirements for copper cable systems as specified herein.
- H. Conductors: 24 AWG stranded copper
- I. Connector: 8P8C male plug
 - 1. Snag-less connector or snag-less boot
- J. Patch Cords:
 - 1. Cord Length: 3 foot, 5 foot, 7 foot, 10 foot, 15 foot and 20 foot cable assemblies as required and as coordinated with End Users.
 - 2. Quantity: Provide one patch cord for each Category 6 work area outlet jack and equipment outlet jack provided as part of this project.
- K. Equipment Cords
 - 1. Cord Length: 15 foot and 20 foot cable assemblies as required and as coordinated with equipment to be installed by this Contractor or other trades.
 - 2. Quantity: One equipment cord for each Category 6 equipment outlet jack provided as part of this project.

PART 3. PART 3 – EXECUTION

3.1. INSTALLATION - GENERAL

- A. All products and materials shall be installed in accordance with the Manufacturer's printed instructions and as otherwise recommended by the Manufacturer.
- B. All work shall be installed as shown on the drawings and as specified herein unless otherwise approved by the Professional.

3.2. BACKBONE CABLE

- A. Cables shall be installed using pulling and placement methods approved by the manufacturer.
- B. Cable maximum pulling tension and minimum installation bend radius shall not be exceeded during installation.
- C. Cables shall be placed and supported so that the minimum operational bend radius and maximum long-term cable tension are not exceeded.
- D. Install backbone cables using break-away swivels and tension meter or dynamometer when pulling cables with a winch.
- E. Use only cable pulling lubricants approved by the cable Manufacturer. Cable lubricants shall be specifically approved by the cable manufacturer for each type of cable installed.
- F. Thoroughly clean the interior of in slab, slab-on grade and underground conduits with duct swabs prior to the installation of cables.

- G. Mandrel test all underground conduits 2 inches and larger with flexible duct mandrels prior to the installation of cables.
- H. Support all cables to the wall or vertical cable ladder at minimum 3 foot intervals (per Motorola R56) in vertical runs.
- I. Do not bundle or tie cables in cable trays, do not bundle cable in groups greater than 24 cables to minimize power over Ethernet (PoE) heat build up.
- J. Install backbone cables separate from horizontal distribution cables in cable trays and conduits.
- K. Install backbone cables separate from other low-voltage systems cables in cable trays and conduits.
- L. Bundle backbone cables separate from other low-voltage systems cables in overhead or vertical cable ladders.
- M. Dress cables and bundle on overhead cable ladder, through the vertical managers and to the rear of termination patch panels and fiber enclosures.
- N. Bundle cables using 1/2" wide hook and loop (Velcro) cable fasteners, do not use plastic wire ties on any cables.
- O. Provide a minimum of 10 feet of cable slack for each backbone cable.
 - 1. In telecommunications rooms, cable slack shall be dressed to the overhead cable ladder above the termination rack.
 - 2. In the main equipment room, cable slack shall be dressed inside the termination cabinet.
- P. Label each backbone cable at both ends of the cable and at each pull box or hand-hole location in accordance with the approved labeling scheme. Refer to Section 270500, Common Work Results - Communications for labeling requirements.
- Q. Any cable damaged or during installation shall be removed and replaced at no additional cost to the End Users or Department.
- R. Any cable that exceeds minimum bend radius or maximum pulling tension during installation shall be removed and replaced at no additional cost to the End Users or Department.

3.3. HORIZONTAL DISTRIBUTION CABLE

- A. Cables shall be installed using pulling and placement methods approved by the manufacturer.
- B. Cable maximum pulling tension and minimum installation bend radius shall not be exceeded during installation.
- C. Cables shall be placed and supported so that the minimum operational bend radius and maximum long-term cable tension are not exceeded.

- D. Use only cable pulling lubricants approved by the cable Manufacturer. Cable lubricants shall be specifically approved by the cable manufacturer for each type of cable installed.
- E. Support all cables to the wall or vertical cable ladder at minimum 5 foot intervals in vertical runs.
- F. Do not bundle or tie cables in cable trays.
- G. Bundle cables to J-hooks using ½" hook and loop type (Velcro) fasteners. Bundle and secure cables in J-hooks only as required to maintain a neat cable dress. Do not bundle cables between J-hooks.
- H. Install a maximum of 24 UTP cables per bundle.
- I. Install horizontal distribution cables separate from backbone cables in cable trays and conduits.
- J. Install horizontal distribution cables separate from other low-voltage systems cables in cable trays and conduits.
- K. Bundle backbone cables separate from other low-voltage systems cables in overhead or vertical cable ladders.
- L. Dress cables and bundle on overhead cable ladder, through the vertical managers and to the rear of termination patch panels and fiber enclosures.
- M. Provide a minimum of 10 feet of cable slack on each cable at the outlet end. Coil and secure the cable slack at the entrance of the conduit feeding the outlet.
- N. Provide a minimum of 20 feet of cable slack on each cable feeding wireless access point outlets. Coil and secure the cable slack at the wireless access point outlet mounting bracket.
- O. Provide a minimum of 10 feet of cable slack on each cable at the telecommunications space termination rack or cabinet.
 - 1. Dress and secure the cable slack on the cable ladder above the termination racks.
 - 2. Dress and secure the cable slack in the rear of the cable termination cabinets.
 - 3. If insufficient room exists to store the cable slack in the termination cabinets, dress and store the cable below the raised floor. Where no raised floor exists, dress the cable on the cable ladder above the termination cabinets.
- P. Install and dress cables under raised floors to minimize the bulk of the cables to avoid blocking airflow in the in the raised floor space.
- Q. Bundle cables using ½" wide hook and loop (Velcro) cable fasteners.
- R. Maintain cable jacket to as close as possible to the termination patch panel connector blocks.
- S. Maintain pair twists to within ½" of the termination connector blocks.

- T. Label each horizontal distribution cable at both ends of the cable in accordance with the approved labeling scheme. Refer to Section 270500, Common Work Results - Communications for labeling requirements.
- U. Any cable damaged or during installation shall be removed and replaced at no additional cost to the End Users.
- V. Any cable that exceeds minimum bend radius or maximum pulling tension during installation shall be removed and replaced at no additional cost to the End Users or Department.

3.4. FIBER CONNECTORS

- A. In telecommunications spaces, terminate 900 micron buffered fibers directly in fiber termination enclosures.
- B. Provide a minimum of two meters of fiber slack for each fiber coiled in the back of the fiber termination enclosure.
- C. In telecommunications outlets, provide cable furcation kits to build up the 900 micron buffered fiber units to a minimum of 2mm before installing connectors.
- D. Provide a minimum of one meter of fiber slack for each fiber coiled inside each outlet. Where one meter of fiber slack cannot be stored inside the outlet, pull the slack up and store with the cable slack at the top of the conduit.
- E. Clean and inspect each connector under a minimum 100 power microscope prior to connecting fiber to the adapter in termination enclosures and outlets. Replace all connectors showing defects upon inspection.
- F. Maintain all dust caps on all connectors and adapters unless the specific fiber is under test.

3.5. CATEGORY RATED COPPER CONNECTORS

- A. Provide a minimum of 12" of slack on each category rated cable in each outlet.
- B. Where the outlet termination space is not sufficient to house the 12" of slack, pull the slack up and store with the cable slack at the top of the conduit.
- C. Maintain cable jacket to as close as possible to the termination connector block.
- D. Maintain pair twists to within ½" of the termination connector block.

3.6. WORK AREA OUTLETS

- A. Coordinate exact location of each work area outlet, floor box and poke-through with the furniture plans prior to rough-in.
- B. Coordinate exact location of each work area outlet, floor box and poke-through with the End Users prior to rough-in.
- C. Provide a minimum 1-1/4" conduit from each wall mounted work area outlet box to the nearest cable tray, pull box, or to above an accessible ceiling.

- D. Dress cables into each outlet box to maintain minimum bend radius.
- E. Label each connector of each outlet in accordance with the approved labeling scheme. Refer to Section 270500, Common Work Results - Communications for labeling requirements.

3.7. EQUIPMENT OUTLETS

- A. Coordinate exact location of each equipment outlet with the equipment to be installed by this Contractor or as the work of other trades.
- B. Where possible, equipment outlets shall be installed in the equipment enclosure adjacent to the equipment network or telecommunications connector.
- C. Equipment outlets shall be installed in the same enclosure as the equipment network or telecommunications connector unless there is insufficient space, or so doing would void the equipment warranty.
- D. Mount equipment outlets inside the equipment enclosure or NEMA 1 enclosure with permanent double sided transfer adhesive or screws.
- E. Where installing the equipment outlet in the equipment enclosure is not possible, provide a 6" x 6" x 4" NEMA 1 screw cover box within six inches of the equipment enclosure. Connect the equipment enclosure to the NEMA 1 box with a minimum 1" conduit.
- F. Provide a minimum 1" conduit from the equipment enclosure or the NEMA 1 enclosure to the nearest cable tray, pull box, or to above an accessible ceiling.
- G. Provide an equipment cord of sufficient length to connect from the equipment outlet to the equipment network or telecommunications connection.
- H. Label each connector of each outlet in accordance with the approved labeling scheme. Refer to Section 270500, Common Work Results - Communications for labeling requirements.

3.8. WIRELESS ACCESS POINT OUTLETS

- A. Provide an outlet box (4-11/16" x 1-11/16" or 5"x5") with a single gang device ring above the accessible ceiling at each wireless access point location. Provide a 3/4" or 1" close nipple with two grommets (or gland nut connector) in one of the knockouts in the outlet box.
- B. Mount the outlet box with an L-bracket and beam clamp (or other demountable attachment) to the building structure to allow the outlet box to be moved by the End Users when installing the wireless access point. Refer to cable slack requirements for wireless access point outlets specified herein.
- C. Secure the cable inside the outlet box with a hook and loop (Velcro) fastener.
- D. Dress cables into each outlet box to maintain minimum bend radius.
- E. Mount the wireless outlet port outlet connector to a single gang stainless steel faceplate attached to the outlet box.

- F. Label each connector of each outlet in accordance with the approved labeling scheme. Refer to Section 270500, Common Work Results - Communications for labeling requirements.
- G. Provide an engraved laminated plastic label applied to the ceiling grid directly below the consolidation point.
 - 1. The engraved laminated plastic label shall be white with black ¼" high letters.
 - 2. The label shall have the same identification number as the wireless access point outlet above the accessible ceiling.
 - 3. Apply the label to the ceiling grid with removable double sided tape.
 - 4. Furnish one roll of removable double sided tape to the End Users for labeling wireless access point outlets that are relocated by the End Users.

3.9. CONSOLIDATION POINTS

- A. Install consolidation points above an accessible ceiling located centrally to the floor boxes it serves.
- B. Install consolidation points to provide full access to the termination blocks.
- C. Attach consolidation points to the building structure with hardware appropriate to the attachment surface/material.
- D. Consolidation point enclosures and termination blocks may be installed in a vertical or horizontal orientation as dictated by the space above the accessible ceiling.
- E. Provide a minimum 1-1/4" conduit from each slab on grade floor box to the consolidation point.
- F. Provide close nipples through the side of the consolidation point for the plenum cable to exit.
- G. Provide one 1" close nipple for each outlet served from the consolidation point.
- H. Provide grommets on both ends of each close nipple.
- I. Dress and terminate outside plant rated cables to the termination block base.
- J. Dress and terminate plenum rated cables to the connecting block contacts.
- K. Bundle and attach cables to the enclosure backboard with ½" hook and loop (Velcro) fasteners.
- L. Label the consolidation point and each cable in accordance with the approved labeling scheme. Refer to Section 270500, Common Work Results - Communications for labeling requirements.
- M. Provide an engraved laminated plastic label applied to the ceiling grid directly below the consolidation point.
 - 1. The engraved laminated plastic label shall be white with black ¼" high letters.

2. Apply the label to the ceiling grid with permanent double sided transfer adhesive, or white #4 metal screws.

3.10. FIBER TERMINATION ENCLOSURES

- A. Mount fiber termination enclosures to the rack/cabinet mounting rails with a minimum of four machine screws.
- B. Secure fiber cable jackets and fiber cable strength members in the fiber termination enclosures as recommended by the manufacturer.
- C. Provide blank connector plates in all unused spaces.
- D. Maintain all dust caps on all connectors and adapters unless the specific fiber is under test.
- E. Label each termination enclosure and each port of each termination enclosure in accordance with the approved labeling scheme. Refer to Section 270500, Common Work Results - Communications for labeling requirements.270500

3.11. PATCH PANELS

- A. Mount patch panel to the rack/cabinet mounting rails with a minimum of four machine screws.
- B. Dress cables from both sides of the patch panel to minimize cable bulk in the termination area.
- C. Provide cable stand-off brackets for dressing cables as required to maintain an orderly termination area.
- D. Secure and bundle cables at the rear of patch panels with ½" hook and loop type (Velcro) fasteners.
- E. Label each patch panel in accordance with the approved labeling scheme. Refer to Section 270500, Common Work Results - Communications for labeling requirements.

3.12. TERMINATION BLOCKS

- A. Mount termination block legs to mounting surface with a minimum of four screws.
- B. Dress backbone cables under the termination base and terminate to the termination block base.
- C. Dress horizontal distribution cables (for interconnects) and cross-connect wire (for cross-connects) and terminate to the front of the connecting blocks.
- D. Provide distribution posts and distribution rings as required to neatly organize and dress cross-connect wires in the cross-connect field.

3.13. PRIMARY PROTECTORS

- A. Provide primary protectors on each end of all copper cables installed outside of the building footprint.

- B. Wall mount all primary protectors as close as practicable to the cable entrance.
- C. Dress cables to the primary protector wiring blocks as specified for routing of cables for termination blocks.
- D. Bond all cable shields (when applicable) to the building entrance protector with a minimum #6 AWG ground wire.
- E. Bond the building entrance protector to the telecom room ground bus bar with a minimum #2 AWG ground wire.
- F. Install protector modules on all wire pairs installed as part of this project.
- G. Furnish spare modules to the End Users for future use.

3.14. CROSS-CONNECTS

- A. Provide cross-connect wire as required to connect telephone circuits from the telephone service provider's demarcation point to the backbone termination blocks.
- B. Provide all cross-connects required to provide telephone circuits to emergency telephones, elevator telephones, fire alarm control panels, security control panels and other equipment requiring hard-wired connections. Coordinate exact requirements with the End Users and the equipment installers.
- C. Provide a minimum one-inch drip loop in each cross-connect wire for wire tracing. dress the drip loops neatly to the side of each termination block.

3.15. PATCH CORDS

- A. Contractor shall install all patch cords between patch panels as coordinated with the Owner.
- B. Contractor shall install all patch cords between patch panels and rack mount equipment as coordinated with the Owner.
- C. Install patch cords along shortest path between patch panels and equipment.
- D. Neatly store all patch cords slack in the vertical management hardware adjacent to the source and destination patch panel and equipment ports. Leave relatively equal amounts of slack at each end of the patch cord.
- E. All patch cords shall be installed with a service loop stored in the vertical management hardware to simplify patch cord tracing.
- F. Do not bundle patch cords in the vertical and horizontal cable management hardware. Cables shall be secured in the vertical cable management channels with retaining clips or by routing over cable spools.
- G. Install patch cords on cable ladder or in cable tray only as required to transition between rows of cabinets and racks. Bundle patch cords installed on cable ladder or in cable tray separately from horizontal distribution cables and backbone cables.

H. Patch cords between cabinets and racks in the same row shall be installed through the horizontal and vertical cable management hardware.

3.16. WORK AREA CORDS

A. Contractor shall furnish all work area cords in their original packaging to the End Users for installation by the End Users.

3.17. EQUIPMENT CORDS

A. Contractor shall furnish equipment cords for connection of wireless access points in their original packaging to the End Users for installation by the End Users.

B. Contractor shall install equipment cords for connection of installed equipment, connect equipment cords between equipment outlets and equipment, coordinate connection to equipment with Contractor responsible for equipment installation. Furnish equipment cord to equipment installer if the equipment is not ready for connection, or the equipment installer must make the connection.

3.18. TESTING

A. Testing shall be as specified in Section 270500 Common Work Results – Communications.

3.19. AS-BUILT RECORD DOCUMENTS

A. As-Built Record Documents shall be assembled and submitted as required by the Division 1 Requirements, Section 270500 Common Work Results – Communications and as described herein.

END OF SECTION