

SECTION 27 05 28 – PATHWAYS FOR COMMUNICATION SYSTEMS

This documentation consists of but is not limited to the University of Pittsburgh Information Technology department's design guidelines by ICT Design professionals when preparing construction documents. The extent of this document includes requirements for IT project processes for structured cabling systems, conduits, data outlets, distribution patch panels, equipment racks, and wire-management systems. As a result, a thoroughly tested and certified data network is required based on a structured cabling end-to-end implementation. The University of Pittsburgh Information Technology (PITT IT) shall provide the active telecommunications electronics for both the data and voice networks, e.g., UPSs, data routers, data switches, wireless access points, voice switches, and telephony peripherals. This document's form and technical content are subject to change due to building construction techniques and IT system technologies developments. As a result, the University of Pittsburgh expressly maintains the right to add to and change the information included in this document. The ICT Designer shall incorporate existing systems to ensure a seamless co-existence of newly provided infrastructure. No deviation from this standard shall be incorporated without the University of Pittsburgh Information Technology department's written direction.

Part 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The Contract's drawings and general provisions, comprising General and Supplementary Conditions and Division 1 Specification Sections, apply.
- B. Related Sections:
- C. Division 01 Specification
- D. Division 27 00 00 – Communications
- E. Division 27 05 26 – Grounding and Bonding for Communications
- F. Division 27 05 28 – Pathways for Communications
- G. Division 27 05 53 – Identification for Communications Systems
- H. Division 27 11 00 – Communication Equipment Room Fittings
- I. Division 27 13 00 – Communication Backbone Cabling Requirements
- J. Division 27 15 00 – Communication Horizontal Cabling Requirements

1.2 SUMMARY

- A. This section outlines the fundamental requirements for communications installations that are indicated or required. It includes requirements shared by more than one specification section of this division (for example, related documents, related sections, definitions, governing requirements, contractor requirements, warranty requirements, submittal requirements/procedures, project closeout requirements/procedures, etc.). This section may supplement and/or expand on the requirements specified in Division 01

- B. Consider the contract documents in their entirety (including drawings and specification sections in other divisions) for requirements or work that may affect the work covered by this section, whether or not expressly specified in this section.
 - 1. This section contains minimum requirements as well as installation instructions for the following: Hangers and Supports for Communications Systems
 - 2. Conduits and Back Boxes for Communications Systems
 - 3. Cable Trays for Communications Systems
 - 4. Surface Raceways for Communications Systems
- C. The references to Division 26, contained herein, are the responsibility of the Electrical Contractor

1.3 REFERENCES

- A. General provisions of Contract, including General and Supplementary Conditions and Division-1
- B. Architectural, Electrical, and Technology Drawings. Other systems drawings may apply. Division 26
- C. ANSI/TIA 568 General Telecommunications Cabling for Customer Premises, the most recent revisions, additions, and system bulletins.
- D. ANSI/TIA–569 Telecommunications Pathways and Spaces, the most recent revisions, bulletins, and addenda
- E. ANSI/TIA–606 Administration Standard for Telecommunications Infrastructure, the most recent revisions, bulletins, and addenda
- F. ANSI/TIA–607 Generic Telecommunications Bonding and Grounding for Customer Premises, the most recent revisions, bulletins, and addenda
- G. ANSI C80.1 Rigid Steel Conduit - Zinc Coated
- H. ANSI C80.4 Fittings for Rigid Metal Conduit
- I. ANSI/NFPA 70/318 – National Electric Code – Cable Trays
- J. ANSI/NFPA 70/770 – National Electric Code – Optical Fiber Cables and Raceways
- K. ASI/NFPA 70/250 - National Electric Code – Ground and Bonding
- L. ASTM A653 - Specifications for Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process
- M. ASTM A123 - Specifications for Zinc (Hot Galvanized) Coatings on Iron and Steel
- N. ASTM – A276-06 Standard Specification for Stainless Steel Bars and Shapes
- O. ASTM A580/A580M-06 Standard Specification for Stainless Steel Wire.
- P. NFPA 70/645 – National Electric Code – Information Technology Equipment
- Q. Telecommunications Distribution Methods Manual, the most recent publication

- R. Information Transport Systems Installation Methods Manual (ITSIMM), the most recent publication
- S. National Electric Codes (NEC) – The applicable
- T. OSHA Standards and Regulations – The applicable
- U. Local Codes and Standards – The applicable

1.4 DEFINITIONS

- A. "EMT shall mean Electrical Metallic Tubing.
- B. "RMC" shall mean Rigid Metal Conduit.
- C. "Raceway" means the enclosed channel for routing wire, cable, or busbars.
- D. "PBB" means Primary Bonding Busbar. There is typically one PBB per building located in the main telecommunications room. Directly bonded the busbar is to the electrical service ground.
- E. "SBB" means Secondary Bonding Busbar. There is typically one SBB per telecommunications room. The SBB connects to the PBB and builds structural steel or other permanent metallic systems.
- F. "TBB" means Telecommunications Bonding Backbone. The TBB is a conductor employed to connect PBBs to the SBBs.
- G. "Pull box" shall mean a metallic box with a removable cover. Place pull boxes in easily accessible locations. Position the Pull boxes to pull the cable through the conduit that runs longer than 100 feet or with more than 180-degree bends. A conduit that enters the pull box from opposite ends should be aligned.
- H. Junction box" shall mean a pull box wherein a conduit run transitions from a feeder conduit to multiple distribution conduits.

1.5 SYSTEM DESCRIPTION

- A. Install pathways for converged low voltage systems to include raceway systems, including underfloor and overhead distribution systems, fish wire, terminal cabinets, outlet boxes, floor boxes, pull boxes, cover plates, conduit, sleeves and caps, cable troughs, service poles, miscellaneous and positioning material to constitute a complete system. as indicated for distribution of Telecommunications wiring which includes cables for Data, Voice, Video, Security, and future signal requirements.
- B. Furnish and install conduit stubs in walls and floors for cable routes.
- C. Coordinate the pathways with Pitt Information Technology (PITT IT).
- D. Changes to the Telecommunication Pathways design are not permitted unless approved in writing by the University of Pittsburgh Information Technology (PITT IT). The contractor shall explain why the change was made and the changes the contractor will make to communication system pathways. The written description is required to ensure new designs adherence to Division L of the Facilities Management Professional Design Manual.
- E. Systems outside this scope require separate cable trays.

1.6 SUBMITTALS

- A. Product Data Submittals: Before delivering materials to the job site, provide submittal information for review. Provide product data submittals for the products at the same time.
- B. Submit a letter outlining the materials provided under the agreement; specify which items will not be delivered. The letter must also state that the contractor has reviewed the specified items and agrees that they apply to this project in every way.
- C. Submit standard manufacturer's cut sheets or other explanatory information, along with a written description detailing the substitution reason, for those items noted as allowing "or equal" and not explicitly named.
- D. Provide standard manufacturer's cut sheets for the operating and maintenance (O&M) instructions for each device in the system at the time of submittal review, regardless of whether it is submitted as specified or as an approved equal. These instructions must include information on installing and servicing the equipment and rough-in and preparing the building facilities to receive the materials.
- E. Provide shop drawings illustrating the routing of the Communications Pathway, which should include:
 - 1. Provide interior conduit routing and Junction Box locations for conduit with an outside diameter of two (2) inches or greater.
 - 2. Cable/Basket Tray Routing. Wall and Floor Sleeve
 - 3. The Mounting height at the base of the pathway for the elements shown
 - 4. Provide drawings of the entire outdoor Plant pathway routing, including depth.
 - 5. Firestop solutions
 - 6. Include dimensioned plans and elevation views of equipment rooms, labeling each component. Show raceway assemblies, method of field assembly, workspace requirements, and access for cable connections.

1.7 CLOSEOUT SUBMITTALS:

- A. Provide the following submittal information for review:
 - 1. O&M Manual for Communications - Submit O&M information from product data submittals (above), updated to reflect the changes during construction, to the designer in the telecommunications-specific O&M Manual for Communications binder marked with the project name and description after the project.

2. Records - Maintain a minimum of one set of Record Drawings, Specification, and Addenda at the job site. The Record Drawings shall include drawings, specifications, and spreadsheets with redline markups.
 - a. Document changes to the system from what was originally shown on the Contract Documents and single out system component labels and identifiers on Record Drawings.
 - b. Maintain Record Drawings on the job site and make them readily available to the Owner and Designer.
 - c. Keep Record Drawings current throughout construction. ("Current" means no more than one week behind the actual building.)
 - d. On Record Drawings, show identifiers for significant infrastructure components.

1.8 DELIVERY STORAGE AND HANDLING:

- A. Delivery: Ensure the manufacturer's original containers and packaging are delivered to the site, with labels that say who made it and what it is, so that the materials don't get mixed up when they get there.
- B. Storage: Store materials in a dry area indoors, protected from damage and per manufacturer's instructions.
- C. Handling: Protect materials and finishes during handling and installation to prevent damage.

1.9 CONTRACTOR WARRANTY

- A. Provide a two-year service warranty backed by the contractor against defects in materials and workmanship.
 1. Provide labor at no cost to the Owner in connection with the fulfillment of this warranty.
 2. The Contractor Warranty period begins when the Owner accepts the work.

Part 2 – PRODUCTS

2.1 GENERAL

- A. Refer to Section 01 25 00 "Substitution Procedures." Project Substitutions shall be approved in writing by the FM Project Manager and the PITT IT Project Manager.
- B. Cable tray sections, tray fittings, connectors, supports, expansion joints, blind endplates, barrier strips, radius drops, bonding conductors, and other accessories are required. Provide the incidental and miscellaneous hardware not explicitly specified or shown on the Contract Documents as are necessary for a fully operational and warranted system
- C. Unless expressly stated as "Or equal," equivalent items are not acceptable. Provide items as specified

- D. Before purchasing and delivering supplies, physically inspect the current site conditions
- E. A single company must manufacture the cable tray components. It is not permitted to combine parts from various manufacturers.

2.2 HANGERS and SUPPORTS

- A. Hanger and supports must be NRTL (Nationally Recognized Testing Laboratories) labeled for support of Category 6A cabling.
- B. **J-hooks and bridal rings are not permitted. Plastic cable ties are not allowed in the location to support station cabling.**
- C. The contractor may use The Arlington Loop cable support size 5-inch loop in a unique circumstance or where the cable must leave the cable tray system University of Pittsburgh Information Technology (PITT IT) Manager shall approve the use of the Arlington Loop before deploying.
- D. The 5-inch Arlington Loop fasteners should be spaced at 4- to 5-foot intervals to ensure that the cables are properly supported and that lower cables are not stressed and deformed due to the weight of the cable bundle. As well as with varied spacing to avoid creating electrical harmonics in high-speed data cabling
- E. The 5-inch Arlington Loop is outside the scope of work of the Facilities Management Professional Design Manual - Division L, which requires the contractor to provide a Cable Tray System in support of the Horizontal Pathways.
- F. PITT IT will require a walk-through of the horizontal Pathways following the cable installation and the 5-inch Arlington Loop pathway to ensure proper support and allow the contractor to correct any unacceptable areas before we take ownership of the cables and the pathway.

2.3 TELECOMMUNICATIONS OUTLET (TO)

- A. Construction of new buildings Telecom Outlets (TO) consists of one (1) flush-mounted 4-11/16" square by 2-1/8" deep box. An EMT conduit must be stubbed above the drop ceiling or extended into the hallway cable tray for each outlet box. The dimensions of the conduit are as follows: Telecom Outlets (TO)
 - 1. For Outlets with Three or less cables, use a 1 inch EMT conduit
 - 2. For Outlets with Three to Six cables, use a 1.25 inches EMT conduit
 - 3. For all other sizes, calculate the fill ratio at 40% for properly sized conduit
- B. Surface-mounted construction currently in use Telecom Outlets (TO) are usually surface-mounted raceways with a base, cover, end fitting, entrance end fitting, and (2) 1" EMT conduits stubbed out top of entrance end fitting to an above ceiling or out to nearest hallway distribution system. The size of the raceway is site-dependent and determined by the number of conductors to be installed.
- C. The intent of the installation of the Telecom Outlets (TO), which consist of the raceway, is as follows:
 - 1. Where ceilings are accessible, the raceway and entrance-end fitting shall extend above the ceiling. The conduits are installed above the ceiling in the room to connect to the nearest hallway distribution system.
 - 2. Anywhere partially accessible ceilings exist or where the Drawings and/or Specifications indicate the installation of access panels, the raceway shall

extend above the ceiling. The conduits shall be built above the ceiling in the room to connect to the nearest hallway distribution system.

3. Where ceilings are inaccessible or nonexistent, the raceway shall extend as high as practicable to install conduits to the nearest corridor distribution system.

2.4 HORIZONTAL DISTRIBUTION SYSTEMS

A. Conduit System

1. Provide conduits secured to the wall above corridor ceilings as shown on the Drawings or specified herein to install telecommunications cables.
2. Corridor conduits shall be 4-inch EMT, delivered in 10-foot lengths whenever possible, with no sharp edges, reamed as needed, and evenly supported at two per 10-foot section spacing locations. Conduits in all TO conduits must be sized and quantified to account for handling cables at 40 percent fill back to the MDF and/or IDF rooms. Before installing, double-check the size. Bushings and/or connectors on ends of EMT are required.
3. Unless conditions prevent this type of installation, the conduits must be installed stacked and attached to walls. When this condition exists, mount conduits side by side, supported by a 3/8 of an inch rod attached to the building structure and formed with a unistrut channel to form a trapeze. At the unistrut, double-nut the top and bottom. To secure conduits to unistrut, use a conduit clamp.
4. Ensure each conduit has a measured pull line that can hold at least 1200 pounds. Increments must be in 12-inch steps.
5. Grounding of conduits is not required by NEC #250-33, Exception No. 2. shall be painted, except conduit above suspended ceilings or in mechanical, electrical, or telecommunications rooms. Color to match the installed surface or as specified by the Owner's Representative. Before painting, coordinate with other trades.
6. Provide restorable fire stops inside and around all conduits penetrating fire-rated construction, as recommended by UL1479 or ASTM E814 for all conduits.

B. CORRIDOR CABLE TRAY SYSTEM

1. Welded Wire (Wire Mesh Tray): The cable tray must be made of welded wire mesh (high-quality steel wires) and have a continuous safety edge wire lip. The cable tray shall be complete with the tray supports, materials, and incidental and miscellaneous hardware required for an entire cable tray system.
2. Finish: Carbon steel with a zinc galvanized electroplated finish
3. Width: Widths must be as specified in the Contract Documents. Wherever cable tray width does not appear on the Contract Documents, the cable tray size will correspond to the amount of cable installed in the trays (as shown on the Contract Documents) plus 100% for future expansion capability.
 - a. Depth: 2 inches
 - b. Mesh: 2 x 4 inches
 - c. Width: 12 inches

4. Fittings: Fittings must be field-fabricated from straight sections using manufacturer-approved tools and adhering to the manufacturer's instructions
5. The complete wall-mounted or suspended cable tray system and all required accessories must be delivered as illustrated in the designs. Install the entire cable tray system per the manufacturer's recommended installation guidelines and applicable local codes.
6. The EC shall coordinate cable tray installation with other trades to allow a minimum of twelve inches above, twelve inches in front, and twelve inches below clearance from plumbing, conduits, ductwork, etc. The EC shall ensure access to the tray with reasonable room to work when installing the cable tray. Obstructions to the tray shall be at a minimum and cannot obstruct more than six feet of the tray throughout the run.
7. The EC must ensure that the load on the cable tray does not exceed sixty of the manufacturer's recommended load capacity.
8. When a new cable tray distribution system comes into contact with a wall, install sufficient four-inch EMT sleeves through the wall to prevent cabling from exceeding twenty percent fill.
9. Where high quantities of cables exit the distribution system, install cable tray dropouts.
10. Size the cable tray to allow for enough growth capacity to allow migration cable plants to coexist in the same tray as existing cable plants.
11. The manufacturer of cable tray in corridors shall be:
 - a. **GS Metals: Flextray Series**
 - b. **Cablofil, Inc.: EZ Tray CF54/xxx Series**

C. TELECOMMUNICATION ROOM PATHWAYS

1. Install ladder rack systems overhead along the rows of equipment, leading to the cross-connects and having three contact points with the wall. Coordination of tray locations with lighting, air handling, and fire suppression systems to fully loaded trays does not obstruct or impair their operation.
2. Install cable trays per the relevant codes and standards. A minimum access headroom shall be eight inches, with twelve inches recommended.
3. The cable tray shall be a minimum width of two inches high x twelve inches wide. Size the cable tray upwards if fill ratio requirements need to be met based on cable quantities.
4. Manufacturer of tubular ladder type cable tray in telecommunication rooms shall be **Chatsworth: TELCO-Style Cable Runway; 12"W x 1.5"H x 9.96'L; Black**
5. Install open pathway/trays a minimum of six inches away from any light fixture or other source of electromagnetic interference (EMI) (Electromagnetic Interference)
6. Ground all pathways per NEC Article 250.

7. Install external grounding straps at expansion joints, sleeves, crossovers, and other locations where the pathway and/or tray are interrupted.
8. Support cable pathways from building construction correctly. Do not support pathways from ductwork, piping, or equipment hangers.
9. Install cable trays level and straight unless otherwise specified on the construction drawings.

2.5 SURFACE RACEWAYS

- A. The University of Pittsburgh's Information Technology Manager must approve the use of Surface Raceway for telecommunications projects in writing.
- B. Do not expose data cables to sharp or binding edges.
- C. Surface raceways must be large enough to accommodate the intended telecommunications cables while allowing for a minimum of 50 percent growth.
- D. Install the raceways and pathways required to support horizontal cabling per ANSI/TIA-569-D.

2.6 WORKSTATION CONDUIT

- A. Workstation Conduit is a conduit that starts at the Telecom Outlet and rises within the walls or conduit that is visible from a raceway and reaches up into the drop ceiling or across the hallway distribution system.
- B. Provide workstation conduits from telecom outlets above the drop ceiling or extend over to the hallway distribution systems consisting of one inch EMT minimum or suitable size as indicated on the Drawings.
- C. Provide an insulating press fit bushing on all telecommunications conduits, including interconnecting nipples and stubs to the distribution system.
- D. Stub conduit at least six inches above or below the conduit and /or cable tray centerline to avoid conflicts with other cables or conduits on the cable tray.
- E. Where space allows bend station conduits down so that the flow of installed cables promotes the shortest length back to the IDF and the fewest number of bends in the cables.
- F. Use plenum-rated bushings in environmental air-handling space.
- G. Install a measured pull line in twelve-inch increments in each empty conduit to the hallway distribution system.
- H. Mark the workstation conduit at the hallway distribution end with the Room # that the conduit serves.
- I. The use of 90-degree electrical pulling elbows is prohibited.
- J. Do not make more than two 90-degree bends between pulling points when installing workstation conduit runs. Install the appropriately sized junction box if the path of the workstation conduits requires more than 180 degrees of total bends.
- K. Install an appropriately sized junction box in each workstation conduit run that exceeds one hundred feet in length.

- L. The addition of the third bend to a conduit is acceptable only if:
 - 1. The total conduit run is shortened by fifteen percent.
 - 2. The diameter of the conduit is increased to the next trade size.
 - 3. One of the bends is within twelve inches from the end of the cable/ conduit run.

2.7 JUNCTION BOX REQUIREMENTS FOR WORKSTATION CONDUITS

- A. Provide outlet box accessories, such as mounting brackets, wallboard hangers, extension rings, fixture studs, cable clamps, and metal straps for supporting outlet boxes, as required for each installation, which are compatible with the outlet boxes outlined in the project requirements.
- B. Back-to-back wall outlet boxes in the same stud wall cavity are not permitted. Ensure that communication and electrical outlet boxes are at least one stud or 16 inches apart when positioned on opposite sides of a partition wall.
- C. When the workstation conduit route exceeds the 180 degrees limit for total bends, install an appropriately sized junction box within a straight section of the conduit run.
- D. The workstation conduit run requires a separate junction box. Multiple conduits shall not share a junction box
- E. A junction box shall not replace a bend. All junction boxes installed in workstation conduit paths must be straight sections of the conduit run.

2.8 TELECOMMUNICATION SERVICE ENTRANCE CONDUITS

- A. Install a minimum of three four-inch or two five-inch Rigid Metal Conduit (RMC) conduits from the nearest utility tunnel to the outside of the building, as shown on the drawings. Entrance conduits that enter ER rooms from below grade shall terminate four inches above the finished floor. Place Entrance conduits within twelve inches of room corners.
- B. Terminate entrance conduits go into ER rooms from above ceiling height shall extend four inches below finished ceiling height or twelve inches above cable tray.
- C. Entrance conduits go into ER rooms shall terminate four inches into the room from below ceiling height.
- D. Entrance conduits shall be uninterrupted into the building and to the ER. Firmly fasten the entrance conduits to the building to resist the cable placing operation. Do not incorporate more than two 90-degree bends between pulling points while installing entrance conduits.
- E. On exterior wall penetrations, seal both sides of the wall around the outside of the conduit with hydraulic cement to block water from entering the building. Seal the inside of the conduit on both sides with conduit plugs, water plugs, or duct sealer to prevent water, vapors, or gases from entering the building.

2.9 PATHWAY REQUIREMENTS FOR ENTRANCE CONDUITS

- A. If the total bends of the entrance conduits exceed 180 degrees, an appropriately sized junction box, maintenance hole, or handhole is required.
- B. Submit as-built drawings of the entrance conduit path to the PITT IT before covering it with soil.

2.10 BACKBONE RISER CONDUITS

- A. Use Riser conduits only for special applications as specified in the Construction Documents. Typically, riser conduits are not required for the riser system.
- B. Requirements for Riser conduits:
 - 1. Install a Minimum of (two) four-inch conduits between the MDF room and each IDF room, as shown on the Drawings
 - 2. Ream or brush the Conduits entering MDF and IDF rooms terminate no more than four inches from the entrance wall and no more than twelve inches from the room corners.
- C. The termination of conduits entering MDF and IDF rooms from below the floor shall terminate four inches above the finished floor.
- D. Riser cable conduits shall be continuous and separate from all other conduit or enclosed raceway systems. When installing riser conduits, ensure no more than two 90-degree bends between pulling points. Locate junction boxes in easily accessible areas, such as above suspended ceilings in hallways.
- E. Conduits shall be a minimum of four-inch trade size and have a measured pull line at twelve inches increments rated at a minimum 1200-pound test.
- F. Provide restorable fire stops inside and around all conduits penetrating fire-rated construction, as recommended by UL1479 or ASTM E814 for all conduits. Verification of fire-rated construction with an AHJ.
- G. Provide an insulating press fit bushing (Plenum) on all telecommunications riser conduits.
- H. Do not use Riser conduits for the distribution of horizontal cables

2.11 FIRESTOPPING MATERIAL

- A. Telecommunication pathways requiring fire stopping shall use removable/re-usable fire-stopping putties from aiding Moves, Adds, and Change.
- B. Seal walls with a 2-hour fire stop assembly.
- C. Firestopping material shall meet both flame (F) and temperature (T) ratings specified by local building codes and as evaluated by nationally recognized testing laboratories in a configuration representative of actual field conditions defined by ASTM E814 or UL 1479 fire tests.
 - 1. Manufactured by Specified Tech. Inc. (STI) EZ path
- D. See Section 27 05 32 - Firestopping for Telecommunications Systems

Part 3 EXECUTION

3.1 GENERAL

- A. The contractor is solely responsible for the public and workers' safety under the applicable rules, regulations, building codes, and ordinances.
- B. The work shall comply with applicable safety rules and regulations, including OSHA and WISHA. The work shall comply with the National Electrical Safety Code (NESC) and the NEC, except where local regulations and ordinances are stringent, the local codes and regulations take priority.
- C. The work shall comply with the standards, references, and codes listed in PART 1 -REFERENCES. The more stringent standard, reference, or code shall prevail where there is a conflict between standards, references, or regulations.
- D. The work shall comply with the requirements and recommendations of the product manufacturers. The more stringent standard, reference, or code shall prevail where there is a conflict between standards, references, or regulations.
- E. Replace or repair the original (or better) condition of the existing structures, materials, equipment, and other design elements inadvertently demolished or damaged by the contractor during construction at no additional cost to the Owner.
- F. Install the pathway system to ensure that the communications circuits installed to comply with ANSI/TIA. Other references listed in Part 1- References above are fully compliant. Remove excess materials and debris from the job site and dispose of them legally.

3.2 EXAMINATION

- A. Examine surfaces and spaces to receive cable pathway system materials for compliance with installation tolerances and other conditions affecting pathway system installation performance. If there are unsatisfactory conditions, correct those areas before installing.
- B. Assess areas to accept the cable management system. Notify the Engineer /Owner's Representative of conditions that would adversely affect the installation or subsequent utilization of the system. Correct the unsatisfactory conditions before proceeding with the installation.

3.3 INSTALLATION

- A. Provide cable trays in the locations and widths specified in the Contract Documents, as determined by the manufacturer and industry standards (NEMA VE 2). Ensure that the cable tray equipment conforms with NEC's requirements and applicable portions of NFPA 70B and NECA's "Standards of Installation" on general electrical installation practices.
 - 1. The contractor must ensure that the cable tray installation is plumb, level, and square with the finished building surfaces. Coordinate installation with other trades
 - 2. Connect each cable tray segment using factory-manufactured connection hardware. Align each element of the cable tray with the adjacent segment. The installation of the connection hardware shall be per the manufacturer's requirements. Cable tray elevation changes shall be gradual.

- B. Slots/sleeves: Where slots/sleeves are required, provide them in the manner specified in the Contract Documents. Provide roto-hammering, core drilling, and saw cutting when needed for installation. Seal and firestop (only if fire-rated barrier) between slot/sleeve and cable tray.
- C. Cable Tray Routing:
 - 1. Route the cable tray in the manner shown on the Contract Documents.
 - 2. Where not shown on the Contract Documents, route cable tray in the most direct route possible, parallel to building lines.
 - 3. Do not route the cable tray system through areas where flammable materials are stored or through wet, hazardous, or corrosive locations
- D. Cable Tray Clearance Requirements:
 - 1. Clearance requirements for cable tray accessibility:
 - a. Maintain a clearance of 6" between the top of the cable tray and ceiling structure or other equipment or raceway.
 - b. Maintain an 8-inch clearance between the cable tray and nearby objects.
 - c. Maintain a clearance of 6" between the bottom of the cable tray and ceiling grid or other equipment or raceway.
 - 2. A Clearance requirement from sources of electromagnetic interference (EMI):
 - a. Maintain a clearance of at least 5" between fluorescent lighting
 - b. Maintain a clearance of 12" or more from conduit and cables used for electrical power distribution.
 - c. Maintain a clearance of 48" or more from motors or transformers.
 - d. Cable Pathways shall cross perpendicularly to electrical power cables or conduits.
 - 3. Maintain a minimum clearance of six inches between pipes and steam, hot water, or other heat sources operating at temperatures greater than one hundred degrees Fahrenheit.
- E. Cable Tray Fittings:
 - 1. Provide field-fabricated fittings from straight cable tray sections using manufacturer-approved tools and per manufacturer's instructions.
 - 2. Bends shall be an extended radius.
 - 3. The use of short radius bends and T-sections is not permitted unless specifically called out on the Contract Documents.

- F. The contractor shall provide cable tray supports where shown on the Contract Documents. If not specified in the Contract Documents, the contractor must have cable tray supports per the manufacturer's recommendations.
 - 1. Supports must be connected to the structural ceiling or walls using hardware or other mounting and support aids specially designed for the cable tray and designed to support the cable tray's weight and the necessary cable weight and volume.
 - 2. Provide wall-mounted supports where cable trays meet walls.
 - 3. Do not attach cable tray supports to the ceiling support system or other mechanical support systems.
- G. Load span criteria:
 - 1. Install tray supports per the load criteria of L/240, as shown on the Contract Documents.
- H. A cable tray shall be installed free of burrs, sharp edges, or projections that may damage cable insulation. Cut the wire-type cable tray with a manufacturer-approved cutter with "offset cutting blade" jaws and a minimum 24-inch handle.
 - 1. The jaws' selection and positioning at the cut's point must make shearing as close to the steel wires' intersection as possible.
 - 2. Cuts will ensure the integrity of the galvanic protective layer
- I. Cable Tray Supports:
 - 1. Trays shall be supported at 6-foot intervals as shown on the Contract Documents or more frequently if the manufacturer requires.
- J. Cable Tray Expansion Joints:
 - 1. Supply cable tray sliding or offsetting expansion joints/fittings wherever cable tray crosses building expansion joints, as specified in the Contract Documents.
 - 2. The bonding jumper shall be installed per each expansion joint's standard approved Contract Documents. The cable tray shall be appropriately bonded together with bonding jumpers.
- K. Cable Tray Thermal Contraction and Expansion:
 - 1. Install cable tray sections with gap settings that correspond to the expected range of thermal expansion and contraction for the space during construction, occupancy, and operation.
- L. Cable Tray Blind End Plates:
 - 1. Close unused openings using factory-made blind endplates.
- M. Cable Tray Barrier Strips:
 - 1. Provide cable tray barrier strips per the requirements specified in the Contract Documents.
- N. Radius Drops:
 - 1. Provide cable tray radius drops shown on the Contract Documents and cable trays cross other telecommunications cable trays or a ladder rack.

3.4 GROUNDING AND BONDING

- A. Grounding/Bonding: Grounding and bonding work must comply with the Uniform Building Code, Uniform Fire Code, WAC, National Electrical Code, and UL 467, as well as the references listed in PART 1 – REFERENCES above, as well as any local codes that may specify additional grounding or bonding requirements. **The Cable Tray shall not be painted.**
- B. Connect metallic raceway (including cable tray) to the nearest SBB (as provided under Division 27 Section — "Grounding and Bonding for Telecommunications"). Ensure that bonding breaks through the paint to the bare metallic surface of the painted metallic hardware.
- C. Cable tray bonding splices: To create a continuous bonding conductor throughout the cable tray, provide cable tray splices in accordance with the manufacturer's specifications.
- D. Bonding conductors:
 - 1. Bond distribution conduits to the cable tray.
 - 2. Install the bonding jumpers at expansion joints, sleeves, and other areas where electrical continuity is interrupted.
 - 3. Attach the cable tray to the electrical power distribution system with a bonding conductor

3.5 FIRE-STOPPING

- A. Only employees trained/certified by the fire-stopping manufacturer shall apply fire-stopping materials.
- B. Ensure that the penetrated fire barriers retain their fire rating. Fire stop and seal the penetrations made during construction.
 - 1. Provide fire-stopping material for through and membrane penetrations of fire-rated barriers.
 - 2. Install firestops in strict accordance with the manufacturer's detailed installation procedures.
 - 3. According to fire test reports, install firestops, fire resistance requirements, proper sample installations, manufacturer's recommendations, local fire, building authorities, and applicable codes and standards referenced in PART 1 REFERENCES. Apply sealing material in a manner acceptable to local fire and building officials.
 - 4. Wherever the contractor has removed cables during the demolition operation, the contractor will apply fire-stopping to open penetrations in fire-rated barriers.
 - 5. Apply fire-stopping regardless of whether the penetrations are used for a new cable or left empty after construction.
 - 6. Fire-stopping material used to seal open penetrations shall be re-usable/re-enterable through cable passes.

3.6 CLEANING AND PROTECTION

- A. On completion of the installation, including outlet fittings and devices, inspect the exposed finish. Remove burrs, dirt, and construction debris from the surface and repair the damage to the finish, such as chips, scratches, and abrasions.
- B. Ensure that coatings, finishes, and cabinets are free of deterioration or damage at Substantial Completion.
- C. Provide final protection and preserve conditions acceptable to the manufacturer and compliant with applicable industry practice.
 - 1. Repair galvanized finishes with the manufacturer's recommended zinc-rich paint.
 - 2. Repair PVC or paint finish damage using the manufacturer's recommended touchup coating.

3.7 TESTING

- A. Evaluate the pathway system to ensure the electrical continuity of bonding and grounding connections.
- B. Compliance with maximum grounding resistance found in NFPA 70B, Chapter 18.

3.8 LABELING AND ADMINISTRATION

- A. Place the following two labels along the entire length of the cable tray pathway system, alternating one every ten feet:
 - 1. Label #1: The label shall read "TELECOMMUNICATIONS / LOW VOLTAGE CABLING ONLY."
 - 2. Label #2: The Label shall read "WARNING! THE CABLE TRAY SERVES AS A TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT DISCONNECT!"

END OF SECTION - 27 05 28

SECTION 27 05 28.28 - FIRESTOPPING, SMOKE, AND ACOUSTICAL SEALING TELECOMMUNICATIONS AND DATA CABLING

This documentation includes, but is not limited to, design guidelines for ICT Design professionals when preparing construction documents for new construction and renovation projects. The extent of this document includes requirements for IT project processes for structured cabling systems, conduits, data outlets, distribution patch panels, equipment racks, and wire-management systems. As a result, a thoroughly tested and certified data network is required based on a structured cabling end-to-end implementation. University of Pittsburgh Information Technology (PITT IT) shall provide the active telecommunications electronics for the data and voice networks, e.g., UPSs, data routers, data switches, wireless access points, voice switches, and telephony peripherals. This document's form and technical content are subject to change due to building construction techniques and IT system technologies developments. As a result, the University of Pittsburgh expressly maintains the right to add and change the information included in this document. The ICT Designer shall incorporate existing systems to ensure a seamless co-existence of newly provided infrastructure. No deviation from this standard shall be incorporated without the University of Pittsburgh Information Technology department's written direction.

Part 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. The construction methodologies and work covered by this section consist of labor, materials, and equipment necessary to complete the installation required for the items specified under this section, including but not limited to:
 - 1. Firestopping of Through Penetrations in Fire Rated Assemblies
 - 2. Smoke and Acoustical Sealing in Non-Rated Assemblies.

1.3 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog data for specified products demonstrating compliance with referenced standards and listing numbers of systems in which each product is to be used.
- B. Schedule of UL System Drawings for Fire Rated Construction: Submit a schedule of all expected opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance ratings.
- C. UL System Drawings for Fire Rated Construction: Furnish copies of all UL Systems identified in the schedule above. Include any engineering recommendations.
- D. Certificates: Product Certificate of Compliance from the by manufacturer certifying material compliance with applicable code and specified performance characteristics.

- E. Installation Instructions: Submit the manufacturer's printed installation instructions.

1.4 QUALITY ASSURANCE

- A. Products/Systems: Provide firestopping systems that comply with the following requirements
 - 1. A qualified testing and inspection agency performs firestopping tests. A qualified testing and inspection agency is UL, or another agency performing testing and follow-up inspection services for firestop system acceptable to authorities having jurisdiction.
 - 2. Firestopping products bear the classification marking of qualified testing and inspection agency.
- B. Installer Qualifications: Experience in performing work of this section, the firestopping manufacturer qualifies as having been provided the necessary training to install firestop products per specified requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery:
 - 1. All Manufacturer products shall be original, unopened, undamaged containers, identification labels intact identifying product and manufacturer, date of manufacture; lot number; shelf life, if applicable; qualified testing and inspection agency's classification are marking, and mixing instruction for multi-component products.
 - 2. Handle and store products according to manufacturer's recommendations published in technical materials. Leave products wrapped or otherwise protected and under clean and dry storage conditions until required for installation.
- B. Storage and Protection:
 - 1. Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by the manufacturer.

1.6 PROJECT CONDITIONS

- A. Do not install products when ambient or substrate temperatures are outside the limitations recommended by the manufacturer.
- B. Do not install products when substrates are wet due to rain, frost, condensation, or other causes.
- C. Do not use materials that contain flammable solvents.
- D. Coordinate the construction of openings and penetrating items to ensure that through-penetration firestop systems are installed per the specifications.
- E. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.
- F. Schedule installation of firestopping after completion of penetrating item installation but before covering or concealing openings

Part 2 – PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. References:
- B. The telecommunications infrastructure shall comply with the specifications of the most recent revision, including addenda and systems bulletins:
1. ANSI/TIA-1179-A "Healthcare Facility Telecommunications Infrastructure."
 2. ANSI/TIA-EIA-569 "Telecommunications Pathways and Spaces"
 3. ASTM E90, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements."
 4. ASTM E814, "Fire Tests of Through Penetration Firestops."
 5. ASTM E1725, "Standard Test Methods for Fire Tests of Fire-Resistive Barrier Systems for Electrical System Components."
 6. UL 1479, "Fire Tests of Through Penetration Firestops."
 7. 8. National Fire Protection Association (NFPA) – NFPA 101: Life Safety Code
 8. National Fire Protection Association (NFPA) – NFPA 70: National Electrical Code.
 9. Underwriters Laboratories Inc. (UL) – Fire Resistance Directory
- C. Fire-rated cable pathway devices shall be used in fire-rated construction for low-voltage data, voice cabling, and optical fiber raceways. Where frequent cable moves, adds, and changes may occur. Pathways required for high voltage cabling will be detailed on the prints. Such devices shall:
1. Meet the hourly fire rating of fire-rated wall and or floor penetrated.
 2. Be tested for the surrounding construction and cable types involved.
 3. Have UL Systems permitting cable loads from; "Zero to 100% Visual Fill." This requirement eliminates the need for fill-ratio calculations to be made by cable technicians to ensure cable load is within the maximum allowed by UL System.
 4. Be "Maintenance-Free," having a corresponding Evaluation Services Report from a Nationally Recognized Third-Party Laboratory. Maintenance-Free is defined as; No action required by cabling technician to open and/or close pathway for cable moves, adds, or changes, such as, but not limited to:
 - a. Opening or closing of doors.
 - b. Spinning rings to open or close fabric liner.
 - c. Removal and or replacement of any material such as, but not limited to, firestop caulk, putty, pillows, bags, foam muffins, foam, foam plugs, foam blocks, or foam closures of any sort.
 - d. Evaluation Services Report (ESR) from an accredited Nationally Recognized Third-party Laboratory certifies compliance with this "Maintenance-Free " definition and all relevant codes and standards.

5. Pathways shall be engineered such that two or more devices may be ganged together for larger cable capacities.
 6. Pathways shall be engineered to be re-enterable so they can be retrofitted and removed from around existing cables without cutting and re-splicing them.
 7. Affix adhesive wall label immediately adjacent to devices to communicate to future cable technicians, authorities having jurisdiction, and others the manufacturer of the device and the corresponding UL System number installed.
- D. Non-rated cable pathway devices shall be used in non-fire-rated construction for all low-voltage, data and voice cabling, optical fiber raceways. Where frequent cable moves, adds, and changes may occur. Pathways required for high voltage cabling will be detailed on the prints. Such devices shall:
1. Limit the movement of smoke and sound of wall and or floor penetrated.
 2. Restore the STC Rating of the penetrated assembly.
 3. Provide L Ratings of greater than 1 CFM when empty and greater than 2.5 CFM at all other loadings up to 100 percent.
 4. Accommodate cable loads from; "Zero to 100% Visual Fill."
 5. Not have an inner fabric liner that tightens around and compresses cables, encouraging potential cable damage or interference.
 6. Be "Maintenance-Free" maintenance-free is defined as; No action required by the cabling technician to open and/or close a pathway for cable moves, adds, or changes, such as but not limited to:
 - a. Opening or closing of doors.
 - b. Spinning rings to open or close fabric liner.
 - c. Removal and or replacement of any material such as, but not limited to, firestop caulk, putty, pillows, bags, foam muffins, foam, foam plugs, foam blocks, or foam closures of any sort.
 - d. Furnish letter from the manufacturer certifying compliance with this definition of "Zero-Maintenance."
- E. Pathways shall be engineered such that two or more devices may be ganged together for larger cable capacities.
- F. Pathways shall be engineered to be re-enterable so they can be retrofitted and removed from around existing cables without cutting and re-splicing them.
- G. Affix adhesive wall label immediately adjacent to devices to communicate to future cable technicians, authorities having jurisdiction, and others the manufacturer of the device and the corresponding UL System number installed.

- H. As an alternative to using a fire-rated or non-rated cable pathway device for a single or two low voltage cables (up to an aggregate cross-sectional area of 0.52 in. (14mm) O.D.) penetrating one or two-hour, gypsum board/stud wall assemblies or non-rated assemblies, either as a through-penetration or as a membrane-penetration, a fire-rated cable grommet may be substituted. The product shall consist of a molded, two-piece, plenum-rated grommet having a foam fire and smoke sealing membrane that conforms to the outside diameter of the individual cable. The grommet product shall be capable of locking to secure the cable penetration within the wall assembly. The grommet shall be UL Classified and tested to ASTM E814 (UL 1479) requirements.
- I. Where non-mechanical pathways must be used, such as sealing (caulking) around single or grouped conduits, the contractor shall provide products that do not re-emulsify, dissolve, leach, break down, or otherwise deteriorate over time due to exposure to atmospheric moisture, sweating pipes, ponding water, or other forms of moisture typical during or after construction. Provide a letter from the manufacturer certifying compliance with this section.
- J. Cable pathway shall replace conduit sleeves in walls and floors, and the following:
 - a. Devices shall pass through core-drilled or preformed openings when installed individually in floors utilizing tested floor plates.
 - b. When multiple units are ganged in floors, devices shall be anchored utilizing a tested grid.
 - c. When installed individually in walls, devices shall pass through a core drilled opening utilizing tested wall plates or integrated flanges.
 - d. When multiple units are ganged in walls, devices shall be anchored employing a tested adjustable gang bracket.
- K. The cable tray shall terminate at each barrier and resume on the other side, so cables pass independently through devices. The cable tray shall be properly supported on each side of the barrier

2.2 MANUFACTURERS

- A. PITT IT Acceptable Manufacturer: Specified Technologies Inc., 210 Evans Way, Somerville, NJ 08876. Tel: (800) 992-1180, Fax: (908) 526-9623, Email: techserv@stifirestop.com, Website: www.stifirestop.com.
- B. Substitutions: **Not permitted. No known equal**
- C. Single Source: Obtain firestop systems for each type of penetration and construction condition indicated only from a single manufacturer.

2.3 MATERIALS

- A. General: Use only products that have been tested for specific fire-resistance-rated construction conditions or acoustical and smoke-related requirements conforming to construction assembly type, penetrating item type, annular space requirements, and rating involved for each separate instance.
- B. Firestop Sealants: Single component latex formulations that, upon cure, do not re-emulsify during exposure to moisture, the following products are acceptable:
 - 1. Specified Technologies Inc. (STI) SpecSeal Series SSS Sealant.
 - 2. Specified Technologies Inc. (STI) SpecSeal Series LCI Sealant.
- C. Firestop Putty: Intumescent, non-hardening, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds. The following products are acceptable:
 - 1. Specified Technologies Inc. (STI) SpecSeal Series SSP Putty.
- D. Firestop Pillows: Re-enterable, non-curing, mineral fiber core encapsulated on six sides with intumescent coating contained in a flame retardant polybag; the following products are acceptable:
 - 1. Specified Technologies Inc. (STI) SpecSeal Series SSB Pillows.
- E. Fire-Rated Cable Grommet: Molded, two-piece grommet with an integral fire and smoke sealing foam membrane for sealing individual cable penetrations through framed wall assemblies. The grommet snaps together around the cable and locks tightly into the wall.
 - 1. Specified Technologies Inc. (STI) EZ-Firestop Grommets.
- F. Fire-Rated Cable Pathways: Device modules comprised of steel pathways with self-adjusting intumescent foam pads allowing 0 to 100 percent cable fill. The following products are acceptable:
 - 1. Specified Technologies Inc. (STI) EZ-PATH Fire Rated Pathway.
- G. Smoke and Acoustical Pathways: The device module comprises a nonmetallic pathway with integral self-adjusting smoke and sound sealing system for cable penetrations through a non-fire-resistance rated wall or floor assemblies. The following products are acceptable:
 - 1. Specified Technologies Inc. (STI) EZ-PATH Smoke & Acoustical Pathway.
- H. Protective Wrap: Endothermic wrap with foil scrim has been tested for protection of cable pathways, liquid fuel lines, through-penetration, and membrane-penetration firestopping. They are testing to incorporate protection of Electrical Metallic Tubing (EMT), Rigid Metallic Conduit (RMC), Cable Trays, and single and/or multi containment liquid fuel lines. Wrap to have a maximum weight of no greater than 1.4 lbs/ft² and allow for the use of steel tie wire when installed around piping, conduits, and/or cable trays. The following products are acceptable:
 - 1. Specified Technologies, Inc. (STI) E-Wrap™ Endothermic Wrap

Part 3 - EXECUTION

3.1 EXAMINATION

- A. Before beginning installation, verify that substrate conditions previously installed under other sections are acceptable for installing firestopping in accordance with the manufacturer's instructions and technical information.
- B. Surfaces shall be free of dirt, grease, oil, scale, laitance, rust, release agents, water repellants, and other substances that may inhibit optimum adhesion.
- C. Provide masking and temporary covering to protect adjacent surfaces.
- D. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install systems according to Performance Criteria and the conditions of testing and classification as specified in the published design.
- B. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of products.

3.3 FIELD QUALITY CONTROL

- A. Keep areas of work accessible until inspection by authorities having jurisdiction.
- B. Where fireproofing products are found deficient, they must be repaired to comply with the standards.

3.4 ADJUSTING AND CLEANING

- A. Remove equipment, materials, and debris, leaving the area undamaged and clean.
- B. Clean all surfaces adjacent to sealed openings to be free of excess firestopping materials and soiling as work progresses

3.5 SCHEDULES

Penetrant Type	Concrete Floor	Concrete Wall	Gypsum Board Wall
Blank Opening	C-AJ-0100, C-AJ-0101, C-AJ-0113, C-AJ-0116	C-AJ-0100, C-AJ-0101, C-AJ-0113, C-AJ-0116	W-L-0020, W-L-0034
Metal Conduits	C-AJ-1080, C-AJ-1240, C-AJ-1353	C-AJ-1080, W-J-1098, W-J-1100	W-L-1049, W-L-1222, W-L-1168
Plastic Conduits/ Raceways	C-AJ-2140, C-AJ-2292, F-A-2186, F-A-2210, F-A-2225	C-AJ-2038, C-AJ-2108, C-AJ-2578, C-AJ-2586, W-J-2018, W-J-2076	W-L-2059, W-L-2074, W-L-2093, W-L-2241
Cables	C-AJ-3214, C-AJ-3231, F-A-3015, F-A-3021, F-A-3054	C-AJ-3214, C-AJ-3231, W-J-3098, W-J-3099, W-J-3124, W-J-3150, W-J-3180	W-L-3219, W-L-3248, W-L-3287, W-L-3356, W-L-3377, W-L-3378, W-L-3379, W-L-3390
Cable Trays	C-AJ-3317, C-AJ-8181, C-AJ-4029, F-A-3015, F-A-3037	C-AJ-8181, W-J-4021, W-J-4022, W-J-4033, W-J-3098, W-J-3145, W-J-3158	W-L-3218, W-L-3271, W-L-3286, W-L-3306, W-L-4008, W-L-4029, W-L-4043, W-L-8073

3.6 DOCUMENTATION

- A. Place system stickers on each side of wall penetrations.
- B. Place a reproduction (photocopy) of the UL System description in a document protector and mount it to the wall next to the wall penetration
- C. Highlight the section of the system description that list the allowed cable types.

END OF SECTION

SECTION 27 05 43 – UNDERGROUND DUCT AND RACEWAYS FOR COMMUNICATION STSYEMS

PART 1 - GENERAL

1.1 RELATED ITEMS

- A. Drawings and General and Supplementary Conditions apply to this section. Refer to the following for additional requirements:
1. Earthwork.
 2. Firestopping.
 3. Raceways and Boxes.

1.2 Related Sections:

1. Division 7 Section — "Firestopping"
2. Division 10 Section — "Cutting and Patching"
3. Division 27 Section – "Telecommunications Room Requirements"

1.3 SUMMARY

- A. This section includes the following:
1. Conduits in direct-buried duct banks.
 2. Conduits in concrete-encased duct banks.
 3. Maintenance holes and maintenance hole accessories.

1.4 SUBMITTALS

- A. Product Data: For the following:
1. Maintenance hole hardware.
 2. Duct-bank materials, including spacers and miscellaneous components.
 3. Warning tape.
 4. Grounding and bonding.
- B. Shop Drawings: Show fabrication and installation details for underground conduits and utility structures and include the following:
1. For maintenance holes:
 - a. Conduit sizes and locations of conduit entries.
 - b. Reinforcement details.
 - c. Maintenance hole cover design.

- d. Step details.
- e. Grounding details.
- f. Dimensioned locations of cable rack inserts, pulling-in irons, and sumps.

For precast maintenance holes, Shop Drawings shall be signed and sealed by a qualified professional engineer and shall show the following:

- g. Construction of individual segments.
 - h. Joint details.
 - i. Design calculations.
- C. Coordination Drawings: Show duct bank profiles and coordination with other utilities and underground structures. Include plans and sections drawn to scale and show all bends and locations of expansion fittings.
 - D. Product Certificates: For concrete and steel used in underground precast maintenance holes, according to ASTM C 858.
 - E. Product Test Reports: Indicate compliance of maintenance holes with ASTM C 857 and ASTM C 858, based on factory inspection.

1.5 QUALITY ASSURANCE

- A. Devices and Accessories (Including Conduits for Communications and Telephone Service): Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for the intended use.
- B. Comply with ANSI C2.
- C. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver conduits to the Project site with ends capped. Store nonmetallic conduits with supports to prevent bending, warping, and deforming.
- B. Store precast concrete units at the Project site as recommended by the manufacturer to prevent physical damage. Arrange so identification markings are visible.
- C. Lift and support precast concrete units only at designated lifting or supporting points.

1.7 COORDINATION

- A. Coordinate layout and installation of conduits and maintenance holes with the final arrangement of other utilities and site grading, as determined in the field.
- B. Coordination of conduit elevations and duct bank entrance into maintenance holes is required, with final conduit profiles determined by coordination with other utilities and underground obstructions. Revise locations and elevations from those indicated as required to suit field

conditions and to ensure conduit runs drain to maintenance holes and as approved by the University of Pittsburgh and Engineer.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match product installed and packaged with protective covering for storage and identified with labels describing contents.
- B. Furnish cable-support stanchions, arms, insulators, and associated fasteners in quantities equal to 5 percent of the amount installed.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Underground Precast Concrete Utility Structures:
 - a. Carder Concrete Products.
 - b. Christy Concrete Products, Inc.
 - c. Elmhurst-Chicago Stone Co.
 - d. Riverton Concrete Products.
 - e. Rotondo Precast/Old Castle.
 - f. Utility Vault Co.
 - g. Wausau Concrete Co.
 - h. AC Miller.
 - 2. Frames and Covers:
 - a. Campbell Foundry Co.
 - b. East Jordan Iron Works, Inc.
 - c. McKinley Iron Works, Inc.
 - d. Neenah Foundry Co.

2.2 CONDUIT

- A. Conduit and fittings are specified in "Raceways and Boxes."
- B. The University of Pittsburgh Information Technology (PITT IT) requires a minimum of two (2) 4" conduits. Specific project plans will identify the required number of conduits.
- C. The underground conduits must be Schedule 40 (thick-walled PVC) or Schedule 80 encased in a 4,000 minimum psi concrete, to a minimum thickness of 6" from the conduit.
- D. Concrete encasement shall be reinforced with ½" steel rebar. The top of the encasement shall be a minimum of 36" below grade. A magnetically detectable tape (minimum width 1") is to be buried 6" below finished grade and following the centerline of the encasement.

- E. Conduits within the encasement are to be spaced 6" apart on center.
- F. Direct-buried conduit is not acceptable unless approved by The University of Pittsburgh Information Technology (PITT IT). The distance between telecommunications maintenance holes shall be no greater than 400 feet.
- G. The conduit segments are to be supplied with a nylon pull rope or ribbon of sufficient tensile strength to facilitate the installation of cable or PVC innerduct.

2.3 PRECAST MAINTENANCE HOLES

- A. Precast Units: ASTM 478, with interlocking mating sections, complete with accessories, hardware, and features as indicated. Include concrete knockout panels for the conduit entrance and sleeve for the ground rod. The size of the vaults is 6' X 8' X 7' in height with a 30" maintenance hole.
- B. Design and fabricate structure according to ASTM C 858.
- C. Structural Design Loading: ASTM C 857, Class A-16.
- D. Joint Sealant: Continuous extrusion of asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.
- E. Source Quality Control: Inspect structures according to ASTM C 1037.
- F. Covers are to be indented with the word "University of Pittsburgh Telecommunications," which shall be cast on the upper side of each cover.

2.4 CAST-IN-PLACE MAINTENANCE HOLES

- A. Loading: AASHTO HS20 traffic load.

2.5 TELECOM IN-GROUND PULL BOXES

- A. The Contractor shall furnish the labor and material to construct the pull boxes, complete with the appurtenances at the locations and shown in detail on the drawings. Pull boxes shall be precast reinforced composite. Pull boxes shall be as manufactured by Quazite Composite Co., or equal as approved by the Architect.
- B. The locations of the pull boxes indicated on the drawings are approximate. Exact locations shall be determined at the job site.
- C. Excavation, shoring, bracing, backfilling, grading, etc., shall be in accordance with the applicable portions of the "Excavating and Backfilling" section of the specification. Pull boxes shall not be installed until final conduit grading has been determined, including the field changes required by underground interferences. Shop drawings shall be submitted for the pull box details.

- D. The pull boxes shall be of the size shown on the drawings. The pull boxes shall be complete with the proper size openings for the conduits. The pull boxes shall be furnished with dowel rods at all openings as required to reinforce conduit envelopes. Refer to underground conduit herein for required reinforcing.
- E. Pull box covers shall be heavy-duty type, suitable for occasional heavy vehicles. Covers are to be indented with the word "University of Pittsburgh Telecommunications," which shall be cast on the upper side of each cover. The cover shall be of a gasket waterproof locking type.

- F. Pull boxes shall be constructed of an aggregate consisting of sand and gravel bound together with a polymer and reinforced with continuous woven glass strands. The material shall have the following Mechanical properties:

Compressive Strength - 11,000 psi.

Tensile Strength - 1,700 psi.

Flexural Strength - 7,500 psi.

ACCESSORIES

- G. Conduit Spacers: Rigid PVC interlocking spacers, selected to provide minimum conduit spacings and cover depths indicated while supporting conduits during concreting and backfilling; produced by the same manufacturer as the conduits.
- H. Maintenance hole Frames and Covers: Comply with AASHTO loading specified for maintenance hole.
1. Provide cast iron covers with the engraved word "University of Pittsburgh Telecommunications" as required.
 2. Maintenance hole Frames and Covers: ASTM A 48; Class 30B gray iron, 30-inch size, machine-finished with flat bearing surfaces.
- I. Sump Frame and Grate: ASTM A 48, Class 30B gray cast iron.
- J. Pulling Eyes in Walls: Eyebolt with reinforcing-bar fastening insert 2-inch- diameter eye and 1-by-4-inch bolt.
1. Working Load Embedded in 6-Inch, 4000-psi Concrete: 13,000-lbf minimum tension.
- K. Pulling and Lifting Irons in Floor: 7/8-inch- diameter, hot-dip-galvanized, bent steel rod; stress relieved after forming; and fastened to a reinforced rod. Exposed triangular opening.
1. Ultimate Yield Strength: 40,000-lbf shear and 60,000-lbf tension.
- L. Bolting Inserts for Cable Stanchions: Flared, threaded inserts of noncorrosive, chemical-resistant, non-conductive thermoplastic material; 1/2-inch ID by 2-3/4 inches deep, flared to 1-1/4 inches minimum at the base.
1. Tested Ultimate Pullout Strength: 12,000 lbf minimum.
- M. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch bolt, 5300-lbf rated pullout, and minimum 6800-lbf rated shear strength.
- N. Cable Stanchions: Hot-rolled, hot-dip-galvanized, T-section steel; 2-1/4-inch size; punched with 14 holes on 1-1/2-inch centers for cable-arm attachment.

- O. Cable Arms: 3/16-inch- thick, hot-rolled, hot-dip-galvanized, steel sheet pressed to channel shape; 12 inches wide by 14 inches long and arranged for secure mounting in a horizontal position at the location on cable stanchions.
- P. Cable-Support Insulators: High-glaze, wet-process porcelain arranged for mounting on cable arms.
- Q. Grounding Materials:
 - 1. Ground Rods: Copper clad, 3/4 inches in diameter by 120 inches.
 - 2. Ground Wire: No. 4 AWG minimum, stranded, hard-drawn copper conductor.
 - 3. Connector Products:
 - a. Comply with IEEE 837 and UL 467 listed for use for specific types and sizes.
 - b. Bolted Connectors: Bolted pressure type connector or compression type. Use only approved connectors. "Split-Bolts" are not approved connectors.
 - c. Welded Connectors: Exothermic-welded type, kit form, and selected per the manufacturer's written instructions.
- R. Ladder: UL-listed, hot-rolled, hot-dip galvanized steel ladder designed explicitly for maintenance hole use. The minimum length equals the distance from the maintenance hole floor to grade. Each maintenance hole contains its own ladder.
- S. Conduit-Sealing Compound: Nonhardening, safe for contact with human skin, not harmful to cable insulation, and workable at temperatures as low as 35 deg F. Capable of withstanding temperature of 300 deg F without slump and of adhering to clean surfaces of plastic conduits, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.
- T. Conduit Duct Plugs:
 - 1. Duct plugs shall be manufactured from high-impact plastic components and shall be corrosion-proof.
 - 2. Duct plugs shall contain a durable elastic compressible gasket, making it effective as a long-term or temporary seal. They shall be removable and reusable.
 - 3. They shall meet or exceed the following mechanical requirements:

a.	Air Pressure	7.5 psi
b.	Water Head	15 ft.
c.	Pull Out	100 Kgf
 - 4. Duct plugs shall be equipped with a rope tie device on the back compression plate to allow the securing of a pull rope. This requirement will allow excess rope slack to be stored within the conduit.
- U. Warning Tape: Underground-line warning tape specified in Section 2.2, "CONDUIT."

2.6 CONSTRUCTION MATERIALS

- A. Damp proofing: Bituminous Damp proofing.

- B. Mortar: Comply with ASTM C 270, Type M, except for quantities less than 2.0 cu. ft. where packaged mix complying with ASTM C 387, Type M, may be used.
- C. Brick for Maintenance hole Chimney: Sewer and maintenance hole brick, ASTM C 32, Grade MS, or approved grade rings.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Maintenance holes: Underground precast concrete utility structures.

3.2 EARTHWORK

- A. Excavation and Backfill: Comply with the "Excavation, Backfilling, and Compacting for Utilities" Section, but do not use heavy-duty, hydraulic-operated compaction equipment.
- B. Unless otherwise indicated, restore surface features at areas disturbed by excavation and reestablish original grades. Replace removed sod immediately after backfilling is completed.
- C. Restore the areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching.
- D. Restore disturbed pavement.

3.3 CONDUIT INSTALLATION

- A. Slope: Pitch conduits a minimum slope of 1:300 down toward maintenance holes and away from buildings and equipment. Slope conduits from a high point in areas between two maintenance holes drain in both directions.
- B. Curves and Bends: Use manufactured long sweep bends with a minimum radius of 24 inches.
- C. Use solvent-cement joints in conduits and fittings and make them watertight according to the manufacturer's instructions. Stagger couplings, so those of adjacent conduits do not lie in the same plane.
- D. Conduit Entrances to Maintenance holes: Space end bells approximately 10 inches o.c. for 5-inch conduits and vary proportionately for other conduit sizes. Change from regular spacing to end-bell spacing 10 feet from the end bell without reducing the conduit line slope and forming a trap in the line. Grout end bells into maintenance hole walls from both sides to provide watertight entrances.
- E. Building Entrances: Make a transition from underground PVC to rigid galvanized steel conduit 5 feet from the exterior wall of the building. Use fittings manufactured for this purpose. Follow the appropriate installation instructions below:

1. Concrete-Encased Conduit: Install reinforcement in conduit banks passing through disturbed earth near buildings and other excavations. Coordinate duct bank with structural design to support duct bank at the wall without reducing structural or watertight integrity of building wall.
 2. Waterproofed Wall and Floor Penetrations: Install a watertight entrance-sealing device with sealing gland assembly on the inside. Anchor device into masonry construction with one or more integral flanges. Secure membrane waterproofing to the device to make it permanently watertight.
- F. Concrete-Encased, Nonmetallic conduits: Support conduits on spacers, spaced as recommended by the manufacturer and coordinated with conduit size, conduit spacing, and outdoor temperature. Install as follows:
1. Separator Installation: Space separators close enough to prevent the sagging and deforming of conduits and secure separators to earth and conduits to prevent floating during concreting. Stagger spacers approximately 6 inches between tiers. Tie the entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around conduits or conduit groups.
 2. Concreting: Spade concrete carefully during pours to prevent voids under and between conduits and at the exterior surface of the envelope. Do not allow a heavy mass of concrete to fall directly onto conduits. Use a plank to direct concrete downsides of bank assembly to trench bottom. Allow the concrete to flow to the center of the bank and rise up in the middle, uniformly filling the open spaces. Do not use power-driven agitating equipment unless designed explicitly for duct-bank application. Pour each envelope run between maintenance holes or other terminations in one continuous operation. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18 inches into concrete on both sides of the joint near the corners of the envelope.
 3. Reinforcement: Reinforce duct banks where they cross disturbed earth and where indicated.
 4. Forms: Use trench walls to form sidewalls of duct bank where the soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
 5. Minimum Clearances between Conduits: 3 inches between conduits and exterior envelope wall, 3 inches between conduits for like services, and 4 inches between power and signal conduits.
 6. Depth: Install top of duct bank at least 30 inches below finished grade in non-traffic areas and at least 36 inches below finished grade in vehicular traffic areas, unless otherwise indicated.
- G. Nonmetallic Conduits - No encasement (with approval from THE UNIVERSITY OF PITTSBURGH INFORMATION TECHNOLOGY (PITT IT)): Support conduits on spacers, spaced as recommended by the manufacturer and coordinated with conduit size, conduit spacing, and outdoor temperature. Install as follows:
1. Separator Installation: Space separators close enough to prevent the sagging and deforming of conduits and secure separators to earth and conduits to prevent floating during backfilling. Stagger spacers approximately 6 inches between tiers. Tie the entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around conduits or conduit groups.
 2. Backfilling: Spade backfill carefully to prevent voids under and between conduits and the exterior surface of the envelope. Do not allow a heavy mass of backfill to fall directly

- onto conduits. Comply with "Earthwork Section," but do not use heavy-duty hydraulic-operated compaction equipment.
3. Reinforcement: Reinforce duct banks where they cross disturbed earth and where indicated.
 4. Minimum Clearances Between Conduits: 3 inches between conduits and exterior envelope wall, 1-1/2 inches between conduits for like services, and 4 inches between power and signal conduits.
 5. Depth: Install top of duct bank at least 30 inches below finished grade in non-traffic areas and at least 36 inches below finished grade in vehicular traffic areas. If depth cannot be met, contact the Owner for a variance before proceeding.
- H. Warning Tape: Bury magnetically detectable warning tape approximately 6 inches below finished grade to make it more easily detectable. Align tape parallel to and within 3 inches of the centerline of the duct bank.
- I. Sealing: Provide temporary closure at terminations of conduits and inner ducts that have cables pulled. At terminations, seal spare conduits and inner ducts. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.
- J. Pulling Cord: Install 100-lbf- test nylon cord in conduits, including spares.

3.4 MAINTENANCE HOLE INSTALLATION

- A. Elevation: Install maintenance holes with rooftop at least 13 inches below finished grade.
- B. Drainage: Install drains in the bottom of units where indicated. Coordinate with drainage provisions indicated.
- C. Access: Install cast-iron frame and cover.
1. Install brick chimney to support frame and cover and connect cover with roof opening. Provide moisture-tight masonry joints and waterproof grouting for the cast-iron frame to the chimney.
 2. Install precast collars and rings to support frame and cover and to connect cover with roof opening. Provide moisture-tight masonry joints and waterproof grouting for the cast-iron frame to the chimney.
 3. Set frames in paved areas and traffic ways flush with finished grade. Set other frames 1 inch above finished grade.
- D. Damp proofing: Apply damp proofing to exterior surfaces of units after the concrete has cured for at least three days. Apply bituminous damp proofing after conduits have been connected and grouted and before backfilling, damp-proof joints and connections, and touch up abrasions and scars. The damp-proof exterior of maintenance hole and handhold chimneys after the brick mortar has cured at least three days.
- E. Hardware: Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors.
- F. Field-Installed Bolting Anchors: Do not drill deeper than 3-7/8 inches for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

- G. Grounding: Install a ground rod through the floor in each structure with the top protruding 4 inches above the floor. Seal floor opening against water penetration with waterproof non-shrink grout. Ground exposed metal components and hardware with bare-copper ground conductors. Train conductors neatly around corners. Use cable clamps secured with expansion anchors to attach ground conductors.
- H. Precast Concrete Maintenance Hole Installation: Unless otherwise indicated, comply with ASTM C 891.
 - 1. Install units' level and plumb and coordinate orientation and depth with connecting conduits to minimize bends and deflections required for proper entrances.
 - 2. Unless otherwise indicated, support units on a level bed of crushed stone or gravel were graded from 1-inch sieve to No. 4 sieve and compacted to the same density as adjacent undisturbed earth.

3.5 FIELD QUALITY CONTROL

- A. Testing: Demonstrate capability and compliance with requirements on completion of the installation of underground conduits and utility structures. Maintenance hole grounds shall measure 10 ohms or less.
- B. Grounding: Test maintenance hole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified. Record test procedures used, test results that comply with requirements, and results of failed tests and corrective action taken to achieve test results that comply with requirements.
- C. Conduit Integrity: Pull aluminum or wood test mandrel through the conduit to prove joint integrity and test for the out-of-round conduit. Provide mandrel equal to 80 percent fill of the conduit. If obstructions are indicated, remove obstructions and retest.
- D. If possible, correct the installations and retest to demonstrate compliance. Remove and replace defective products and retest.

3.6 CLEANING

- A. Pull leather-washer-type conduit cleaner, with graduated washer sizes, through the entire length of conduits. Follow with rubber conduit swab for final cleaning and to assist in spreading lubricant throughout conduits.
- B. Internal surfaces of maintenance holes, including sump, should be cleaned. Remove foreign material.

PART 4 - GENERAL

4.1 RELATED ITEMS

A. Drawings and General and Supplementary Conditions apply to this section. Refer to the following for additional requirements:

1. Earthwork.
2. Firestopping.
3. Raceways and Boxes.

4.2 Related Sections:

1. Division 7 Section — "Firestopping"
2. Division 10 Section — "Cutting and Patching"
3. Division 27 Section – "Telecommunications Room Requirements"

4.3 SUMMARY

A. This section includes the following:

1. Conduits in direct-buried duct banks.
2. Conduits in concrete-encased duct banks.
3. Maintenance holes and maintenance hole accessories.

4.4 SUBMITTALS

A. Product Data: For the following:

1. Maintenance hole hardware.
2. Duct-bank materials, including spacers and miscellaneous components.
3. Warning tape.
4. Grounding and bonding.

B. Shop Drawings: Show fabrication and installation details for underground conduits and utility structures and include the following:

1. For maintenance holes:
 - a. Conduit sizes and locations of conduit entries.
 - b. Reinforcement details.
 - c. Maintenance hole cover design.
 - d. Step details.
 - e. Grounding details.
 - f. Dimensioned locations of cable rack inserts, pulling-in irons, and sumps.

For precast maintenance holes, Shop Drawings shall be signed and sealed by a qualified professional engineer and shall show the following:

- g. Construction of individual segments.
- h. Joint details.
- i. Design calculations.

- C. Coordination Drawings: Show duct bank profiles and coordination with other utilities and underground structures. Include plans and sections drawn to scale and show all bends and locations of expansion fittings.
- D. Product Certificates: For concrete and steel used in underground precast maintenance holes, according to ASTM C 858.
- E. Product Test Reports: Indicate compliance of maintenance holes with ASTM C 857 and ASTM C 858, based on factory inspection.

4.5 QUALITY ASSURANCE

- A. Devices and Accessories (Including Conduits for Communications and Telephone Service): Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for the intended use.
- B. Comply with ANSI C2.
- C. Comply with NFPA 70.

4.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver conduits to the Project site with ends capped. Store nonmetallic conduits with supports to prevent bending, warping, and deforming.
- B. Store precast concrete units at the Project site as recommended by the manufacturer to prevent physical damage. Arrange so identification markings are visible.
- C. Lift and support precast concrete units only at designated lifting or supporting points.

4.7 COORDINATION

- A. Coordinate layout and installation of conduits and maintenance holes with the final arrangement of other utilities and site grading, as determined in the field.
- B. Coordination of conduit elevations and duct bank entrance into maintenance holes is required, with final conduit profiles determined by coordination with other utilities and underground obstructions. Revise locations and elevations from those indicated as required to suit field conditions and to ensure conduit runs drain to maintenance holes and as approved by the University of Pittsburgh and Engineer.

4.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match product installed and packaged with protective covering for storage and identified with labels describing contents.
- B. Furnish cable-support stanchions, arms, insulators, and associated fasteners in quantities equal to 5 percent of the amount installed.

PART 5 - PRODUCTS

5.1 PRODUCTS AND MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Underground Precast Concrete Utility Structures:
 - a. Carder Concrete Products.
 - b. Christy Concrete Products, Inc.
 - c. Elmhurst-Chicago Stone Co.
 - d. Riverton Concrete Products.
 - e. Rotondo Precast/Old Castle.
 - f. Utility Vault Co.
 - g. Wausau Concrete Co.
 - h. AC Miller.
 2. Frames and Covers:
 - a. Campbell Foundry Co.
 - b. East Jordan Iron Works, Inc.
 - c. McKinley Iron Works, Inc.
 - d. Neenah Foundry Co

5.2 CONDUIT

- A. Conduit and fittings are specified in "Raceways and Boxes."
- B. The University of Pittsburgh Information Technology (PITT IT) requires a minimum of two (2) 4" conduits. Specific project plans will identify the required number of conduits.
- C. The underground conduits must be Schedule 40 (thick-walled PVC) or Schedule 80 encased in a 4,000 minimum psi concrete, to a minimum thickness of 6" from the conduit.
- D. Concrete encasement shall be reinforced with ½" steel rebar. The top of the encasement shall be a minimum of 36" below grade. A magnetically detectable tape (minimum width 1") is to be buried 6" below finished grade and following the centerline of the encasement.
- E. Conduits within the encasement are to be spaced 6" apart on center.
- F. Direct-buried conduit is not acceptable unless approved by The University of Pittsburgh Information Technology (PITT IT). The distance between telecommunications maintenance holes shall be no greater than 400 feet.
- G. The conduit segments are to be supplied with a nylon pull rope or ribbon of sufficient tensile strength to facilitate the installation of cable or PVC innerduct.

5.3 PRECAST MAINTENANCE HOLES

- A. Precast Units: ASTM 478, with interlocking mating sections, complete with accessories, hardware, and features as indicated. Include concrete knockout panels for the conduit entrance and sleeve for the ground rod. The size of the vaults is 6' X 8' X 7' in height with a 30" maintenance hole.
- B. Design and fabricate structure according to ASTM C 858.
- C. Structural Design Loading: ASTM C 857, Class A-16.
- D. Joint Sealant: Continuous extrusion of asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.
- E. Source Quality Control: Inspect structures according to ASTM C 1037.
- F. Covers are to be indented with the word "University of Pittsburgh Telecommunications," which shall be cast on the upper side of each cover.

5.4 CAST-IN-PLACE MAINTENANCE HOLES

- A. Loading: AASHTO HS20 traffic load.

5.5 TELECOM IN-GROUND PULL BOXES

- A. The Contractor shall furnish the labor and material to construct the pull boxes, complete with the appurtenances at the locations and shown in detail on the drawings. Pull boxes shall be precast reinforced composite. Pull boxes shall be as manufactured by Quazite Composite Co., or equal as approved by the Architect.
- B. The locations of the pull boxes indicated on the drawings are approximate. Exact locations shall be determined at the job site.
- C. Excavation, shoring, bracing, backfilling, grading, etc., shall be in accordance with the applicable portions of the "Excavating and Backfilling" section of the specification. Pull boxes shall not be installed until final conduit grading has been determined, including the field changes required by underground interferences. Shop drawings shall be submitted for the pull box details.
- D. The pull boxes shall be of the size shown on the drawings. The pull boxes shall be complete with the proper size openings for the conduits. The pull boxes shall be furnished with dowel rods at all openings as required to reinforce conduit envelopes. Refer to underground conduit herein for required reinforcing.
- E. Pull box covers shall be heavy-duty type, suitable for occasional heavy vehicles. Covers are to be indented with the word "University of Pittsburgh Telecommunications," which shall be cast on the upper side of each cover. The cover shall be of a gasket waterproof locking type.

- F. Pull boxes shall be constructed of an aggregate consisting of sand and gravel bound together with a polymer and reinforced with continuous woven glass strands. The material shall have the following Mechanical properties:

Compressive Strength - 11,000 psi.

Tensile Strength - 1,700 psi.

Flexural Strength - 7,500 psi.

ACCESSORIES

- G. Conduit Spacers: Rigid PVC interlocking spacers, selected to provide minimum conduit spacings and cover depths indicated while supporting conduits during concreting and backfilling; produced by the same manufacturer as the conduits.
- H. Maintenance hole Frames and Covers: Comply with AASHTO loading specified for maintenance hole.
1. Provide cast iron covers with the engraved word "University of Pittsburgh Telecommunications" as required.
 2. Maintenance hole Frames and Covers: ASTM A 48; Class 30B gray iron, 30-inch size, machine-finished with flat bearing surfaces.
- I. Sump Frame and Grate: ASTM A 48, Class 30B gray cast iron.
- J. Pulling Eyes in Walls: Eyebolt with reinforcing-bar fastening insert 2-inch- diameter eye and 1-by-4-inch bolt.
1. Working Load Embedded in 6-Inch, 4000-psi Concrete: 13,000-lbf minimum tension.
- K. Pulling and Lifting Irons in Floor: 7/8-inch- diameter, hot-dip-galvanized, bent steel rod; stress relieved after forming; and fastened to a reinforced rod. Exposed triangular opening.
1. Ultimate Yield Strength: 40,000-lbf shear and 60,000-lbf tension.
- L. Bolting Inserts for Cable Stanchions: Flared, threaded inserts of noncorrosive, chemical-resistant, non-conductive thermoplastic material; 1/2-inch ID by 2-3/4 inches deep, flared to 1-1/4 inches minimum at the base.
1. Tested Ultimate Pullout Strength: 12,000 lbf minimum.
- M. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch bolt, 5300-lbf rated pullout, and minimum 6800-lbf rated shear strength.
- N. Cable Stanchions: Hot-rolled, hot-dip-galvanized, T-section steel; 2-1/4-inch size; punched with 14 holes on 1-1/2-inch centers for cable-arm attachment.

- O. Cable Arms: 3/16-inch- thick, hot-rolled, hot-dip-galvanized, steel sheet pressed to channel shape; 12 inches wide by 14 inches long and arranged for secure mounting in a horizontal position at the location on cable stanchions.
- P. Cable-Support Insulators: High-glaze, wet-process porcelain arranged for mounting on cable arms.
- Q. Grounding Materials:
 - 1. Ground Rods: Copper clad, 3/4 inches in diameter by 120 inches.
 - 2. Ground Wire: No. 4 AWG minimum, stranded, hard-drawn copper conductor.
 - 3. Connector Products:
 - a. Comply with IEEE 837 and UL 467 listed for use for specific types and sizes.
 - b. Bolted Connectors: Bolted pressure type connector or compression type. Use only approved connectors. "Split-Bolts" are not approved connectors.
 - c. Welded Connectors: Exothermic-welded type, kit form, and selected per the manufacturer's written instructions.
- R. Ladder: UL-listed, hot-rolled, hot-dip galvanized steel ladder designed explicitly for maintenance hole use. The minimum length equals the distance from the maintenance hole floor to grade. Each maintenance hole contains its own ladder.
- S. Conduit-Sealing Compound: Nonhardening, safe for contact with human skin, not harmful to cable insulation, and workable at temperatures as low as 35 deg F. Capable of withstanding temperature of 300 deg F without slump and of adhering to clean surfaces of plastic conduits, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.
- T. Conduit Duct Plugs:
 - 1. Duct plugs shall be manufactured from high-impact plastic components and shall be corrosion-proof.
 - 2. Duct plugs shall contain a durable elastic compressible gasket, making it effective as a long-term or temporary seal. They shall be removable and reusable.
 - 3. They shall meet or exceed the following mechanical requirements:

a.	Air Pressure	7.5 psi
b.	Water Head	15 ft.
c.	Pull Out	100 Kgf
 - 4. Duct plugs shall be equipped with a rope tie device on the back compression plate to allow the securing of a pull rope. This requirement will allow excess rope slack to be stored within the conduit.
- U. Warning Tape: Underground-line warning tape specified in Section 2.2, "CONDUIT."

5.6 CONSTRUCTION MATERIALS

- A. Damp proofing: Bituminous Damp proofing.

- B. Mortar: Comply with ASTM C 270, Type M, except for quantities less than 2.0 cu. ft. where packaged mix complying with ASTM C 387, Type M, may be used.
- C. Brick for Maintenance hole Chimney: Sewer and maintenance hole brick, ASTM C 32, Grade MS, or approved grade rings.

PART 6 - EXECUTION

6.1 APPLICATION

- A. Maintenance holes: Underground precast concrete utility structures.

6.2 EARTHWORK

- A. Excavation and Backfill: Comply with the "Excavation, Backfilling, and Compacting for Utilities" Section, but do not use heavy-duty, hydraulic-operated compaction equipment.
- B. Unless otherwise indicated, restore surface features at areas disturbed by excavation and reestablish original grades. Replace removed sod immediately after backfilling is completed.
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6.3 CONDUIT INSTALLATION

- A. Slope: Pitch conduits a minimum slope of 1:300 down toward maintenance holes and away from buildings and equipment. Slope conduits from a high point in areas between two maintenance holes drain in both directions.
- B. Curves and Bends: Use manufactured long sweep bends with a minimum radius of 24 inches.
- C. Use solvent-cement joints in conduits and fittings and make them watertight according to the manufacturer's instructions. Stagger couplings, so those of adjacent conduits do not lie in the same plane.
- D. Conduit Entrances to Maintenance holes: Space end bells approximately 10 inches o.c. for 5-inch conduits and vary proportionately for other conduit sizes. Change from regular spacing to end-bell spacing 10 feet from the end bell without reducing the conduit line slope and forming a trap in the line. Grout end bells into maintenance hole walls from both sides to provide watertight entrances.
- E. Building Entrances: Make a transition from underground PVC to rigid galvanized steel conduit 5 feet from the exterior wall of the building. Use fittings manufactured for this purpose. Follow the appropriate installation instructions below:

1. Concrete-Encased Conduit: Install reinforcement in conduit banks passing through disturbed earth near buildings and other excavations. Coordinate duct bank with structural design to support duct bank at the wall without reducing structural or watertight integrity of building wall.
 2. Waterproofed Wall and Floor Penetrations: Install a watertight entrance-sealing device with sealing gland assembly on the inside. Anchor device into masonry construction with one or more integral flanges. Secure membrane waterproofing to the device to make it permanently watertight.
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 4. Forms: Use trench walls to form sidewalls of duct bank where the soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
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- H. Warning Tape: Bury magnetically detectable warning tape approximately 6 inches below finished grade to make it more easily detectable. Align tape parallel to and within 3 inches of the centerline of the duct bank.
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- J. Pulling Cord: Install 100-lbf- test nylon cord in conduits, including spares.

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 2. Install precast collars and rings to support frame and cover and to connect cover with roof opening. Provide moisture-tight masonry joints and waterproof grouting for the cast-iron frame to the chimney.
 3. Set frames in paved areas and traffic ways flush with finished grade. Set other frames 1 inch above finished grade.
- D. Damp proofing: Apply damp proofing to exterior surfaces of units after the concrete has cured for at least three days. Apply bituminous damp proofing after conduits have been connected and grouted and before backfilling, damp-proof joints and connections, and touch up abrasions and scars. The damp-proof exterior of maintenance hole and handhold chimneys after the brick mortar has cured at least three days.
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- F. Field-Installed Bolting Anchors: Do not drill deeper than 3-7/8 inches for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

- G. Grounding: Install a ground rod through the floor in each structure with the top protruding 4 inches above the floor. Seal floor opening against water penetration with waterproof non-shrink grout. Ground exposed metal components and hardware with bare-copper ground conductors. Train conductors neatly around corners. Use cable clamps secured with expansion anchors to attach ground conductors.
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 - 1. Install units' level and plumb and coordinate orientation and depth with connecting conduits to minimize bends and deflections required for proper entrances.
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- D. If possible, correct the installations and retest to demonstrate compliance. Remove and replace defective products and retest.

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END OF SECTION -27 05 43

SECTION 27 11 00 – COMMUNICATION EQUIPMENT ROOM FITTINGS

This documentation includes, but is not limited to, design guidelines for ICT Design professionals when preparing construction documents for new construction and renovation projects. The extent of this document includes requirements for IT project processes for structured cabling systems, conduits, data outlets, distribution patch panels, equipment racks, and wire-management systems. As a result, a thoroughly tested and certified data network is required based on a structured cabling end-to-end implementation. University of Pittsburgh Information Technology (PITT IT) shall provide the active telecommunications electronics for both the data and voice networks, e.g., UPSs, data routers, data switches, wireless access points, voice switches, and telephony peripherals. This document's form and technical content are subject to change due to building construction techniques and IT system technologies developments. As a result, the University of Pittsburgh expressly maintains the right to add to and change the information included in this document. The ICT Designer shall incorporate existing systems to ensure a seamless co-existence of newly provided infrastructure. No deviation from this standard shall be incorporated without the University of Pittsburgh Information Technology department's written direction.

Part 2 – GENERAL

1.1 RELATED DOCUMENTS

- A. The contract's drawings and general provisions, comprising General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.
- B. Related Sections:
- C. Division 01 Specification
- D. Division 27 00 00 – General Requirements
- E. Division 27 02 00 – General Communication Requirements
- F. Division 27 05 28 – Pathway for Communication Systems
- G. Division 27 11 00 – Communication Equipment Room Fittings
- H. Division 27 13 00 – Communication Backbone Cabling Requirements
- I. Division 27 15 00 – Communication Horizontal Cabling Requirements

1.2 SUMMARY

- A. The construction methodologies and work covered by this section consist of furnishing the appropriate telecommunication room equipment (MDF/IDF) workforce, management, materials, and equipment, as seen in the drawings. The construction practices use current best practices and general and commercial building codes.

- B. Design and place the telecommunications rooms (MDF/IDF) in suitable areas for the floor, building, or campus tenants. TR must be located close to the center of the building floor space to provide connectivity to reduce the cable length. Locate the MDF/IDF telecommunications rooms so that no permanent link exceeds 290 feet of the most distant telecommunications outlets they serve. Additional telecommunications rooms (MDF/IDF) are needed if the cable length between MDF/IDF and the telecommunications outlet site, including slack, exceeds 290 feet. Telecommunication rooms (MDF/IDF) in multi-floor buildings will be vertically stacked.
- C. The location of the telecommunications spaces must be above and free of the possibility of water entry. The design of the MDF / IDF must include a floor drain if there is a risk of water entering the telecommunications room. The TR shall not be located below the water level unless protective precautions against water penetration are incorporated. The telecommunications room (MDF/IDF) doors must be accessible through a common corridor or an outside door.
- D. Both telecommunications rooms (MDF/IDF) are dedicated areas for telecommunications use only. There shall be no obstructions in the room, such as columns or building structures. Telecommunications rooms may not be inside or part of mechanical space, equipment room, washroom, storage area, or janitor closet. Equipment associated with telecommunications space support (e.g., plumbing, ductwork, building power distribution) must not be placed in or transferred via the MDF & IDF telecommunications system. The University of Pittsburgh Information Technology (PITT IT) will not install University of Pittsburgh equipment in MDFs or IDFs that do not meet the Water Entry Prevention requirement.
- E. Main Distribution Frame (MDF)
 - 1. The University of Pittsburgh Information Technology (Pitt It) requires a room size of 20' x 20.' Proper cooling and ventilation, electricity, grounding, lighting, VCT-SD (Static Dissipating) flooring, and protection are required. A finished ceiling is not necessary unless the area above the space acts as a plenum. Plywood is not mandatory on the walls of the telecommunications space. The telecommunications racks/cabinets will house the equipment and cable necessary to support the telecommunications space (MDF). Provide a cable runway system that includes, but is not limited to, straight sections of the continuous runway, field-formed horizontal and vertical bends, tees, drop-outs, supports and accessories, core drills, and wire lines in the telecommunications rooms as indicated on the drawings. Both equipment and cable shields shall be connected to the space infrastructure for telecommunications bonding and grounding (earthing). There are no other utilities to reside in the MDF. The University of Pittsburgh Information Technology (Pitt It) will collaborate to determine the specifications and requirements for the building's telecommunications delivery.

F. Intermediate Distribution Frame (IDF)

1. The University of Pittsburgh Information Technology (PITT IT) requires a room-sized 10 feet x 8 feet if the serving area is 5000 square feet. When the total serving area is less than 5000 square feet, The University of Pittsburgh Information Technology (PITT IT) requires a room-sized of 8 feet x 6 feet. The room shall have proper cooling and ventilation, power, grounding, lighting, VCT-SD (Static Dissipating) flooring, and security. A finished ceiling is not required unless the area above the space acts as a plenum. Plywood is not mandatory on the walls of the telecommunications space. The telecommunication racks/cabinets will house all equipment and cable required to support the telecommunication room (IDF). Provide a cable runway system to include, but is not limited to, straight sections of the continuous raceway, field-formed horizontal and vertical bends, drop-outs, supports and accessories, core drills, and conduits in telecommunication rooms as indicated on drawings. Telecommunication rooms (IDF) in multi-floor buildings are to be vertically stacked. Both equipment and cable shields shall be connected to the space infrastructure for telecommunications bonding and grounding (earthing). These requirements apply to the IDF. No other utilities are to reside in the IDFs. The University of Pittsburgh Information Technology (PITT IT) will collaborate to determine the specifications and conditions for the building's telecommunications delivery.

G. Provide wire management in the rooms as indicated on the drawings.

H. Provide equipment racks and the necessary hardware in the rooms as shown on the drawing.

1.3 REFERENCES

- A. NFPA 70 -National Fire Protection Association, National Electrical Code of Article 110: Requirements for Electrical Installations.
- B. NFPA 75 - Standard for the Protection of Information Technology Equipment
- C. ASTM A36/A36M-19 - Standard Specification for Carbon Structural Steel
- D. A1011/A1011M-18a – Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength (Formerly ASTM A570)
- E. ASTM A513/A513M-20a - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing.
- F. ASTM B633-19 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
- G. ANSI/TIA-568.0 - General Telecommunications Cabling for Customer Premises, the most recent revisions, additions, and system bulletins.
- H. ANSI/TIA-568.1 - Commercial Building Telecommunications Cabling Standards, the most recent revisions, additions, and system bulletins.
- I. ANSI/TIA-606 - Administration Standard for Commercial Telecommunications Infrastructure, the most recent revisions, additions, and system bulletins.

- J. ANSI/TIA-607 - Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premise, the most recent revisions, additions, and system bulletins.
- K. ANSI/ TIA-862-B - Structured Cabling Infrastructure Standard for Intelligent Building Systems, the most recent revisions, additions, and system bulletins.
- L. BICSI Information Technology Systems Installation Methods Manual (ITSIMM), 7th Edition, the most recent revisions, and additions.
- M. BICSI Telecommunications Distribution Methods Manual (TDMM), the most recent revisions and additions.
- N. ANSI/BICSI 007-2020 - Information Communication Technology Design and Implementation Practices for Intelligent Buildings and Premises.
- O. ANSI/BICSI N2-17 - Practices for the Installation of Telecommunications and ICT Cabling Intended to Support Remote Power Applications
- P. ANSI/BICSI N3-20 - Planning and Installation Methods for the Bonding and Grounding of Telecommunication and ICT Systems and Infrastructure

1.4 SUBMITTALS

- A. Submittal Drawings: Submit drawings of runway and accessories, including connector assemblies, clamp assemblies, brackets, splice plates, splice bars, grounding clamps, and hold-down plates showing accurately scaled components.
- B. Product Data: Submit manufacturer's data on cable runway system including, but not limited to, types, materials, finishes, and inside depths.

1.5 RECORD DOCUMENTS

- A. Before final acceptance, the contractor shall provide a complete set of CAD-marked drawings clearly illustrating the work and labeling defined in the contract.
- B. Mark up a clean set of Specifications to indicate approved substitutions, change orders, and actual equipment and materials used.

Part 3 – PRODUCTS

2.1 GENERAL

- A. Product: New, free from defects, and listed by UL when an applicable UL Standard exists; provide products of a given type from one manufacturer.
- B. Regardless of the descriptive paragraph's length or completeness, provide a product complying with the specified manufacturer's published specifications to ensure a complete system.

2.2 CABLE RUNWAY SYSTEMS

- A. Manufacturers: Chatsworth
- B. General: Except as otherwise indicated, provide metal cable runways of types, classes, and sizes shown with splice connectors, bolts, nuts, and washers for connecting units.

- C. Runway Types: Material specifications for each runway type are as follows:
 - 1. Solid Bar style runway: Runway shall be ladder type with 1-1/2 inches stringer height with welded rungs.
 - 2. Stringer side rail shall conform to the minimum chemical and mechanical properties of ASTM A36 structural steel. Use cable runway rungs constructed from ASTM A1011 SS Grade 33 structural steel. Each rung shall be 1/2 inch by 1-inch steel c-channel shape with radius edges.
 - 3. The runway shall be 12 inches wide and installed as shown on drawings.
- D. Ground and label runway sections to grounding bus bar located in MDF/IDF Room per ANSI/TIA/EIA 606 & 607 specifications.

2.3 CABLE SEPARATION

- A. Separate the data cables from possible EMI and RFI interference sources when installing the telecommunications cables. Keep the power cables away from the telecommunications cabling for safety and operational purposes.

2.4 CEILING

- A. A suspended ceiling is not recommended in telecommunications spaces unless part of the air cooling or room, as described above, acts as a plenum. The area above the telecommunications rooms (MDF/IDF) acts as a plenum. The minimum ceiling height should then be 8 feet AFF.
- B. Providing a height of 10 feet should be given special consideration to maximize the telecom space's versatility and usability. The University of Pittsburgh Information Technology (PITT IT) requires a cable distribution system within the MDF/IDF room. Design the telecommunications rooms with sufficient pathways or openings through walls and other obstacles to an accessible ceiling area.
- C. To prevent possible water leakage from the sprinkler pipe onto the telecommunication equipment. The University of Pittsburgh Information Technology (PITT IT) requires drainage troughs beneath the sprinkler pipe. Sprinkler heads with a sprinkler cage must be installed as high as possible to avoid accidental operation due to cable pulling activities.

2.5 CLEARANCES

- A. The working clearance shall consider the depth of the rack-mounted equipment and the wall-mounted equipment and hardware for racks and cabinets.
- B. Provide a minimum working clearance (front and rear) of 3.23 feet from installed equipment. Supply minimum side clearance of 12 inches for corners. For specific requirements, consult the manufacturer's documentation and local codes.

2.6 CONDUITS, TRAYS, SLOTS, SLEEVES, AND DUCTS

- A. If possible, situate the sleeves, slots, or conduits so that cable terminations on the rack can be made evenly from both sides of the angled patch panels.
- B. Trays and conduits situated in the ceiling should protrude into the room from 1 inch to 2 inches without a bend and above 8 feet high. The type and location of the cross-connected fields may influence the best possible location of the paths. Slot/sleeve systems should be where pulling and stopping are easy to accomplish. Where vertical and horizontal offsets are required, the EC must follow the bend radius requirements and service loop guidelines.
- C. The available floor space will determine the backbone distribution system's size and the number of backbone conduits or sleeves. The University of Pittsburgh Information Technology (PITT IT) requires at least four (4 trade size) sleeves to serve the telecommunication room. Multiple telecommunications spaces on the same floor are designed to be interconnected. The University of Pittsburgh Information Technology (PITT IT) requires a minimum of two ducts (4 trade sizes) or a pathway providing similar capabilities. The sleeves and slots shall be fire-stopped per the industry standards and project requirements

2.7 DOOR AND PHYSICAL SECURITY

- A. The minimum door dimensions for the doors are 42" wide and 80" high with no doorsills. The doors to the telecommunications rooms must open 180 degrees outward unless restricted by building code and have the same fire rating as the room. Double doors center posts are not allowed. All entries must have access controls. The primary method of securing MDF/IDF rooms is via the RS/2 keycard system of the Police Department of the University of Pittsburgh. If the conditions do not allow this door protection, a five-button Unican lock is required

2.8 EQUIPMENT RACKS

- A. Manufacturers: Panduit. The University of Pittsburgh Information Technology's (PITT IT) preferred local distributor for infrastructure materials is Anixter. The University of Pittsburgh Information Technology (PITT IT) will provide the initial racks or cabinets for the MDF/IDF rooms. Racks shall be UL listed and aluminum construction with a black polyurethane or mil finish.
- B. The rack base shall be pre-drilled and secured to the floor. Racks shall have 12/24 mounting screws included in the package. Rack rails shall be spaced for 19" mounting rail-to-rail and shall be of a U-shaped construction with 12/24 pre-tapped holes in the EIA/ECA-310-E standard hole pattern on both the front and rear.
- C. The rack shall be 84" high. When physical restrictions apply, racks/cabinets may be shorter in height. The University of Pittsburgh Information Technology (PITT IT) will determine the frame (s) positioning within the telecommunication room floor MDF & IDF.
- D. Securely bolt the racks to the telecommunication room floor (MDF/IDF) per the University of Pittsburgh Information Technology (PITT IT) layout and the manufacturer's instructions.
- E. A TrippLite PDU power strip serves each rack. The University of Pittsburgh Information Technology (PITT IT) will provide the power strip(s).

- F. The applicable horizontal and vertical wire management will correctly support the cabling (fiber and copper) per the University of Pittsburgh Information Technology (PITT IT) specifications. Solid Bar Ladder Tray in the MDF, Basket Tray throughout the Floor. "J" Hooks or Bridal Rings are not acceptable

2.9 ELECTRICAL POWER

- A. The contractor shall supply power receptacles situated at least 6 inches of AFF and placed at 6 feet around the telecommunications rooms' perimeter wall (MDF/IDF) per the University of Pittsburgh Information Technology (PITT IT) project requirements.
- B. The University of Pittsburgh Information Technology (PITT IT) will list the number, the source (normal power, optional standby power, UPS power), the voltage, the amperage, the phase, and the power receptacles' position in the room.
- C. Uninterruptible Power Supplies (UPS) will determine the number of circuits required and installed to support the Switch Stack.
- D. Receptacles for power to the UPS shall be mounted to the overhead ladder tray above the back of the rack, facing back, with sufficient clearance to prevent interference with cable installation or rack access. Label the receptacles with panel number, breaker number, and circuit ID.
- E. The University of Pittsburgh Information Technology (PITT IT) Standard installation for power is two single-phase, 120v, 30-amp circuits with an L5-30 (Locking) Receptacle above each rack/cabinet.
 - 1. One circuit will be fed by Optional Standby Power, if available.
 - 2. One circuit will be fed by Normal (House) power.
- F. The University of Pittsburgh will provide cut sheets and single-line diagrams to facilitate the installation and placement of appropriate power for the University of Pittsburgh Information Technology (PITT IT) provided devices requiring hard-wired power. Follow the local and national electrical codes when installing the receptacles.

2.10 ESD CONTROL FLOORING

- A. The contractor shall install ESD Control Flooring in the telecommunication room (MDF/IDF).
 - 1. Primary Manufacturers: Roppe ESD Rubber Static Control Tile
 - 2. Secondary Manufacturers: Armstrong SDT Static Dissipative Excelon Vinyl Composition Tile
- B. The solid, homogeneous Roppe ESD rubber static control tile (F404 Niebla) shown in the finish schedule or listed herein shall be Roppe ESD rubber static control tile manufactured by Roppe Corporation Fostoria, Ohio. The construction of the flooring shall be of first-quality materials and smooth and free from imperfections that detract from its appearance.
- C. The ESD rubber static control tiles shall conform to ASTM-F1700-20, Class 1, Type A. The Stat Defend conductive floor's resistance shall be less than an average of 1,000,000 ohms and shall be more than 25,000 ohms as tested per NFPA 99 6-2.3.8, ASTM F-150 ESD S7.1 at 100 or 500 volts.

- D. The tile shall be 1/8 inches / 3.175mm in thickness and of size 12 inches x 12 inches and in color per the architect's recommendation.
- E. To properly install the Roppe ESD rubber static control tile, the flooring contractor must use Roppe adhesive product Excelsior ASD-800 ESD Adhesive or Excelsior USD-810 ESD Epoxy Adhesive per the manufacturer's specification. Roppe rubber welding beads .160" in diameter are available in matching colors.
- F. Armstrong Excelon SDT comparable ESD flooring is acceptable.
- G. The flooring contractor must ground per the manufacturer's specification.

2.11 ENVIRONMENTAL CONTROL

- A. Cooling and ventilation are mandatory in the telecommunication rooms (MDF/IDF).
- B. Room temperatures must be maintained at 64 degrees Fahrenheit to 75 degrees Fahrenheit at 30 percent to 55 percent relative humidity.
- C. The final TR design shall accommodate the unique or specific requirements, including future applicable provisions. Capacity and type of unit to be determined by MEP engineer.

2.12 FIRE PROTECTION

- A. Each MDF/IDF room must have fire protection according to applicable codes. Coordinate the design of fire protection systems with the equipment layout to avoid obstructing sprinklers, access to the alarm, or other protective measures.
- B. To prevent water from leaking from the sprinkler pipe and damaging the telecommunications equipment. The University of Pittsburgh Information Technology (PITT IT) necessitates the installation of drainage troughs under the sprinkler pipe. Position sprinkler heads with sprinkler cages as high as possible to prevent unintended activity due to cable pulling tasks.
- C. In some cases, the telecommunications room may contain mission-critical equipment or highly-valuable assets that could dictate a dry pipe pre-action system. A portable fire extinguisher with appropriate ratings will be installed and provided per project requirements and applicable fire code.

2.13 GROUNDING & BONDING

- A. The University of Pittsburgh Information Technology (PITT IT) requires a telecommunications grounding system for the Telecommunication spaces per the project requirements and TIA-607-D - Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premise.
- B. The Main Distribution Frame (MDF) shall have the Primary Bonding Busbar (PBB) to facilitate the secondary bonding Busbars (SBBs) located in the IDF, which will connect via the Telecommunications Bonding Backbone (TBB).
- C. The telecommunications rooms' equipment, such as racks, conduits, cable shields, entrance protectors, cable runways, sleeves, structural steel, and local electrical panels, shall be bonded to the primary bonding busbar (PBB) or Secondary Bonding Busbars(SBB).

- D. The Primary Bonding Busbar (PBB) shall be attached to the building's normal main electrical service ground with a Telecommunications Bonding Conductor (TBC).
- E. A copper busbar is required if multiple equipment grounding or intersystem grounding is part of the telecommunication design.

2.14 LIGHTING

- A. The provided electrical power for the lighting shall not come from the same circuits as the telecommunications equipment. The specified must have a minimum of ≈ 500 lx (46 foot-candles) lighting in the horizontal plane and ≈ 200 lx (18.6-foot candles) in the vertical plane, measured 3.28 feet above the finished floor middle of the aisles between cabinets and racks.
- B. Locate the light fixtures at a minimum of 8.5 feet AFF and match the rack, cabinet, or enclosure positions.
- C. Locate the light switches near the entrance(s) to the telecommunications space. Dimmers are not permitted.
- D. The University of Pittsburgh Information Technology (PITT IT) requires a light-colored finish on the telecommunication room walls to improve room lighting.

2.15 WATER ENTRY PREVENTION

- A. The location of the telecommunications spaces must be above and free of the possibility of water entry. The design of the MDF / IDF must include a floor drain if there is a risk of water entering the telecommunications room. Liquid transport pipes (water, waste, steam, other liquid transport piping) shall not travel through, above, or inside the telecommunications room or walls. The University of Pittsburgh Information Technology (PITT IT) will not install University of Pittsburgh equipment in MDFs or IDFs that do not meet the Water Entry Prevention requirement.

Part 4 - EXECUTION

3.1 GENERAL

- A. Coordinate the integration of the work specified herein with other project work to promote a coherent finished result.
- B. The installations shall be professional and neatly performed. The installation of a telecommunications raceway strictly adheres to all industry manufacturers' Category 6A UTP (500 MHz) installation practices.
- C. Reference the BICSI TDDM manual for acceptable installation methods.

3.2 DELIVERY, STORAGE, AND HANDLING

- A. Ship the merchandise in its original container to avoid damage or the introduction of foreign matter.
- B. Oversee the handling and deliveries in compliance with the manufacturer's recommendation.

- C. Provide protective covering during construction to prevent damage.
- D. Product damaged during storage, handling, or construction will be replaced at no cost to the owner.

3.3 INSTALLATION

- A. Locate cable runway fitting supports to meet the strength requirements of straight sections. Install fitting supports per NEMA VE-2 guidelines or by manufacturer's instructions.
- B. Install the cable runways as indicated on the drawings. Mount raceways plumb, level, and no diagonal routing will be acceptable.
- C. Support: Raceway shall be supported by walls and shall not attach to floor-mounted equipment racks, according to the manufacturer's recommendations and load capacities.
- D. Cutting: Cut the raceways to a smooth, even surface. Make all cuts with a fine-tooth hacksaw and a miter box.
- E. Ground the runway trays, racks, flooring, and equipment per TIA/EIA and NEC codes.

END OF SECTION - 27 11 00

SECTION 27 13 00 – COMMUNICATION BACKBONE CABLING

This documentation consists of but is not limited to the University of Pittsburgh Information Technology department's design guidelines for ICT Design professionals to use when preparing construction documents for new construction and renovation projects. The extent of this document includes requirements for IT project processes for structured cabling systems, conduits, data outlets, distribution patch panels, equipment racks, and wire-management systems. As a result, a thoroughly tested and certified data network is required based on a structured cabling end-to-end implementation. University of Pittsburgh Information Technology (PITT IT) shall provide the active telecommunications electronics for both the data and voice networks, e.g., UPSs, data routers, data switches, wireless access points, voice switches, and telephony peripherals. This document's form and technical content are subject to change due to building construction techniques and IT system technologies developments. As a result, the University of Pittsburgh expressly maintains the right to add to and change the information included in this document. The ICT Designer shall incorporate existing systems to ensure a seamless co-existence of newly provided infrastructure. No deviation from this standard shall be incorporated without the University of Pittsburgh Information Technology department's written direction

Part 1 – General

1.1 RELATED DOCUMENTS

- A. Telecommunications Systems Drawings and general contract provisions apply to this section, including general supplementary and special conditions and Division 1 Specification Sections.
- B. Related Sections:
 - 1. Division 27 05 28 – Pathways for Communications Systems
 - 2. Division 27 05 43 – Underground Ducts Banks and Utility Structures
 - 3. Division 27 11 00 – Communication Equipment Room Fittings
 - 4. Division 27 15 00 – Communications Horizontal Cabling
 - 5. BICSI Telecommunications Distribution Methods Manual (TDMM), Latest Edition.

1.2 SUMMARY

- A. This specification describes the required actions, tasks to be completed, and responsibilities of the certified Communications Contractor to provide and install an entire Backbone Cabling System. The sections that follow that describe such actions, tasks, and responsibilities refer to the Contractor unless otherwise specified.
- B. The University of Pittsburgh Information Technology (PITT IT) Network Architect will review and approve the new building network classification to determine equipment, copper, and fiber requirements.
- C. The outside plant fiber optic cable shall terminate in the building's MDF. The new building that has more than 2 IDFs shall have a Building Entrance Switch
- D. Copper and optical fiber backbone cabling will connect the MDF/IDF rooms. Demarcation Point shall be serviced by various sources with optical fiber and

copper cables. The Contractor will coordinate these services to ensure no interruption and extend the services defined in the planning documents.

- E. Inside plant fiber, riser cabling shall connect each building's MDF to each IDF within the building.
- F. No phrases used in this specification imply that the work or equipment required will be less than entirely executed or installed or that the system will be less than fully functional.

1.3 SUBMITTALS

- A. General: Submit the following per the Conditions of the Contract and Specifications Sections.
- B. The product data for each type of product is indicated. Product data shall comprise cut sheets, shop drawings, or other drawings showing the proposed design's specified components' dimensions. For installed electrical parts such as Uninterruptible Power Supply (UPS), systems Automatic Transfer Switches (ATS), or Power Distribution Units (PDU), electrical single-line diagrams are also required. The University of Pittsburgh Technology (PITT IT) will order equipment for a given project and require the cut sheets and other related drawings to be integrated into the design drawings.
- C. The Contractor shall have a complete set of drawings that outline the entire scope of the work, including the construction systems that land in or move through the work area. The work could include but is not limited to electrical, plumbing, HVAC, lighting, and physical security work. Furthermore, the Contractor must provide drawings detailing the demolition or site preparation work before construction. The requirement for the drawings is an electronic format (PDF files or CAD drawings); however, printed drawings are acceptable.
- D. The Contractor will meet with representatives from the University of Pittsburgh Information Technology and Facilities Management groups to review the scope of work and submittals before beginning the work

1.4 QUALITY ASSURANCE

- A. The equipment and materials must be of the specified quality and manufacture. The equipment specified is based on the list of acceptable manufacturers. When the term "approved equal" is used, it means that the equipment is equivalent to the equipment specified and is subject to approval by the University of Pittsburgh based on the submittals provided.
- B. UL Compliance: Provide cables that have passed the UL 1581 VW-1 flame test. The rating of the cables must be for use in the environment in which intended.
- C. Installations, materials, equipment, and quality must be per the specifications and drawings and all applicable provisions of the most current versions of the following regulations, codes, and standards, including all applicable addenda:
 - 1. ANSI/TIA-568 – Generic Telecommunications Cabling for Customer Premises, the most recent revisions, additions, and system bulletins.
 - a. Commercial Building Telecommunications Cabling Standard.
 - b. Balanced Twisted-Pair Telecommunications Cabling and Components Standard.
 - c. Optical Fiber Cabling Components Standard.

2. ANSI/TIA-606 – Administration Standard for Commercial Telecommunications Infrastructure, the most recent revisions, additions, and system bulletins.
3. ANSI/TIA-607– Generic Telecommunications Bonding and Grounding for Customer Premises, the most recent revisions, additions, and system bulletins.
4. ANSI/TIA-758-B – Customer-Owned Outside Plant Telecommunications Cabling Standard, the most recent revisions, additions, and system bulletins.
5. ANSI/NFPA 70 – National Electrical Code
6. IEEE C2-2017 – National Electrical Safety Code (NEC)
7. BICSI - Telecommunications Distribution Methods Manual (TDMM) Latest Edition
8. BICSI - Information Technology Systems Installation Methods Manual (ITSIMM) Latest Edition
9. BICSI - Outside Plant Design Reference Manual (OSPDRM) Latest Edition

1.5 ABBREVIATIONS

A. Use the following abbreviations for the Drawings and Specifications.

1. IDF– Intermediate Distribution Frame
2. MDF – Main Distribution Frame
3. ABF – Air Blow Fiber

1.6 SCHEDULING

A. University of Pittsburgh Information Technology collaborates with the Facilities Project Manager to generate and reconcile budgets during each enabling, design and bidding phase. The ICT designer must begin proactive collaboration with the Facilities project manager to simplify this process and correctly prepare for active systems deployment. At each step, the ICT designer should provide to the University of Pittsburgh Information Technology (PITT IT) the following Coordination of Service Documentation (COSD):

1. Each information technology system involved in the scope of work must be identified and reviewed on a project-by-project basis.
2. Project Summary: project name, project number, location, departments, and occupancies, building space program with sq. ft., and plan diagrams.
3. Provide a description of the anticipated site work and the potential of disturbing existing infrastructure, such as campus utility service providers.
4. Floor drawings for demolition and new construction, highlighting existing, relocated, and projected Telecom Rooms.
5. Schedule of the project, including enabling phases, departmental relocation moves dates, certificate of occupancy dates, and final occupancy dates.

6. Narrative of the ICT Basis of Design (BoD). The aim is to describe the reasons and conclusions taken throughout a project's design phase.
7. Organize all work with the General and Sub-contractors and the scheduled work of the other trades. The pathway's size and bend radius must adhere to TIA/EIA standards and manufacturers' requirements.

1.7 RECORD DOCUMENTS

- A. When all work has been finalized, and before final acceptance, the Contractor shall furnish to The University of Pittsburgh Information Technology (PITT IT) a complete set of Computer-Aided Design (CAD) marked drawings clearly showing the contract work and labeling.
- B. Mark up a clean set of specifications to show approved substitutions, change orders, and actual equipment and materials used
- C. During construction, the Contractor shall meet with representatives from The University of Pittsburgh Information Technology (PITT IT) and Facilities Management groups to review progress and address issues.

1.8 DELIVERY, STORAGE & HANDLING

- A. Comply with section 27 00 00.

Part 2 - PRODUCTS

2.1 GENERAL

- A. When a relevant UL Standard exists, UL must be new, free of faults, and listed. Provide products of a given type from one manufacturer.
- B. The Contractor shall install the telecommunications equipment and data cables neatly and professionally in conjunction with the manufacturer's specifications and the University of Pittsburgh's contract requirements.
- C. Regardless of the extent or completeness of the descriptive paragraph herein, provide a product that meets the specified manufacturer's published specifications.
- D. Provide products specified with the quality and standards established.
- E. The abandoned backbone, vertical, fiber & riser copper shall be removed completely, per NEC 770.25 and 800.25, to each termination point, including the Fiber LIU or Copper Patch Panel. Within seven working days, coordinate and schedule the removal of the abandoned backbone with the University of Pittsburgh Information Technology (PITT IT) Project Manager.

2.2 ACCEPTABLE MANUFACTURERS

- A. The model numbers and manufacturers included in this specification are listed to establish a standard of product quality.
- B. Other eligible manufacturers will be considered after complete technical data samples. The results of independent testing laboratory tests of proposed equipment are approved if requested.
- C. All copper cable, connectors, and hardware shall comply with the warranty requirements of Section 27 15 00 – Horizontal Cabling Requirements.
- D. Manufacturers:
 - 1. General is the primary manufacturer for the vertical copper cabling. Panduit is the secondary manufacturer for copper riser cable and is acceptable. The University of Pittsburgh Information Technology (PITT IT) preferred local distributor for infrastructure materials is Anixter
 - 2. AFL / Dura-line is the Primary Inside and Outside Plant fiber optic cable manufacturer.
 - a. eABF Optical Fiber (SM-OS2 BIF)
 - b. eABF Optical Fiber (50/125- OM4 BIF) - only to be used with University of Pittsburgh Technology (PITT IT) approval
 - 3. Panduit and Corning are the secondary fiber cable manufacturers for use **only** in the inside plant infrastructure. Panduit and Corning are not authorized to use the University's outside plant infrastructure.
 - a. The Contractors must have written approval from the University of Pittsburgh Information Technology (PITT IT) Manager to use Panduit and Corning fiber cabling for the inside plant infrastructure.
 - b. The University of Pittsburgh Information Technology (PITT IT) representative will determine the fiber cable type and strand count.

2.3 FIBER OPTIC BACKBONE CABLING

- A. Optical Fiber Distribution Cable-Multimode50/125- OM4 BIF (AFL) University of Pittsburgh Technology (PITT IT) 's preferred local distributor for infrastructure materials is Anixter.
 - 1. Multimode Cable Fiber: 50um OM4 Multimode - Bend Insensitive Fiber
 - 2. Modal Bandwidth: 3500 MHz-km at 850 nm, 500 MHz-km at 1,300 nm for Overfilled Launch and 4700 MHz-km at 850 nm for "Laser" Launch
 - 3. Maximum attenuation of 3.50dB/km at 850 nm and 1.50dB/km at 1,300 nm.
 - 4. Link distance support for 10GBase-SR of 550 meters, 10GBase-LX4 of 300 meters, 40GBase-SR4 of 150 meters, and 100GBase-SR10 of 150 meters.
 - 5. EIA/TIA 568-E / GR-409-CORE compliant
 - 6. Flame Rating: UL Listed, non-conductive, ONFP rated
 - 7. Fiber Count: specified by the University of Pittsburgh Information Technology (PITT IT) per project requirement.

8. Optical Connectivity Multimode: AFL FuseConnect LC Connectors or Poli-MOD Patch and Splice Module
 - a. Mated pair insertion loss shall be less than 0.75 dB.
 - b. The connector shall accept both 250 and 900-micron fiber coatings.
 - c. Fiber Optic Connector utilizes a zirconia ferrule for fiber alignment.
 - d. The LC connector has anti-snag latch hardware for more direct connections and high optical stability.
 - e. The connector must be compliant with TIA/EIA 568-D.3.
9. Under no circumstances are "crimp-and-cleave" type connectors acceptable for terminating multimode fiber.
- B. Optical Fiber Distribution Cable-Single Mode (AFL) - University of Pittsburgh Technology's preferred local distributor for infrastructure materials is Anixter.
 - a. Single-Mode Cable: (eABF) Cable OS2 - G.652D/G.657.A1
 - b. Maximum attenuation of 0.4 dB/km at 1300 nm, 0.4 dB/km at 1,550 nm. EIA/TIA 568-D.3, IEEE 802 compliant.
 - c. Flame Rating: UL Listed, non-conductive, ONFP rated
 - d. Fiber Count: as specified by The University of Pittsburgh Information Technology (PITT IT) per project requirement
 - e. Single Mode Connectivity: AFL FuseConnect LC Connectors or Poli-MOD Patch and Splice Module
 - f. The insertion loss average shall be 0.15 dB. The LC connector has anti-snag latch hardware for more accessible connections and high optical stability.
 - g. LC Connector must be compliant with TIA/EIA 568-D.3.
2. Under no circumstances are "crimp-and-cleave" type connectors acceptable for terminating Single-Mode fiber.
- C. Optical Fiber Interconnect/Rack Mount – AFL- Xpress fiber management patch panels the University of Pittsburgh Information Technology (PITT IT) preferred local distributor for infrastructure materials is Anixter.
- D. Provide rack-mounted optical fiber cabinets and adapters in each MDF/IDF Room as indicated on drawings per the University of Pittsburgh Technology's construction requirements. The installed Fiber Management Patch Panels shall include rack mounting brackets that enable the Fiber Management to be mounted in a 19" frame.
- E. Fiber Management Patch Panels shall have rear corner slots for cable entry, wire retainers for gripping the buffered fiber, and fiber storage drums for keeping a minimum bend radius of 1.5 inches for the buffered fiber.
- F. Provide LC duplex adapter panels and blank filler panels for all unused openings.

- G. All connectors must have appropriate dust covers installed immediately upon termination to ensure a clean end-face. The termination work should be scheduled at a point in the construction timeline to minimize the likelihood of the new connectors becoming contaminated with dust and construction debris.
- H. Provide a minimum 30 feet service loop on all fiber cables inside each MDF/IDF room. The University of Pittsburgh Technology (PITT IT) will provide guidance on the location of the service loop
- I. Provide only Velcro-type wire wraps in all MDF/IDF Rooms. No tape or plastic wraps shall be permitted. Install the Velcro wire wraps' hook side out.'
- J. The University of Pittsburgh Technology (PITT IT) will provide a single optical fiber cabinet for each MDF/IDF.
 - 1. IDF– Intermediate Distribution Frame
 - a. Xpress Fiber Management (XFM) 1U or 2U Patch Panel for IDF rooms
 - 2. MDF – Main Distribution Frame
 - a. Xpress Fiber Management (XFM) 4U Patch Panel for MDF rooms
- K. Any additional optical fiber cabinets are the responsibility of the EC.

2.4 COPPER BACKBONE CABLE

- A. Copper Distribution Cable: The University of Pittsburgh Information Technology (PITT IT) 's preferred local distributor for infrastructure materials is Anixter.
- B. The University of Pittsburgh Information Technology (PITT IT) Manager will determine the need for a copper backbone cable for all University projects.
 - 1. Outside Plant:
 - a. General is the primary manufacturer.
 - b. Essex is the secondary manufacturer and is acceptable; pair count as specified by The University of Pittsburgh Information Technology (PITT IT) per project requirement.
 - 2. Inside Plant/Rise Rated:
 - a. Panduit is the primary Manufacturer; General is the secondary manufacturer and is acceptable; per project requirement, pair count as specified by The University of Pittsburgh Information Technology (PITT IT).
- C. The CAT 5E (25 pair) cable is the standard for Vertical Backbone copper cabling from each MDF to each IDF.
 - 1. CAT 5E Patch Panels (Copper Riser):
 - a. Panduit Part Number (#DPA245E88TGY) The University of Pittsburgh Information Technology (PITT IT) 's preferred local distributor for infrastructure materials is Anixter. The installed Copper Patch Panels shall include rack mounting brackets that enable Copper Patch Panels to be mounted in a 19" frame.
 - b. Wiring blocks shall be available for 24 pairs. (The EC will install a single 25-pair CAT 5E copper cable from each MDF to each IDF.

- c. Connecting blocks shall be available as kits that consist of the wiring blocks, the correct number of connecting blocks, and label strips for 24 pair sizes.
- d. Connecting Blocks shall be four pair configurations. Provide all connecting blocks to terminate 24 pairs.
- e. Wiring blocks shall be fire-retardant molded plastic blocks with horizontal strips, each of which secures and organizes cable pairs.
- f. Connecting blocks shall be rated EIA/TIA Category 5E compliant and shall accept 22-26 (0.4-0.65mm) solid copper conductors and 22-26 (0.4-0.65mm) 7-stranded copper conductors
- g. Provide only Velcro-type wire wraps in all MDF/IDF Rooms. No tape or plastic wraps shall be permitted. Install Velcro wire ties' hook side out'.
- h. Binder can forgo the last pair (Violet Slate).
- i. The University of Pittsburgh Information Technology (PITT IT) will provide a single 24 Port Patch Panel for each MDF/IDF. Additional 24 Port Patch Panels are the responsibility of the EC

D. Inner Duct – (Inside Plant)

- 1. **eABF** - The University of Pittsburgh Information Technology's (PITT IT) preferred local distributor for infrastructure materials is Anixter. (Both Inside & Outside Plant) – Must be a ducted tube (microcell) capable of being pushed without air 200 feet. Each microcell must be capable of carrying at least (48) strands of fiber.
 - a. The Contractor must install the optical fiber in the Inner Duct Ducted Tube (microcell) raceway. All inner ducts installed must be UL approved and have a diameter of 1.25 inches.
 - b. The standard number of microcells for each IDF is nine for the ducted cell Inner Duct.
 - c. Each IDF should have an individual nine microcell ducted tube, Inner Duct from the MDF.
 - d. The Backbone Inner Duct into the MDF from the Outside Plant should contain nineteen microcells.
 - e. The inner duct will be plenum rated, UL listed, and contain a factory-installed pull tape.
 - f. The inner duct shall be corrugated, orange in color, and labeled "Danger Optical Fiber" a minimum of every 50 feet.
 - g. Label the Inner Duct with the cable count at far-and-near endpoints. The University of Pittsburgh Information Technology (PITT IT) will provide specific labeling requirements.

E. Cable Runway System

- 1. Manufacturers: Chatsworth
- 2. General: Except as otherwise indicated, provide metal cable runways of types, classes, and sizes shown with splice connectors, bolts, nuts, and washers for connecting units.

3. Runway Types: Material specifications for each runway type are as follows:
4. Solid Bar style runway:
 - a. The runway shall be ladder type with 1-1/2 inch stringer height with welded rungs.
 - b. The stringer side rail shall conform to the minimum chemical and mechanical properties of ASTM A36 structural steel.
 - c. The construction of the cable runway rungs shall be from ASTM A1011 SS Grade 33 structural steel. Each rung shall be 1/2 inch by 1-inch steel c-channel shape with radius edges.
 - d. The runway shall be 12 inches wide and fitted as shown on drawings.
 - e. Ground runway sections to grounding bus bar located in MDF/IDF Room per ANSI/TIA/EIA 606 & 607 specifications.

Part 3 – EXECUTION

3.1 GENERAL

- A. Coordinate the work specified herein with other project work to facilitate an industry-standard final product.
- B. Install cables within industry best practices and standards.
- C. Strictly adhere to all industry and manufacturer's installation practices when installing optical fiber cabling, maximize duct and raceway utilization and maintain a 40% fill factor.
- D. Plywood is not mandatory on the walls of the telecommunications space. Terminate the fiber/copper cable in the racks/cabinets.
- E. The Contractor will be responsible for all consumables required to perform an industry-standard installation as part of the base bid and per PITT IT standards.

3.2 DELIVERY, STORAGE, AND HANDLING

- A. Ship product in its original container to prevent damage or entrance of foreign matter.
- B. Oversee the handling and deliveries in compliance with the manufacturer's recommendation.
- C. During construction, provide a protective covering to prevent damage or the entry of foreign matter. Provide protective cover during construction to avoid damage
- D. Product damaged during storage, handling, or construction will be replaced at no cost to the Owner.
- E. Any remaining consumables will be packaged and delivered to the University of Pittsburgh Information Technology (PITT IT) within two weeks of project completion.
- F. All job sites must be appropriately secured, with access limited only to authorized persons. At the end of each working day, the Contractor is responsible for securing the job site.

3.3 INSTALLATION

A. Copper Backbone Cabling

1. Install copper distribution cables and associated equipment in accordance with industry standards and manufacturer's written recommendations.
2. Install copper cable without damage to pairs or jacket. Do not exceed the manufacturer's recommended pulling tensions. Do not bend cables to smaller radii than recommended by the manufacturer.
3. Terminated the usable copper pairs to meet specifications. Do not splice fiber or copper cable runs between MDF and IDF.
4. At each MDF/IDF room, coil a minimum of ten feet of copper cable as a Service Loop for future relocation.

B. Optical Fiber Backbone Cabling

1. Install optical distribution fiber, copper distribution cables, and associated equipment in accordance with industry standards and the manufacturer's written recommendations.
2. Install optical distribution fiber cable without damage to fibers, cladding, or jacket. Clean the optical fiber cable and dirt and construction debris components upon installation and termination. Install dust covers on fibers after cleaning.
3. Do not exceed the manufacturer's recommended pulling tensions.
4. All fiber shall not have a bending radius of more than ten (10) times the cable's diameter or exceeds the bending radius specs of the cable manufacturer.
5. Mid-span fiber splicing is not allowed for both the outside and inside fiber plant systems. It is permitted to perform a transition splice at each run end of the eABF for inter-building runs and intra-building fiber runs between the IDF and MDF. Such splices are made inside the building at each end, in a location determined by the University of Pittsburgh Information Technology (PITT IT).
6. The Fiber Distribution Units (FDUs) housing fiber optic terminations shall be sized to accommodate the total fiber count installed at each location as defined in the drawings
7. Terminate fibers with LC-style connectors.
8. Fusion-Spliced, Field-Installable Connectors must be AFL's FUSEConnect fusion-spliced, field-installable connector or Poli-MOD Patch and Splice Module.
9. Pre-connectorized fiber cable, in-the-field connectorization, and "Crimp and cleave" type connectors are not acceptable under any circumstances.
10. The installed optical fiber cables shall be in a plenum-rated microcell innerduct.

11. Use an approved pulling lubricant where necessary.
12. Terminated the usable optical fiber to meet specifications.
13. At each MDF/IDF room, coil a minimum of thirty feet of optical fiber cable for future relocation. Properly support innerduct and cable along the entire pathway.
14. The University of Pittsburgh Information Technology (PITT IT) will provide guidance on the placement of service coils.

3.4 LABELING

- A. Securely label all cables at each entry and exit point of conduit, innerduct, or raceway. Label the inner duct with the "Fiber Optic Cable" cable number, fiber count, starting location, end location, and installation date. Label the copper cable with starting location, end location, pair count, and installation date
- B. "Rack" in this context could refer to a relay rack or an enclosed cabinet.
- C. Each rack is assigned a row number and a rack number
- D. These numbers start at one (1) and increment in sequence as needed.
- E. The Pittsburgh Information Technology (PITT IT) will determine the row and rack numbers. The typical row and rack numbers begin from left to right in a given row, and rows run front to back.
- F. Fiber termination bays in a given rack start at 1, at the top of the frame, incrementing as more bays are added, working down from the top. Existing devices (Electronics, Ethernet patch panels.) in a given rack do not interfere with the numbering of the fiber termination bays.
- G. A room ID (EHB4A, for example) is a combination of the two-letter building code assigned by The University of Pittsburgh Information Technology (PITT IT) ("EH" for Old Engineering Hall) and the MDF/IDF room number ("B4A" in this example). The University of Pittsburgh Information Technology (PITT IT) will provide the actual building code.
- H. In the "EHB4A" example above, the first rack in the first row in that room would be "EHB4A-R1-1", with the "R" indicating that the unit is a rack.
 1. A rack mounted fiber termination bay ID follows the form:
 - a. (ROOM_ID)-R(RACK_ROW_ID)-(RACK_ID)-
(POSITION_IN_RACK)
- I. Extending the examples above, the first (uppermost) fiber termination bay in the first rack in the first-row in-room EHB4A would be "EHB4A-R1-1-1". The next bay below this one, in the same rack, would be "EHB4A-R1-1-2". The first bay in the next rack in that row would be "EHB4A-R1-2-1," The first bay in the first rack in the next row would be "EHB4A-R2-1-1".

J. Additional notes:

1. Fiber to multiple locations, such as fiber from an MDF to several IDFs in the same building, may terminate in the same bay in the MDF, if necessary. The bay needs to be labeled appropriately to denote which panels terminate fiber to each specific location. A label is to include both endpoints of the fiber terminations.
2. Pre-printed labels shall meet the UL 969 requirements for legibility, defacement, adhesion, and exposure. Hand-written labels are not allowed.
3. Notations made to the legend card (if applicable) in a given bay will be made using a label printer.
4. When the finish of a termination bay prevents adhesive labels from sticking correctly, it is permitted to improve the contact between the label and the surface by lightly sanding the area to receive the label. This problem is common on bays that have a textured finish.

K. Provide a typed label on each patch panel designating the port signal.

L. Provide an 80 lb. card stock with a 10-point block sans serif font, unless products come with manufacturer-supplied labels and schemes.

M. Properly label the Fiber Panels on the front and back with each port's cable number and port connections.

N. Provide labeling compliant with ANSI/TIA/EIA 606 standards and per the Owner's requirements.

O. Provide logical and legible cable wiring label permanently affixed for easy identification.

1. Cable labels will be adhesive strip type, covered with clear heat-shrink tubing. Instead of the adhesive strip style, the use of factory stamped heat shrink tubing is permitted.
2. The wiring designator is to be an alphanumeric code unique for each cable.
3. Labels shall not be hand-written.

3.5 TESTING

A. Testing is vital in assuring the overall integrity and satisfactory performance of the intrabuilding backbone system.

B. Schedule and conduct final testing in the presence of the PITT IT representative as specified.

C. Test all equipment and components before usage per manufacturers' published test procedures. In addition, test optical fiber cable following TIA/EIA 568-D.3 at both 850 nm and 1300 nm window for multimode optical fiber. As specified in section 3.08, keep a record of all results, and submit an electronic copy.

1. Test Multimode fiber at wavelengths of 850 and 1300 nm.
2. Test Singlemode fiber at wavelengths of 1310 and 1550 nm.

- D. The outlets, cables, patch panels, and related components shall be fully assembled and labeled before field testing. The copper and fiber optic cables that fail testing shall be removed, replaced, and re-tested at no additional cost to the Owner
1. A complete and submit the electronic test results for all UTP copper and fiber optic cable. Before scheduling final testing with PITT IT. Test UTP copper and fiber optic cabling on every piece of cabling (connector to connector).
 2. Any cable that fails any test must be removed, replaced, and re-tested at no additional expense to the Owner.
- E. The optical fiber tests shall include but are not limited to:
1. Backbone Link Measurement
 - a. Perform fiber testing using high-quality test cords of the same fiber type as the cabling under test. Conduct link attenuation (OLTS) tests on all fiber optic strands installed following splicing and termination following current ANSI/TIA standards.
 - b. A bidirectional end-to-end attenuation test of each strand of the backbone link segment shall be.
 - c. Conduct the test at two wavelengths to account for attenuation variations due to wavelength:
 - i. For multimode strands: 850 nm and 1300 nm
 - ii. For Singlemode strands: 1310 nm and 1550 nm
 - d. Test multimode strands following TIA-526-14, One Reference Jumper with Encircled Flux.
 - e. Test Singlemode strands following TIA-526-7, One Reference Jumper
 - f. All Test cords used for link attenuation testing shall be between 1 m and 5m in length.
 - g. The total attenuation budget for the length of each fiber cable (end-to-end) shall be determined and used to determine acceptable values for each of the appropriate wavelengths specified in this standard, ANSI/TIA – 568.E.1 11.3.3.4.
 2. Polarity Testing:
 - a. Perform A paired duplex fibers test for polarity using an OLTS for Multi-fibers/channel.
 3. After splicing and terminating the optical fiber, use an OTDR to test the fiber-optic strand per ANSI/TIA standards.
 - a. End-to-end bidirectional signature trace with fault detection, connection point reflections, fiber bend, pressure point locations, and other features.
 - i. One wavelength, 1300 nm for multimode strands
 - ii. One wavelength, 1550 nm for Singlemode strands

- b. The installed launch cable between the OTDR, and the initial link connection shall be approximately 100 m.
 - c. Installed the receive cable after the last link connection shall be at least 25 m in length.
- F. Fiber End-face Inspection:
 - 1. After completing tier 2 testing of the optical fiber link, an image of each optical fiber end face must be taken and recorded. Take end face image at either 250X or 400X magnification for end face quality per the IEC 61300-3-35 criteria
 - 2. Scuffed, uneven, or dirty connectors shall be diagnosed and corrected.
- G. Test cabling segment for fiber optic cabling (connector to connector).
- H. A link found to be defective will be diagnosed and repaired.
- I. Document any necessary fiber-optic corrective action needed during the installation process. Conduct a new testing protocol to demonstrate that the modified connection has met the University of Pittsburgh's performance requirements.
- J. The new fiber links shall have a final and passing result recorded in the test results documentation.
- K. The broken or damaged fibers shall be replaced at no cost to the University of Pittsburgh and replaced fiber optic cables shall be re-tested.
- L. The Contractor shall submit electronic OTDR test results reports for each fiber optic cable strand to PITT IT before the project is closed.
- M. The Copper Distribution Testing
 - 1. The tests shall include but are not limited to:
 - a. Pair Integrity
 - i. Continuity to the remote end
 - ii. Shorts between any two or more conductors
 - iii. Crossed pairs
 - iv. Reversed pairs
 - v. Split pairs
 - vi. Power faults
 - vii. Ground faults
 - viii. Foreign voltage
 - ix. Sheath continuity
 - x. Any other miswiring
- N. Record and submit a hard copy of all results.

3.6 TEST EQUIPMENT

- A. Thirty days before the start of testing, provide a list of test equipment make, model numbers, adaptors, and calibration dates used. Test equipment to be of the type and quality recommended by the manufacturer of the tested components.
- B. Inform the Owner and Engineer seven (7) working days before testing. The Owner or Owner's representative shall have the right to witness any/all testing. The test results and a certification statement shall be forwarded to the Engineer for approval upon testing. A failure to comply can lead to the Contractor performing all tests in the presence of the Owner or Owner's representative at no additional cost.
- C. The equipment listed by manufacturer and model number establishes a quality standard; other approved equal equipment will be acceptable.
- D. At his own expense, the Contractor shall perform all tests directed by an inspection authority, Engineer, or as required by the manufacturer.
- E. Furnish the following equipment if needed. The equipment to be available for the entire test period through final System testing:
 - 1. Ladders and scaffolding are necessary to inspect the cable in cable trays and ceiling-mounted junction boxes.
 - 2. Optical Time Domain Reflectometer (OTDR). The OTDR must do Tier 1 and Tier 2. Optical Power Meter. 850/1300nm LED light source.
 - 3. For Singlemode fiber, 1310/1550 nm laser light source for testing purposes.
 - 4. Test-All 25-Independent Technologies Inc.
 - 5. Fluke Level III Cable Tester.

3.7 FINAL INSPECTION AND TEST

- A. After the completion of installation, initial adjustments, tests, and measurements specified above, and submission and review of the results, a final inspection and test will be observed by the Owner, Owner's Representative, or Engineer no earlier than two weeks after receipt of the written results.
- B. Provide a minimum of one person for inspection and two persons for testing familiar with the system's aspects to assist
- C. Moving and adjusting specific components may be required for the system testing process.
- D. Testing includes the operation of each primary system and any other modules considered essential. Perform tests and provide the necessary test equipment, tools, and materials to make any necessary repairs, corrections, or adjustments.
- E. The Contractor shall complete the following procedures on each system:
- F. Examine the methods and means used to integrate the system into the facility.
- G. Verify proper equipment adjustment, balance, and alignment for optimum quality and meet the manufacturer's published specifications.

- H. Other tests on equipment or systems are deemed appropriate.
- I. In the event the need for further adjustment or work becomes evident during testing, the Contractor is to continue his work until the system is acceptable at no addition to the contract price. Suppose approval is delayed due to defective equipment or the equipment or installation failing to meet the requirements of these specifications. In that case, an extension of the inspection and testing period is needed. The contract price will be reduced to reflect the additional time and expenses incurred by the Owner at the standard rate in effect at the time.

3.8 DOCUMENTATION

- A. The installer shall provide test documents to CSSD in electronic format, delivered either via electronic mail or on appropriate storage media (CD-ROM, USB flash drive). PDF documents are preferred, but other industry-standard formats are acceptable.
 - 1. The documents should include the following:
 - a. Fiber test results
 - b. Copper test results.
 - c. Manufacturers and warranty certificates

END OF SECTION – 27 13 00

SECTION 27 13 23 - COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING

Part 1 GENERAL

1.1 SUMMARY

- A. The following section specifies the jettted optical fiber backbone cabling portion of a structured cabling system. The scope of this section is defined by American National Standards Institute / Telecommunications Industry Association (ANSI/TIA) standards, meaning that the equipment specified in this section supports devices that are part of the backbone and horizontal cabling. No deviation from this standard shall be incorporated without the University of Pittsburgh Information Technology department's written direction
- B. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section's work.
- C. Related Sections
 - 1. This section shall be used in conjunction with the following other specifications and related Contract Documents to establish the total requirements for the Communications Optical Fiber Backbone Cabling
 - a. Division 01 Specifications
 - b. Section 27 02 00 - General Communication Requirements
 - c. Section 27 05 28 - Pathways for Communication Systems
 - d. Section 27 10 00 - Structure Cabling Testing
 - e. Section 27 11 00 - Communication Equipment Room Fittings
 - f. Section 27 13 00 - Communication Copper Cable Backbone
 - g. Section 27 15 00 - Communications Horizontal Cabling
- D. CAUTION: Using this Section without providing all the components indicated above will remove basic requirements
- E. In the event of a conflict regarding communications jettted optical fiber backbone cabling requirements between this section and any other section, the provisions of this section shall govern

1.2 REFERENCES

- A. These specifications shall implement by reference to the relevant parts of the following specifications, guidelines, rules, and regulations. Refer to the most recent version, update, or addenda of the following:
 - 1. National Electrical Safety Code (NESC)
 - 2. National Electrical Code (NEC)
 - 3. IEEE C2 – National Electric Safety Code
 - 4. Occupational Safety and Health Act (OSHA)
 - 5. All applicable State and Local Electrical Codes
 - 6. ANSI/TIA-568-E.0 - Generic Telecommunications Cabling for Customer Premises

7. ANSI/TIA/EIA - 568-E.1: Commercial Building Telecommunications Cabling Standard
 8. ANSI/TIA-568-D.3 - Optical Fiber Cabling Components Standard
 9. ANSI/TIA/EIA - 569: Commercial Building Standard for Telecommunication Pathways and Spaces
 10. ANSI/TIA/EIA - 606: The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
 11. ANSI/TIA/EIA - 607: Commercial Building Grounding and Bonding Requirements for Telecommunications
 12. ANSI/TIA-758-A - Customer-Owned Outside Plant Telecommunications Infrastructure Standard
 13. Telcordia Standards and Specifications
 14. BICSI: Telecommunications Distribution Methods Manual (TDMM)
- B. The UL label must be present on all materials that require UL certification. Use the ETL and Telcordia testing standards if there are no documented UL standards for a given item, and the item is labeled accordingly. Where UL provides a system listing and label that applies, the complete system must be labeled
- C. Definition
1. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails
 2. BICSI: Building Industry Consulting Service International
 3. LAN: Local Area Network
 4. RCDD: Registered Communication Distribution Designer
 5. OSP: Outside Plant "Raceway" shall mean any enclosed channel for routing wire, cable, or busbars.
 6. EMT shall mean Electrical Metallic Tubing.
 7. "RMC" shall mean Rigid Metal Conduit.
 8. "PBB" shall mean Primary Bonding Busbar.
 9. "SBB" shall mean Secondary Bonding Busbar.
 10. "TBB" shall mean Telecommunications Bonding Backbone.
 11. "Pull box" shall mean a metallic box with a removable cover.
 12. "Junction box" shall mean a pull box wherein a conduit run transitions from a feeder conduit to multiple distribution conduits

1.3 SYSTEM DESCRIPTION

- A. Provide and install all materials, equipment, and devices required to provide a complete jettted fiber optic distribution system, including but not limited to:
1. Indoor and outdoor Micro-duct.
 2. Optical fiber Jettted Micro Cable backbone and terminations.

3. All conduits, Micro-ducts, fiber optic Micro Cables, terminations, patch panels, racks, and telecommunication outlets must be labeled.
 4. All fiber optic Micro Cables and connections are tested and documented. Perform the optical testing using an OTDR and a power meter to provide a bi-directional test at the highest possible wavelength.
- B. The optical fiber section of this universal cabling scheme here specified, except such parts as specifically exempted, shall be installed and function as a complete system. The specification and plans ensure that the project furnishes full cabling and equipment system. It is sufficient to include an item in the contract if specified in the specification or illustrated on the blueprints.

1.4 SUBMITTAL INFORMATION

- A. Provide submittals in accordance with the specifications for the project.
- B. Six sets shall be submitted; the Contractor shall receive two of the six, according to Division 01, General Conditions.
- C. Provide the materials as specified; no further qualification is necessary, except for items requiring shop drawings.
- D. The successful bidder must provide the Engineer with drawings and manufacturer's data on the following materials within ten days of receiving the Notice to Proceed:
 1. Micro-duct.
 2. Optical Fiber Micro Cables
 3. Splice Closures
 4. Strain Relief Grips
 5. Optical Fiber Connectors
 6. Optical Fiber Patch Panels
 7. Optical Fiber Adapter Panels
 8. Optical Fiber Patch Cables
 9. Tube Cable Routing Diagrams
 10. Logical Fiber Optic Diagrams

1.5 CLOSEOUT SUBMITTALS

- A. See Division 01.
- B. Front of bay elevation drawings showing completions and as-built corrections.
- C. Provide as-built records of equipment cabinet/rack addressing or numbering by cabinet/rack, shelf, or row.
- D. Provide as-built fiber strand, adapter panel, and FDU addressing or numbering lists as installed.

1.6 QUALITY ASSURANCE

- A. The Contractor shall be a Dura-Line FuturePath® eABF certified installer and shall provide documentation signed by the manufacturer.
- B. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of an RCDD / RCDD/NTS.
 - 2. Installation Supervision: Installation shall be under the direct supervision of a BICSI Registered Technician, who must always be on-site while this section's work is being performed.
 - 3. Field Inspector: Currently registered by BICSI as an RCDD, to conduct on-site inspections at least three days per week for four hours per day.
- C. Submit documentation with the bid that includes the names of employees working on this project, their experience, level of expertise, and training certificates signed by Dura-Line FuturePath® eABF representatives.
- D. Provide grounding of cable shields, cabinets, racks, and IDF equipment enclosures per the latest version of the Grounding, Bonding, and Electrical Protection chapter of the BICSI TDMM Manual ANSI-J-STD-607-A, NFPA 70, NESC.
- E. Perform work in accordance with the State of Pennsylvania and local AHJ standards.
- F. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

- A. The manufacturing company of products specified in this section must have a minimum of five years of documented experience and made in America must list said manufacturer does not explicitly make ALL products and OEM.
- B. The installing company performing this section must be Dura-Line certified and have a minimum of two years of documented experience approved by the manufacturer.

1.8 FIELD MEASUREMENTS

- A. The Contractor is to measure, verify, locate, and coordinate with all trades and the University of Pittsburgh Telecommunications system before installing all communications equipment, hardware, cabling, and supporting appurtenances.
- B. The Contractor is to measure all ground connections to the communications equipment and provide ground measurement readings to the University of Pittsburgh before actual system component installations and completion of the project.

1.9 COORDINATION

- A. The Contractor must contact the University of Pittsburgh's Telecommunications system before commencing any Optical Fiber Backbone Cabling installation.
- B. The Contractor must organize a minimum of one meeting one week before commencing work on this section.

Part 2 – PRODUCTS

2.1 GENERAL

- A. Furnish and install all micro-ducts and micro-cables, connectors, adapter panels, fiber distribution units, and equipment as shown on drawings and as specified below.
 - 1. The Contractor shall furnish and install optical fiber micro-cables as identified on the drawings. Fiber optic micro-cables shall not be spliced or patched at transition points from indoor to outdoor. Fiber optic micro-cables shall be installed end to end or home-run from MDF to application to eliminate splicing and patching.
- B. Micro-duct.
 - 1. Indoor micro-duct – All micro-duct shall be composed of dielectric materials. The micro-duct shall be suitable for installation in cable tray, metallic conduit, and conventional inner duct. Micro-duct cable ends must be completely sealed during installation to prevent contaminants, including water, from entering. According to the manufacturer's recommended procedures, all internal micro-ducts must pass the standard pressure test and proof test after installation. The remaining unoccupied micro-ducts shall be plugged or capped on both ends. Indoor micro-duct specifications are as follows:
 - a. Manufacturer: Dura-Line
 - b. Micro-duct Type: 1, 2, 3, 4, 7, 12, 19 and 24 way, 8.5mm OD / 6mm ID
 - c. Micro-duct rating: UL rated Riser, Plenum, or LSHF Handling
Temperature: 0 degrees C to +40 degrees C
 - d. Maximum Pulling Tension: Per Manufacturer's Recommendations
 - e. Bending Radius: 20x OD during installation, 10x OD after installation
 - f. All micro-ducts shall be tested to and in compliance with Telcordia GR-3155-CORE. Micro-ducts must be compliant as a stand-alone element of the air-blown cabling system.
 - g. Micro-ducts shall have internal ribs and low friction silicone lining to allow required jetting performance.

2. Outdoor micro-duct – All micro-duct shall be composed of all-dielectric materials (except for armored version or locate wire where applicable). The micro-duct shall be suitable for underground conduit, direct buried, or aerial applications as appropriate. Micro-duct cable ends and individual micro-ducts shall be sealed entirely during installation to prevent contaminants, including water, from entering. Upon completion of micro-duct installation, all micro-ducts shall pass the standard pressure test and proof test per the manufacturer's recommended procedures. All unoccupied micro-ducts must have airtight/water-tight end caps on both ends. Outdoor micro-duct specifications are as follows:
 - a. Manufacturer: Dura-Line
 - b. Micro-duct Type: 1, 2, 3, 4, 7, 12, 19, and 24 way, 8.5mm OD / 6mm ID
 - c. Micro-duct Rating: HDPE/OSP
 - d. Handling Temperature: -20 degrees C to +40 degrees C
 - e. Maximum Pulling Tension: Per Manufacturer's Recommendations
 - f. Bending Radius: 20x OD during installation, 10x OD after installation
 - g. Micro-ducts shall have internal ribs and low friction silicone lining to allow required jetting performance.

C. Indoor/Outdoor air-blown fiber optic micro-cable Specifications

1. Fiber optic cables installed inside micro-ducts shall be indoor/outdoor rated and adhere to the most current version of the Telcordia GR-409 Interconnect Cable specification for premise building cabling applications. The cable shall meet the following requirements.
 - a. The cable shall be listed as OFNP, OFNR, or LSZH as a stand-alone fiber optic cable.
 - b. The cable shall have a maximum cable diameter of 4.5mm and be suitable for installation in micro-ducts/micro-tubes with a nominal inside diameter of 6.0mm. The cable product line must support the air-blown system requirement to install up to 96-fibers per 6.0mm micro-duct.
 - c. Install the cable so that the mechanical properties allow 6.0 mm inside diameter of the micro-ducts for a minimum straight and level run distance of 200 feet. The requirement listed above is using a cable installation push-jetting device with drive wheels/belts powered by a non-air delivery system. An example of this push-jet machine is the Plumettaz model UltimaZ V-20.
 - d. The cable shall be water-blocked and comply with the water penetration requirements of GR-20-CORE.
 - e. The cable has an operating temperature range of -40C to +70C per the requirements of Telcordia GR-20-CORE. Test the cable to and in compliance with Telcordia GR-409-CORE. The cable shall be compliant as a stand-alone element of the air-blown cabling system.

- f. The use of add-on micro-duct/micro-tube or furcation tubes is not required to protect the cable/fibers after exiting the distribution micro-duct/micro-tube pathway.
- g. The cable shall be suitable for installation in all NFPA/NEC fiber cable pathway systems, either riser or plenum rated.
- h. Optical fibers shall be bend-insensitive, SM or MM.
- i. Optical fiber options shall be available as defined in the following table:

D. Fiber Distribution Units (FDU)

- 1. The Fiber Distribution Units (FDUs) housing fiber optic terminations shall be sized to accommodate the total fiber count installed at each location as defined in the drawings.
- 2. Connector panels and connector couplings (sleeves, adapter panels.) adequate to accommodate the number of fibers to be terminated shall be furnished and installed by the Contractor.
- 3. FDU's shall provide for strain relief of incoming cables.
- 4. FDU's shall incorporate radius control mechanisms to limit bending of the fibers to the manufacturer's recommended minimums or 3", whichever is larger.
- 5. The patch panels shall have a standard key lock that opens all panels installed for this project.
- 6. The terminated fibers shall be mated to LC couplings for single-mode, and LC couplings for multimode mounted on adapter panels. Adapter panels, in turn, snap into the housing assembly. Adapter panels shall be available to accommodate LC connectors and LC connectors.
- 7. The patch panels shall be cabinet/rack-mounted in the floor IDFs and rack-mounted in the MDF unless otherwise specified on the drawings.
- 8. Manufacturers:
 - a. AFL
 - b. Substitutes: No Substitutions.
- 9. ANSI-TIA-568-D.3 Compliant

E. Splice Closures

- 1. The splice closure for use within buildings shall be a minimum of 16" W x 14" H x 8" D (dependent upon the number of Micro-ducts and conduit entries) NEMA 12 pull box. Provide strain relief for Micro-ducts directly entering the splice closure from cable trays.
- 2. The splice closure for use above ground outside of buildings shall be a minimum of 16" W x 14" H x 8" D (dependent upon the number of Micro-ducts and conduit entries) NEMA 4X pull box. Provide strain relief for Micro-ducts directly entering the splice closure from cable trays. Substitutions as approved by the Engineer.

3. The splice closure for use in below-ground vaults shall be Preformed Armadillo NEMA 6P (IP68) rated or 3M 2-Type 505. Size is dependent upon the number of tube bundles. Provide strain relief for Micro-ducts directly entering the splice closure.
- F. Strain Relief Grips
1. Install strain relief grips at all splice closures where micro-ducts enter directly from cable trays. Conduit entries require tube bundle support, such as in vertical runs.
 2. When using strain relief grips for micro-ducts directly entering splice closures from cable trays, take care not to crush or deform the Micro-duct when tightening the strain relief grip around the tube bundle.
 3. Manufacturer:
 - a. FuturePath Enclosure Connector from Dura-Line
 - b. Substitutes: As approved by Dura-Line
- G. Optical Fiber Patch Cables
1. Optical fiber patch cables shall incorporate LC UPC (Ultra Physical Contact) connectors for single-mode and LC UPC connectors for multimode.
 2. The optical fiber patch cables shall be single-mode and multimode optical fiber utilizing tight buffer construction. The optical fiber patch cables shall be a minimum of 1.5 meters long (verify length needed before purchase). The Contractor shall provide two (2) duplex optical fiber patch cables of the appropriate type (single-mode or multimode) for each fiber link.
 3. Manufacturer:
 - a. AFL
 - b. Substitutions: No substitutions
 4. Field terminated optical fiber patch cables, and jumpers shall not be allowed. All patch cords and jumpers shall be factory manufactured
- H. Connectors
1. The connector type shall be LC for single-mode optical fiber and LC for multimode optical fiber.
 2. The attenuation per mated pair shall not exceed 0.75 dB (individual) and 0.5 dB (average).
 3. The connectors shall sustain a minimum of 200 mating cycles per EIA/TIA-455-21 without violating specifications.
 4. The connector shall meet the following performance criteria:

5. Manufacturers:
 - a. AFL Substitutes:
 - b. No Substitutions
6. ANSI-TIA-568-D.3 Compliant

Part 3 - EXECUTION

3.1 PRE-INSTALLATION SITE SURVEY

- A. Before starting systems installation, meet at the project site with the PITT IT representatives and representatives of trades performing related work to coordinate efforts; before proceeding with the installation, review areas of potential interference and resolve conflicts. The General Contractor shall be necessary to plan the crucial scheduled completions of the equipment rooms and telecommunications closets.
- B. Before installing the fiber cable system, examine the areas and conditions. Do not proceed with the installation until satisfactory conditions shall be field verified with PITT IT representatives.
- C. The exact location of backbone cable terminations shall be field verified with the PITT IT representatives.

3.2 HANDLING AND PROTECTION OF EQUIPMENT AND MATERIALS

- A. The Contractor shall be responsible for safekeeping their materials and subcontractor's property, such as equipment and materials, on the job site. the University of Pittsburgh assumes no responsibility for protecting the above property against fire, theft, and environmental conditions.

3.3 PROTECTION OF OWNER'S FACILITIES

- A. Effectively protect the Owner's facilities, equipment, and materials from dust, dirt, and damage during construction.
- B. Remove protection at the completion of work.
- C. The materials delivered and installed under the contract fail to conform with the Engineer's specifications and drawings or any portion thereof. Respect or regard to the quality, amount of value of material, appliances, or labor used in work shall be rejected and replaced by the Contractor. All work distributed by changes necessitated by said defects or imperfections shall be made good at the Contractor's expense.

3.4 INSTALLATION

A. Micro-duct Installation

1. Beginning installation means the Contractor accepts existing conditions.
2. The Contractor shall furnish all essential tools to facilitate Micro-duct installation without damaging the micro-duct. Such equipment includes, but is not limited to, sheaves, winches, cable reels, cable reel jackets, duct entrance funnels, pulling tension gauges, and similar devices. All equipment shall be of substantial construction to allow steady progress once pulling has begun. No improvised devices that may move or wear in such a way as to endanger the micro-duct shall be permitted. It is not acceptable to pull a Micro-duct with a motorized vehicle.
3. Perform Micro-duct pulling per the manufacturer's recommendations. The manufacturer's recommendations shall be part of the Micro-duct submittal. During the installation of the Micro-duct, the Contractor must not exceed the recommended pulling tensions and bending radii. Do not install any bent or kinked micro-duct to a radius less than the manufacturer's recommendations.
4. During pulling operation, an adequate number of workers shall be present to allow observation at all points of duct entry and exit and feed Micro-duct and operate pulling equipment.
5. The Contractor shall utilize lubricant for ease of pulling tensions and ensure that the type of lubricant used is non-injurious to the Micro-duct sheath material used. Lubricant shall not harden or become adhesive with age.
6. Avoid abrasion and other damage to Micro-duct during installation.
7. Before pulling Micro-duct, thoroughly mandrel conduits to remove foreign materials verify cable trays are free of foreign debris, sharp edges, and protruding uncapped bolts.
8. Seal the tubes before pulling Micro-duct.
9. Pull Micro-duct with Kellem grips and break away swivels using the manufacturer's recommended pulling tension for a breakpoint.
10. A minimum of 24 hours must pass between the installation of the Micro-duct and the installation of fiber units according to the manufacturer's specifications.
11. Following the installation of the micro-duct, the installers shall perform the following three test sequences per the manufacturer's specifications:
 - a. Air Flow Testing
 - b. Pressure Testing
 - c. Continuity Testing
12. Before jetting the fiber, the Contractor shall verify and remove any water in Micro-ducts.

B. Fiber Optic MicroCable Installation

1. Before jetting fiber optic MicroCable, thoroughly test micro-ducts
2. Beginning installation means the Contractor has fulfilled Micro-duct installation and testing requirements per manufacturer's specifications and pre-installation testing of fiber optic Micro-Cable per this specification.
3. The Contractor shall furnish all necessary tools to facilitate Micro-Cable jetting without damaging the cable jacket. Such equipment includes, but is not limited to, blowing head and wheel, air compressor, air preparation kit, blowing beads, and similar devices. All equipment shall be of ample construction to allow steady progress once jetting has begun. Utilizing makeshift devices or devices not approved by the manufacturer is not permitted. Pulling Micro-Cables is not acceptable.
4. Jetting of the fiber optic Micro-Cables shall be done following the manufacturer's recommendations. The manufacturer's recommendations shall be part of the Micro-Cable submittal. During the installation of the Micro-Cable, the Contractor must not exceed the recommended bending radii. Any fiber optic cable bent or kinked to a radius less than recommended shall not be installed.
5. An adequate number of workers shall be present during the jetting operation to allow cable observation at all cable entry points, exit, feed cable, and operate jetting machinery.
6. When jetting Micro-Cables, do not use "Pulling" lubrication and avoid abrasion and other damage to cables during installation.
7. Each Micro-Cable must include cable slack. Follow the manufacturer's suggested methods for slack cable length, guaranteeing a minimum of 5 meters (about 15 feet) of coiled and secured cable at each termination position. Micro-Cable slack is meant to facilitate cable repair and/or equipment relocation. It is separate from the fiber length necessary to accommodate termination requirements. The cable slack shall be stored to protect it from cable damage. The use of suitable enclosures designed for this purpose is encouraged.
8. Fiber optic MicroCables shall be indoor/outdoor rated. According to the manufacturer's requirements, fiber optic Micro-Cables must be installed continuously, and splices are not permitted.
9. Slack in each fiber Micro-Cable shall be provided to allow for future re-termination in the event of connector or fiber end-to-end damage. Keep Adequate slack to allow termination at a 30-inch high workbench positioned adjacent to the termination enclosure(s). Retain a minimum of 1 meter (39-inches) of slack in the work area, and maintain a minimum of 3 meters (about 10 inches) in equipment rooms and telecommunications closets. Label each fiber bundle.
10. Qualified personnel utilizing state-of-the-art equipment and techniques shall complete all-optical fiber terminations.

C. Labeling

1. All labeling shall be in accordance with ANSI/TIA-606-A and noted on Telecommunication drawings unless otherwise indicated by the University of Pittsburgh.
2. The Contractor shall deliver three sets of as-built drawings to the Owner within four weeks of acceptance of the project. A set of as-built drawings shall be provided to the Owner in digital form (CD-ROM) and utilizing software acceptable to the University of Pittsburgh. The Contractor shall deliver the digital media to the Owner within six weeks of acceptance of the project.

D. Cooperation: The Contractor shall cooperate with all other trades and Owner's personnel to locate work properly. Should it be necessary to raise, lower, or relocate any portion of the work longitudinally to accommodate the overall installation, the Contractor shall perform the work at no extra cost to the Owner, providing the decision was before installation. The Contractor shall check the location of electrical outlets concerning coordination between trades before installing the equipment.

E. Testing

1. The Contractor shall provide the cable manufacturer's test report for each reel of fiber optic cable provided. These test reports shall include the manufacturer's on-reel attenuation test results at 1310 nm and 1550 nm for each single-mode optical fiber of each reel and 850nm and 1300nm for each multimode optical fiber of each reel before shipment from the manufacturer.
2. The Contractor will perform an attenuation test with an OTDR of each optical fiber of each cable reel before installation. The Contractor shall supply this test data to the Engineer before installation.
3. The fibers utilized in the installation shall be traceable to the manufacturer. The Contractor must provide On-the-reel bandwidth performance as tested at the factory upon request.
4. Optical fiber bundles shall be tested before utilization as follows:
 - a. Test equipment: The Contractor is responsible for supplying all equipment and personnel necessary to conduct the acceptance tests. The bidder shall detail each cable type's proposed test plan, including equipment to use, test frequencies, and wavelengths.
 - b. Contractor responsibility: The Contractor shall conduct acceptance testing according to a schedule coordinated with the Owner. Representatives of the Owner may be in attendance to witness the test procedures. The Contractor shall offer adequate advance notice (at least one week) to the Owner to allow for such participation.
 - c. Procedures: The Contractor describes how they will conduct the tests and provide copies of all test results to the architect/engineer.

5. All fibers shall be initially tested with a light source and power meter, utilizing procedures stated in ANSI/TIA-526-7: OFSTP-7 Measurement of Optical Power Loss of Installed Single-mode Fiber Cable Plant. Measured results shall be plus/minus 1dB of the submitted loss budget calculations. If loss figures are outside this range, test the cable with an optical time-domain reflectometer to determine the cause of variation. Remove and replace damaged fiber at no charge to the Owner.
 - a. Test Fibers shall be at 1310 nm and 1550 nm for single-mode optical fiber MicroCables and 850 nm and 1300 nm for multimode optical fiber MicroCables.
 - b. Testing procedures shall utilize "Method B" – One jumper reference.
 - c. Bi-directional testing of all-optical fibers is required.
6. Test results shall include a record of wavelength, fiber type, fiber and bundle number, test equipment and model number, date reference setup, and operator (crew members).
7. The Contractor shall provide written reports of all test data in written form to the Owner. The Contractor also turns over test data to the Engineer at such time. In the event that test results are not satisfactory, the Contractor shall make adjustments, replacements, and changes as necessary and shall then repeat the test or tests that disclosed defective material, equipment, or installation method, and shall perform additional tests as the Engineer deems essential.
8. The testing related to connected equipment of others shall be with the permission and presence of the Contractor involved. The Contractor shall perform all testing necessary by the project requirements to prove the fiber connections are correct.
9. Before testing, send a copy of the test equipment calibration to the Engineer for approval. The equipment calibration certificate date must be no more than six months old before testing begins. Submit three record copies of all test data to the Engineer for approval. The Contractor shall notify the Engineer at least one week before the test date so that the Engineer may be present

3.5 WARRANTY

- A. Submit to Owner at project closeout a signed and registered manufacturer's 25 Year Warranty consisting of extended product warranty and applications assurance per the warranty program.
- B. Submit to the Owner at notice to proceed with the most current copy of the manufacturer's registration certificate and the warranty terms and conditions that apply to the manufacturer's solution.
- C. Submit to Owner, at notice to proceed, a statement of any Contractor warranties in addition to the manufacturer's stated and supplied warranties. Submit at closeout signed copies of the Contractor provided warranties that are in addition to the manufacturer stated and supplied warranties

END OF SECTION - 27 13 23

SECTION 27 15 00 – COMMUNICATION HORIZONTAL CABLING

This documentation consists of but is not limited to the University of Pittsburgh Information Technology department's design guidelines for ICT Design professionals to use when preparing construction documents for new construction and renovation projects. The extent of this document includes requirements for IT project processes for structured cabling systems, conduits, data outlets, distribution patch panels, equipment racks, and wire-management systems. As a result, a thoroughly tested and certified data network is required based on a structured cabling end-to-end implementation. University of Pittsburgh Information Technology (PITT IT) shall provide the active telecommunications electronics for both the data and voice networks, e.g., UPSs, data routers, data switches, wireless access points, voice switches, and telephony peripherals. This document's form and technical content are subject to change due to building construction techniques and IT system technologies developments. As a result, the University of Pittsburgh expressly maintains the right to add to and change the information included in this document. The ICT Designer shall incorporate existing systems to ensure a seamless co-existence of newly provided infrastructure. No deviation from this standard shall be incorporated without the University of Pittsburgh Information Technology department's written direction.

Part 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Telecommunications Systems Drawings and general provisions of the contract, including general supplementary, special conditions, and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

- A. This specification describes the actions to be taken, tasks to be performed, and responsibilities of the Certified Cabling Contractor to provide and install a complete Warranted Horizontal Structured Cabling Panduit System. A Certification Plus System Warranty shall provide a comprehensive system warranty to guarantee end-to-end high-performance cabling systems that meet application requirements. The guarantee shall include cable and connectivity components and have one point of contact for cabling system issues. The system warranty shall be for at least 20 years. Unless otherwise noted, the following sections describe such actions, tasks, and responsibilities referred to the contractor. A factory registered Panduit PCI contractor shall complete network installation.
 1. The contractor shall have completed standards-based product and installation training. The proposal shall consist of a copy of the PCI Contractor Registration.
 2. A factory registered Panduit PCI contractor shall have a Superintendent on the job with at least ten years of experience.
 3. A factory registered Panduit PCI contractor shall have at least one BICSI RCDD on staff locally.
 4. A factory registered Panduit PCI contractor shall be Union Affiliated.

- B. The contractor shall be a Dura-Line FuturePath® eABF certified installer and shall provide documentation signed by the manufacturer.
1. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 2. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of an RCDD / RCDD/NTS.
 3. Installation Supervision: Installation shall be under the direct supervision of a BICSI Registered Technician, who must always be on-site while this section's work is being performed.
 4. Field Inspector: Currently registered by BICSI as an RCDD, to conduct on-site inspections at least three days per week for four hours per day.
 5. Submit documentation with the bid that includes the names of employees working on this project, their experience, level of expertise, and training certificates signed by Dura-Line FuturePath® eABF representatives.
 6. Provide grounding of cable shields, cabinets, racks, and IDF equipment enclosures per the latest version of the Grounding, Bonding, and Electrical Protection chapter of the BICSI TDMM Manual ANSI-J-STD-607-A, NFPA 70, NESC.
 7. Perform work in accordance with the State of Pennsylvania and local AHJ standards.
 8. Maintain one copy of each document on site.
- C. The horizontal segment of the telecommunications cabling system ranges from the work area telecommunications outlet to the termination in the main distribution frame (MDF) OR the intermediate distribution frame (IDF)
- D. No terms used in this specification are not intended to suggest that work or equipment asked for shall be less than completely performed or installed or that system shall be less than complete in respect.
- E. Copper and optical fiber backbone cabling will connect the demarc and IDF(s). Specify section 27 13 00.
- F. Install the cabling plant constructed in a physical star topology. Serve information outlets from IDF(s) through unshielded twisted pair (UTP) Category 6A copper, with 568B pin configuration.
- G. Provide the services, labor, materials, tools, and testing needed to professionally install and terminate new horizontal "station" cabling as specified in these requirements and associated drawings.

1.3 ABBREVIATIONS

A. Utilize the following abbreviations for the Drawings and Specifications.

1. ANSI - American National Standards Association
2. ASA - American Standards Association
3. EC - Electrical Contractor, not Tele-data Contractor
4. EIA - Electronic Industries Association
5. FCC - Federal Communications Commission
6. ICEA - International Cable Engineers Association
7. IEEE - Institute of Electrical and Electronics Engineers
8. NEC - National Electrical Code
9. NEMA - National Electrical Manufacturers Association
10. NFPA - National Fire Protection Association
11. OEM - Original Equipment Manufacturers
12. OSHA - Occupational Safety and Health Act
13. STM - American Society of Testing Materials
14. TDC – Tele-data Contractor
15. TIA - Telecommunications Industries Association
16. UL - Underwriters' Laboratories, Inc.

1.4 DEFINITIONS

A. Utilize the following definitions for the Drawings and Specifications

1. "PROVIDE" or "FURNISH" means to supply, purchase, transport, place, erect, connect, test, and turn over to the owner, complete and ready for regular operation, the work in question.
2. "SUPPLY" means purchasing, procuring, acquiring, and delivering complete with related accessories.
3. "INSTALL" means moving from the property line, setting in place, joining, fastening, attaching, setting up, or otherwise connecting before testing and turning over to the owner. Installation is to be complete and ready for regular operation.
4. "WIRING" or "CABLING" includes furnishing fittings, conductors, connectors, grounding accessories, tape, connections, splices, labeling, and necessary items.
5. "CONDUIT" and "CABLE SUPPORTS" include furnishing fittings, hangers, supports, sleeves, and grounding.
6. "AS DIRECTED" means as directed by the owner or their representative.

7. "ACCEPTED" means as accepted by the owner or their representative.
8. "CONCEALED" means embedded in masonry or other construction, installed behind wall furring or double partitions, or installed within hung ceilings.
9. "EXPOSED" means not installed underground or "CONCEALED" as defined above.
10. "EQUAL" means equivalent as approved by the owner or their representative.
11. "PBB" means Primary Bonding Busbar is the busbar that connects to the main service equipment (power) ground
12. "SBB" means Secondary Bonding Busbars, central bond attachment points for ICT systems located in the data room.
13. "TBB" means Telecommunications Bonding Backbone
14. "TBC" means Telecommunications Bonding Conductor (TBC), a conductor used to interconnect the telecommunications bonding infrastructure to the service equipment.

1.5 PROJECT DRAWINGS AND SPECIFICATIONS

- A. Drawings and Specifications do not intend to define the details, finish materials, and unique construction that may be required or necessary.
- B. The Drawings diagrammatically show cabling and arrangements of equipment fitting the space available without interference. The contractor shall verify other trades' work and arrange their efforts to avoid conflicts. If conditions make it challenging to install the work as indicated, recommend solutions, or submit drawings for approval to the Engineer demonstrating how the contractor intends to complete the installation. The Drawings and Specifications intend to provide a complete and workable system ready for the owner's use.
- C. The Drawings and Specifications intend to provide a complete and workable system ready for the owner's use. Item not explicitly shown on the drawing or called for in the Specifications, but usually required to conform to the intent, is considered part of the contract. The Drawings and Specifications are not intended as a complete materials list of items needed by the contract.

1.6 SUBMITTALS

- A. C General: Submit the following per the Conditions of Contract and Supplementary Conditions Specifications Sections.
- B. Submittals shall be made as complete systems, including the required accessories and special installation tools (i.e., termination hardware).

- C. Product information includes the following cable transmission characteristics:
1. Frequency
 2. Attenuation (min. at 100 MHz)
 3. Characteristic Impedance
 4. NEXT (min. at 100 MHz)
 5. PS-NEXT (min. at 100 MHz)
 6. EL-FEXT (min. at 100 MHz)
 7. PS-ELFEXT (min. at 100 MHz)
 8. PS-ANEXT (min. at 500 MHz)
 9. PS-AELFEXT (min. at 500 MHz)
 10. Return Loss (min. at 100 MHz)
 11. Delay Skew (max. per 100m)
- D. Manufacturers' complete installation instructions include the following information:
1. Minimum bend radius
 2. Maximum pulling tension
 3. Recommended installation pulling points (i.e., every 270 degrees of bend in the raceway or every 150 feet of raceway)
 4. Recommended pulling lubricants
- E. Provide information regarding the termination and connectors required for a complete installation.
- F. Product Data: The University of Pittsburgh Information Technology (PITT IT) preferred local distributor for infrastructure materials is Anixter.
1. Provide manufacturer's product datasheets for the following equipment for approval to The University of Pittsburgh Information Technology (PITT IT) no later than thirty (30) days after issuing notice but before the commencement of work to proceed.
 - a. Panduit Copper Systems
 - 1) Cat 6a Cables
 - 2) Cat 6a UTP Patch Panel and Accessories
 - 3) Cat 6a UTP and Shielded Jack Modules
 - 4) Cat 6a Patch Cords
 - 5) Faceplates
 - 6) Cabinets and Rack Systems
 - 7) Cable Management Devices
 - b. AFL Fiber Systems
 - 1) AFL Fiber Optic Enclosures
 - 2) ISP and OSP eABF MicroDuct
 - 3) ISP and OSP eABF Cable
 - 4) AFL: LC Panels, LC Connector, and Accessories
 - c. Labeling
- G. Submit a complete list of the equipment identified or inferred for Engineer/Owner approval.

1.7 PERMITS, CODES, AND INSPECTIONS

- A. General: The Contractor is responsible for obtaining and paying for permits and inspections required for the warranty and execution of work related to the installation and submitting final approval certificates to the owner or their representative.
- B. Codes: The Telecommunications System installation shall comply fully with the local, county, and state laws, ordinances, and regulations applicable to electrical installations.
- C. The Telecommunications System shall comply with the specifications of the most recent revision, including addenda and systems bulletins:
 - 1. American National Standards Institute (ANSI)
 - 2. American Society for Testing and Materials (ASTM)
 - 3. Americans with Disabilities Act (ADA)
 - 4. Building Officials and Code Administrators (BOCA)
 - 5. Building Industry Consulting Services International (BICSI)
 - 6. Telecommunications Distribution Methods Manual (TDMM)
 - 7. Electronics Industries Association (EIA)
 - 8. Federal Communications Commission (FCC)
 - 9. Institute of Electrical and Electronics Engineers (IEEE)
 - 10. Legislative Act 235 (1965) - Handicapped
 - 11. National Board of Fire Underwriters (NBFU)
 - 12. The Internet & Television Association (NCTA)
 - 13. National Electrical Manufacturers Association (NEMA)
 - 14. National Electrical Safety Code (NESC)
 - 15. National Electrical Code (NEC)
 - 16. Society of Cable Telecommunications Engineers (SCTE)
 - 17. International Society Broadband Experts (ISBE)
 - 18. Telecommunications Industries Association (TIA)
 - 19. Underwriters Laboratories (UL)
 - 20. The requirements of the electrical and utility companies
 - 21. The approved, published instructions are set forth by equipment manufacturers.

1.8 QUALITY ASSURANCE

- A. Provide work complying with the applicable codes, standards, and manufacturers' requirements.
- B. UL Compliance: Comply with applicable requirements of UL Standard 910, "UL Standard for Safety Tests for Flame-Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air." Provide products that are UL-listed and labeled as such
- C. The telecommunications infrastructure is to be designed and installed in accordance with the following codes, standards, and practices governed by the following:
 - 1. NFPA 70 -National Fire Protection Association, National Electrical Code of Article 110: Requirements for Electrical Installations.
 - 2. NFPA 75 - Standard for the Protection of Information Technology Equipment
 - 3. ANSI/TIA-568 General Telecommunications Cabling for Customer Premises. (Current Edition)
 - a. Commercial Building Telecommunications Cabling Standards.
 - b. Balanced Twisted-Pair Telecommunications Cabling and Components
 - c. Optical Fiber Cabling Components
 - 4. ANSI/TIA/EIA 569 Commercial Building Standards for Telecommunications Pathway and Spaces (Current Edition)
 - 5. ANSI/TIA-606 Administration Standard for Commercial Telecommunications Infrastructure. (Current Edition)
 - 6. ANSI/TIA-607 Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premise. (Current Edition)
 - 7. ANSI/ TIA-862 Structured Cabling Infrastructure Standard for Intelligent Building Systems. (Current Edition)
 - 8. BICSI Information Technology Systems Installation Methods Manual (ITSIMM) (Current Edition)
 - 9. BICSI Telecommunications Distribution Methods Manual (TDMM) (Current Edition)
 - 10. ANSI/BICSI 007-2020 Information Communication Technology Design and Implementation Practices for Intelligent Buildings and Premises
 - 11. ANSI/BICSI N3-20 - Planning and Installation Methods for the Bonding and Grounding of Telecommunication and ICT Systems and Infrastructure
 - 12. ANSI/TIA-526-7 - Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant (Current Edition)
 - 13. ANSI/TIA-526-14 - Measurement of Optical Power Loss of Installed Multimode Fiber Cable Plant (Current Edition)
 - 14. TSB-162-A: Telecommunications Cabling Guidelines for Wireless Access Points
 - 15. The related State, Municipal & Campus codes, standards, and Statutes

1.9 VISITING PREMISES

- A. General: The bidder shall visit the project site before submitting the bid to check the worksite conditions relevant to the proposal. Notify Engineer, in writing, of the inconsistency, dispute, or omission immediately upon discovery.
- B. By submitting a bid, the contractor certifies that the responsible personnel did, indeed, visit the site during the bidding period and verified the existing pertinent conditions.

1.10 COOPERATION AND COORDINATION WITH OTHER TRADES

- A. Coordinate the work with the General and Electrical Contractors and the scheduled work of the other trades.

1.11 RECORD DOCUMENTS

- A. After the work and before final approval, the contractor shall provide the Engineer with a complete set of computer-aided design (CAD) marked drawings clearly displaying the contract work and labeling.
- B. Mark up a clean set of Specifications to indicate approved substitutions, change orders, and actual equipment and materials used.

1.12 WARRANTY/WARRANTY MANUALS

- A. Following the work, prepare warranty manuals per the following information.
- B. The material or equipment that does not comply with the Contract Documents requirements or is damaged before acceptance will be deemed defective. The material or equipment shall be removed and replaced at no additional cost to the owner.
- C. Warranty and Certification of the Structural Cabling System:
 - 1. Provide a minimum twenty-year product and performance warranty against material, quality, and fabrication defects in the cable, connectors, and connecting hardware.
 - 2. The system shall be certified by the cable/component manufacturer and warranted for at least twenty years for the specified performance. The contractor must follow the manufacturer's certification program, including submitting the required documentation to the manufacturer.
 - 3. Obtain a Registration Document and Certificate for the specific installation from the manufacturer. Once you obtain the Registration Document and Certificate, create a copy for the Engineer and deliver the original to the owner.
- D. Deliver complete warranty information for each item, including the date the warranty began, the manufacturer's name and address, the contractor's telephone number, and the method for filing a claim for warranty service.
- E. Within the warranty period, answer service calls within eight hours, and correct the deficiency within twenty-four hours.
- F. Do not paint installed data cabling because it will void the manufacturer's warranty and will not meet Pitt IT's acceptance criteria. The painted cables must be removed, replaced, and re-tested at no extra cost to the owner.

Part 2 PRODUCTS

2.1 GENERAL

- A. The product shall be new, free from defects, and listed by UL when an applicable UL Standard exists. Provide products of a given type from one manufacturer.
- B. Regardless of the descriptive paragraph's length or completeness, provide a product complying with the specified manufacturer's published specifications.

2.2 ACCEPTABLE MANUFACTURERS

- A. The University of Pittsburgh Information Technology (PITT IT) has included the model numbers and suppliers in this specification as part of the standard. The University of Pittsburgh Information Technology's (PITT IT) preferred local distributor for infrastructure materials is Anixter.
- B. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. The proposed equipment shall be equivalent to the equipment selected and subject to approval if the contractor chooses a product from an approved manufacturer's list, not on the approved manufacturer's inventory. The equipment or materials must meet or surpass the standards and quality criteria outlined in this document. Alternate manufacturers must provide catalog cuts and samples ten days before the bid date for approval.

2.3 EQUIPMENT

- A. General: Do not interpret the products listed below as a "bill of materials." They represent items of significance used during the design of the Horizontal Cabling System. The items indicated are one portion of an assembly. Unless specified otherwise, provide the entire assembly where items do not have a manufacturer or part number listed, where items do not have a manufacturer or part number listed. At this time, no specific items have been cited. The University of Pittsburgh Information Technology's (PITT IT) preferred local distributor for infrastructure materials is Anixter.

Part 2 The contractor shall provide the following items:

- B. Relay Racks and Cabinets:
 - 1. Panduit 2 Post Rack, 45RU, #12-24 Threaded E-Rails, Aluminum, Black: Anixter part #188864 / Panduit (Part # R2P)
 - 2. Panduit Rack Anchor Kit: Anixter Part # 443968 / Panduit Part # RFAKIT
 - 3. Network Cabinets - The type of cabinet will be determined by The University of Pittsburgh Information Technology (PITT IT) based on the needs and environment of the telecommunications room.
 - 4. The University of Pittsburgh Information Technology (PITT IT) will furnish the first Relay Racks or Cabinets unless otherwise noted.
 - 5. The EC is responsible for the remaining Relay Racks or Cabinets per contract requirements. The EC will install the Relay Racks or Cabinets. Before installing the Relay Racks or Cabinets, the EC will work with the University of Pittsburgh Information Technology to ensure optimal layout.

C. Vertical Cable Management:

1. Patchrunner 2 Vertical Cable Manager, Dual Sided, 45U, 6 in. 1 Piece, Dual-Hinged, Door, Black: Anixter Part # 989129 / Panduit Part # PR2VSD06
2. Patchrunner 2 Vertical Cable Manager, Dual Sided, 45U, eight in. 1 Piece, Dual-Hinged, Door, Black: Anixter PART # 989130 / Panduit PART # PR2VSD08 (Note: To be used only with TRs that have a double rack configuration)
3. When correctly installed, patch cord organizers can assist in the creation of a clean installation and enable access when circuits are relocated, added, or updated.
4. The IDF may require multiple racks depending on the density of cables in the IDF. Patch cord organizers create defined pathways for patch cords. Vertical organizers shall be supplied in each rack as indicated on the drawings.
5. Unless otherwise noted, the University of Pittsburgh Information Technology (PITT IT) will furnish the first Vertical Cable Management.
6. The EC is responsible for the remaining Vertical Cable Management per contract requirements. The EC will install the Vertical Cable Management. Before installing the Vertical Cable Management, the EC will work with the University of Pittsburgh Information Technology to ensure optimal layout

D. Copper Patch Panels:

1. Provide necessary panels equipped with 110-style termination made of fire-retardant UL 94V0 rated thermoplastic and provide the following items:
 - a. Panduit Cat 6A Angled Punchdown Patch Panel 24 Port 1 RU (UTP): Anixter Part # 311385 / Panduit Part # DPA246X88TGY
 - b. Panduit Cat 6A Angled Punchdown Patch Panel, 48 Port, 2 RU (UTP): Anixter Part # 311386 / Panduit Part # DPA486X88TGY
 - c. Panduit Cat 5e Angled 24 Port 1 RU (UTP): Anixter Part # 311405 / Panduit Part # DPA245E88TGY
2. Panel circuit boards shall be fully enclosed front and rear for physical protection and have port identification numbers on the front and back panels.
3. Panels shall provide wiring identification & color code and maintain a paired punch down sequence that does not require overlapping cable pairs and is available in T568B wiring schemes.
4. Panels shall be ANSI/TIA/EIA-568-D.2 and ISO/IEC 11801 Category 6A compliant and UL VERIFIED for TIA/EIA Category, 6A performance
5. Panels shall include rear cable management brackets to facilitate cable terminations. 9. Cables shall route from the right and left of patch panels to facilitate terminations.
6. Wall Mount 110 Wiring Blocks or 110 Connecting Blocks are not acceptable.
7. The University of Pittsburgh Information Technology (PITT IT) will furnish the first 48 Port Patch Panel for the Data and the first port of twenty-four wireless and ISD cameras Port Patch Panel as part of the Relay Rack Kit. The EC is responsible for all remaining Port Patch Panels unless otherwise noted.

- E. Horizontal and Vertical Pathways:
1. The Horizontal Pathway System is the pathway that cables take from the IDF to the outlets on that floor. Connect outlets to an IDF on the same floor.
 2. Connect each telecommunications outlet (TO) to the IDF via a home run 1" conduit from the cable tray. Run Conduits in the most direct path possible.
 3. The EC shall keep Conduit bends should to a minimum. No more than two 90-degree bends are allowed per conduit run. It is not permitted to use "condulets" or "LB" type fittings.
 4. A continuous run of the conduit may not be longer than 100'. Install Pull boxes so that no segment between pull boxes exceeds one hundred feet for runs longer than one hundred feet.
 5. The conduit shall have a pull-string with 200 lbs. minimum test rating— label all conduits terminating in the IDF at both ends per PITT IT standards and NEC requirements.
- F. Cable Runway Systems:
1. Manufacturers: Chatsworth
 2. General: Except as otherwise indicated, provide metal cable runways of types, classes, and sizes shown with splice connectors, bolts, nuts, and washers for connecting units.
 3. Runway Types: Material specifications for each runway type are as follows:
 4. Solid Bar style runway: Runway shall be ladder type with 1-1/2-inch stringer height with welded rungs.
 5. Stringer side rail shall conform to the minimum chemical and mechanical properties of ASTM A36 structural steel.
 6. The construction of the cable runway rungs shall be from ASTM A1011 SS Grade 33 structural steel. Each rung shall be one-half inch by 1-inch steel c-channel shape with radius edges.
 7. The runway shall be twelve inches wide and installed as shown on drawings.
- G. The basket tray is the delivery system for horizontal cabling throughout the floor. J- Hooks or bridal rings are not acceptable.
- H. Ground runway sections to grounding bus bar located in MDF/IDF Room per ANSI/TIA 606 & 607 specifications.
- I. Category 6A UTP Cable:
1. The primary manufacturer is Plenum Rated: General GenSPEED 10 Category 6A F/UTP Cable.
 2. Panduit TX6A 10Gig UTP Copper Cable Vari-MaTriX HD Technology is the secondary manufacturer and is acceptable.
 3. The cable tray will provide the pathway to distribute the cable throughout the floors.
 4. Unless otherwise specified, the cable shall be plenum-rated. One exception is where the cables are installed in a wet-rated environment, such as conduits poured into slabs-on-grade.

5. Cutting and relocating to reuse existing data cables regardless of category classification is not permitted. Cutting and relocating data cables voids the warranty. The EC shall replace the data cable with a new Category 6A cable to provide a Panduit Warranty as part of the Horizontal Structured Cabling System.
6. Category 6A - Physical Specifications: Cable diameter: Plenum (CMP): 0.230 in. (5.8mm) nominal, Characteristic Impedance: 100 Ohm +/-15% up to 100 MHz, Mutual Capacitance <5.6 nF per 328 ft. (100m) at 1 kHz., Capacitance Unbalance <330 pF per 328 ft. (100m) at 1 kHz., and ANSI/TIA 568.2-D and ISO/IEC 11801 Ed. 2.0 (Class E compliant)
7. Category 6A – Cable Construction: Consists of 23-AWG solid-copper conductors insulated with color-coded FEP (all pairs & jacket) compounds and sheathed with an LSPVDF outer jacket. Plenum UL910, CMP rated.
8. Category 6A – TIA/EIA Internal Channel Test Limits over Category 6A cabling (568-B.2-10) at 500 MHz:
 - a. Frequency Range 1-500 MHz
 - b. Propagation Delay 536 nSec
 - c. Attenuation 49.4 dB
 - d. NEXT 26.1 dB
 - e. Power-sum NEXT 23.2 dB
 - f. ACR -23.2 dB
 - g. Power-sum ACR -26.1 dB
 - h. ELFEXT 9.3 dB
 - i. Power-sum ELFEXT 6.3 dB
 - j. Return Loss 6.0 dB
9. Category 6A Cables for both Data and Voice (VoIP) station cabling shall be color BU (Blue)
10. Category 6A for wireless access point station cabling shall be color GR (Green),
11. Category 6A for ISD Camera and device station cabling shall be color YL (Yellow)
12. Category 6A for BAS and device station cabling shall be color VL (Violet)
13. Alternate UTP Cable: (Panduit Part # PUP6AHD04*-G, to (* designate color, add suffix RD (Red), BU (Blue), GR (Green), YL (Yellow), or VL (Violet) to the end of the part number.) No Substitutions.
14. Do not paint installed cabling because it will void the manufacturer's warranty and will not meet PITT IT's acceptance criteria. The painted cables must be removed, replaced, and re-tested at no extra cost to the owner. Painting schedules must be coordinated with Telecom contractor so that cabling can be installed after painting. The contractor is responsible for shielding existing cabling from paint and paint overspray.
15. The following paragraph must be clearly placed on the same sheet as the finish schedule and in the painting specification. **"The Contractor Is Responsible for Protecting All Cabling from Paint and Paint Overspray. Painting Must Be Completed Before Cable Installation."**

J. Faceplates:













1. Provide Panduit faceplates for single gang and double gang installation.
2. Panduit faceplates shall accept modular eight position and eight conductor information Jack Modules.
3. Color, finish, and design shall be white, E/I, or building location requirements.
4. See drawings for faceplate configurations

K. Faceplates-Wall Phones:

1. Provide Panduit stainless steel faceplates for single gang installation.
2. Faceplates shall accept modular eight position and eight conductor information Jack Modules.

L. Modular Jack Modules:

1. All information outlets have eight positions and eight conductor high-density non-keyed modular information Jack Modules designed for networking applications using transmission rates of up to 100 MHz transmission rates.
2. Mini-Com UTP RJ45 Cat 6A TG Jack Module (Anixter Part # 307319 / Panduit Part # CJ6X88TGEI) compatible with IEEE 802.3 applications. It fully supports 10 Mbps, 100 Mbps, and Gigabit Ethernet applications at 328 ft (100 m) over UTP.
3. Each jack shall be an individually constructed unit and snap mount in an industry-standard keystone opening.
4. Jack Modules shall have a temperature rating of -10 °C (14°F) to sixty°C (140 °F) in conformance with ANSI/TIA/EIA-568-D.2-10. Pin/pair assignment shall be T568-B and mark the jack as such.
5. Jack Modules shall utilize a paired punch-down sequence. Cable pairs shall be maintained up to the IDC, terminating all conductors adjacent to its pair mate to maintain better pair characteristics designed by the cable manufacturer.
6. Jack Modules shall terminate 22-26 AWG stranded or solid conductors. Jack Modules shall terminate insulated conductors with outside diameters up to .050."
7. Jack Modules shall accept Snap-On icons for identification or designation of applications.
8. Supply Jack Modules with installed dust covers to protect the jack opening and internal elements during installation.
9. Jack Modules shall be UL VERIFIED for TIA/EIA 568-B.2-10 Category 6A electrical performance. Jack Modules shall be UL LISTED 1863 and CSA certified. The Supplied Jack Modules shall be from an ISO 9002 Certified Manufacturer.
10. Jack Modules shall be keystone type for poke-thru locations only—quantity and location as per drawings.
11. Provide twenty additional Jack Modules as maintenance spares.

- M. Category 6A Copper Patch Cords:
1. The contractor is responsible for providing the Category 6A Copper Patch Cords for the MDF/IDF to cross-connect from patch panel to data switch and WAP to outlet
 2. Category 6A Copper Patch Cords shall be Panduit TX6A-28 Category 6A Performance 28 AWG UTP Patch Cords. No Substitutions
 - a. Data and Voice (VoIP) station cabling shall be color BU (Blue)
 - b. Wireless access point station cabling shall be color GR (Green)
 - c. Wireless access point station cabling shall be color WH (White)
 - d. Camera and device station cabling shall be color YL (Yellow)
 - e. BAS and device station cabling shall be color VL (Violet)
- N. The EC will confer with the University of Pittsburgh Information Technology Project Manager to confirm the sizes need to cross-connect from patch panel to data switch and WAP to outlet.
- O. Drawing Nomenclature
1. The following are the required drawing nomenclatures for University of Pittsburgh telecommunications cabling drawings:
 2.  1/0 – [1 Data = 1 Cable]
 3.  2/0 – [2 Data = 2 Cable]
 4.  1/0 – [3 Data = 3 Cable]
 5.  1/1 – [1 Data/1 Voice (VoIP) = 1 Cable]
 6.  1/2 – [1 Data/2 Voice (VoIP) = 2 Cable]
 7.  2/1 – [2 Data/1 Voice (VoIP) = 2 Cable]
 8.  2/2 – [2 Data/2 Voice (VoIP) = 2 Cable]
 9.  3/2 – [3 Data/2 Voice (VoIP) = 3 Cable]
 10.  3/3 – [3 Data/3 Voice (VoIP) = 3 Cable]
 11.  0/1 – Wall Phone Jack – 1 Cable] or simply 
 12.  2/0 – [2 Wireless Device Data = 2 Cable- Green]
 13. The University of Pittsburgh Information Technology (PITT IT) requires voice requirements for electronics estimates and requires them on the Telecommunication drawings. No deviation from this standard shall be incorporated without the University of Pittsburgh Information Technology department's written direction.
- P. Horizontal Optical Fiber
1. The contractor shall furnish and install optical fiber micro-cables as identified on the drawings. Fiber optic micro-cables shall not be spliced or patched at transition points from indoor to outdoor. Fiber optic micro-cables shall be installed end to end or home-run from MDF to application to eliminate splicing and patching. The model numbers and manufacturers included in this specification are listed to establish a standard of product quality.

2. AFL / Dura-line ABF system is the Primary Inside and Outside fiber optic cable manufacturer.
3. Panduit and Corning are the secondary fiber cable manufacturers for use only in the inside plant infrastructure. The use of Panduit and Corning optical fiber cable for the University's outside plant infrastructure is not permitted.
4. The Contractors must have written approval from the University of Pittsburgh Information Technology (PITT IT) Manager to use Panduit and Corning fiber cabling for the inside plant infrastructure.
5. Before beginning the horizontal optical fiber installation, the EC will confer with the University of Pittsburgh Information Technology Project Manager to confirm the Horizontal Optical Fiber criteria. (Micro-duct Type, fiber strand count, and type)

Q. ABF Micro-duct:

1. The micro-duct shall be suitable for installation in cable tray, metallic conduit, and conventional inner duct.
2. Micro-duct cable ends must be completely sealed during installation to prevent contaminants, including water, from entering.
3. According to the manufacturer's recommended procedures, all internal micro-ducts must pass the standard pressure test and proof test after installation.
4. The remaining unoccupied micro-ducts shall be plugged or capped on both ends. Indoor micro-duct specifications are as follows:
 - a. Manufacturer: Dura-Line
 - b. Micro-duct Type: 2,3, 4, 7, 12, 19 and 24 way, 8.5mm OD / 6mm ID
 - c. Micro-duct rating: UL rated Riser, Plenum, or LSHF Handling
Temperature: 0 degrees C to +40 degrees C
 - d. Micro-duct Type will be determined by The University of Pittsburgh Information Technology (PITT IT) based on the needs of the Horizontal backbone design.

R. Air-blown fiber optic micro-cable:

1. Fiber optic cables installed inside micro-ducts shall be indoor/outdoor rated and adhere to the most current version of the Telcordia GR-409 Interconnect Cable specification for premise building cabling applications.
 - a. eABF Optical Fiber (SM-OS2 BIF)
 - b. eABF Optical Fiber (50/125- OM4 BIF) - only to be used with University of Pittsburgh Technology (PITT IT) approval.
2. The University of Pittsburgh Information Technology (PITT IT) requires twelve strands of single-mode & twelve strands of OM4 Multimode between IDF and MDF telecommunications rooms.
3. Before beginning the horizontal optical fiber installation, the EC will confer with the University of Pittsburgh Information Technology Project Manager to confirm the Horizontal Optical Fiber criteria. (Micro-duct Type, fiber strand count, and type.)

- S. Fiber Management Patch Panels:
1. The University of Pittsburgh Technology (PITT IT) will only provide the first optical fiber cabinet for each MDF/IDF.
 - a. IDF– Intermediate Distribution Frame
 - 1) Xpress Fiber Management 2U Patch Panel, Black: AFL Part # FM002712-BE
 - b. MDF – Main Distribution Frame
 - 1) Xpress Fiber Management 4U Patch Panel, Black: AFL Part # FM001090-B
 2. Provide rack-mounted optical fiber cabinets and adapters in each MDF/IDF Room as indicated on drawings per the University of Pittsburgh Technology's construction requirements.
 3. The EC shall provide the LC Optical Cassette, Poli-MOD, and blank filler panels for Fiber Management Patch Panels.
- T. Optical Connectivity:
1. The EC shall provide the LC - AFL FuseConnect, Poli-MOD Patch, Splice Module, and blank filler panels for Fiber Management Patch Panels.
 2. Single Mode Connectivity:
 - a. AFL FuseConnect LC Connectors or Poli-MOD Patch and Splice Module
 3. The insertion loss average shall be 0.15 dB. The LC connector has anti-snag latch hardware for more accessible connections and high optical stability.
 4. LC Connector must be compliant with TIA/EIA 568-D.3.
 5. Under no circumstances are "crimp-and-cleave" type connectors acceptable for terminating fiber.
- U. Horizontal Optical Fiber Testing
1. Schedule and conduct all final testing in the presence of the PITT IT representative.
 2. Test all equipment and components before usage per manufacturers' published test procedures. In addition, test optical fiber cable following TIA/EIA 568-D.3 at both 850 nm and 1300 nm window for multimode optical fiber. As specified in section 3.08, keep a record of all results, and submit an electronic copy.
 - a. Test multimode optical fiber at 850 and 1300 nm wavelengths
 - b. Test single-mode optical fiber at 1310 and 1550 nm wavelengths.
 3. All outlets, cables, patch panels, and related components must be fully assembled and labeled before field testing.

- V. The optical fiber tests shall include but are not limited to:
1. Backbone Link Measurement
 - a. Perform fiber testing using high-quality test cords of the same fiber type as the cabling under test. Conduct link attenuation (OLTS) tests on all fiber optic strands installed following splicing and termination following current ANSI/TIA standards
 - b. The provider will perform bidirectional end-to-end attenuation tests on each strand of the backbone link.
 - c. Conduct the test at two wavelengths to account for attenuation variations due to wavelength:
 - 1) For multimode strands: 850 nm and 1300 nm
 - 2) For Singlemode strands: 1310 nm and 1550 nm
 - d. Test multimode strands following TIA-526-14, One Reference Jumper with Encircled Flux.
 - e. Test Singlemode strands following TIA-526-7, One Reference Jumper
 - f. All Test cords used for link attenuation testing shall be between 1 m and 5m in length.
 2. The total attenuation budget for the length of each fiber cable (end-to-end) shall be determined and used to determine acceptable values for each of the appropriate wavelengths specified in this standard, ANSI/TIA – 568.E.1 11.3.3.4.

Part 3 – EXECUTION

3.1 GENERAL

- A. The contractor will ensure a coherent final product by coordinating the integration of the work stated herein with other project work.
- B. The contractor will ensure a neat and professional installation of the cables and equipment.
- C. The contractor will strictly adhere to the industry and manufacturer installation practices when installing the UTP Category 6A cabling and Air Blown Fiber (ABF) system.

3.2 DELIVERY, STORAGE, AND HANDLING

- A. Ship product in its original container to prevent damage or entrance of foreign matter.
- B. Handling and shipping the materials per the manufacturer's recommendation.
- C. Provide protective covering during construction to prevent damage or entrance of foreign matter.
- D. Replace at no expense to the owner product damaged during storage, handling, or the course of construction

3.3 INSTALLATION

- A. The installation recommendations within
 - 1. ANSI-TIA-568.0-E - Generic Telecommunications Cabling for Customer Premises
 - 2. ANSI-TIA-568.1-E - Commercial Building Telecommunications Cabling
 - 3. ANSI/TIA-568.2-D - Balanced Twisted-Pair Telecommunications Cabling and Components
 - 4. ANSI-TIA-568.3-D - Optical Fiber Cabling Components
 - 5. ANSI-TIA-569-E- Telecommunications Pathways and Spaces
 - 6. ANSI-TIA-606-C _ Administration Standard for Telecommunications Infrastructure
 - 7. ANSI-TIA-607-D _ Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
 - 8. BICSI/TDMM and manufacturer recommendations are mandatory minimum standards and requirements
- B. Install the mounted equipment and enclosure plumb and level.
- C. Install the data cables without causing damage to the conductors or jackets.
- D. Ensure that the manufacturers recommended pulling tension and bending radius specifications are adhered to when installing the data cable.
- E. Pull the cables simultaneously when more than one cable is installed in the same raceway.
- F. Cables shall be run from the serving MDF/IDF rooms using Avenue and Streets design
- G. All avenues and streets shall run perpendicular to the building structure. No diagonal routing shall be acceptable.
- H. No splicing of the copper cable shall be allowed.
 - I. Provide a minimum service loop of ten feet at both ends of cable runs. The total cable distance shall not exceed one hundred meters in the permanent link.
 - J. Provide Velcro-type tie wraps to bundle and manage cabling in the telecommunication rooms.
- K. Plastic cable ties or tape are not acceptable

3.4 LABELING

- A. Copper Labeling:
- B. Provide labeling corresponding to the workstation jacks and respective patch panel ports.

- C. PITT IT copper labeling scheme requirements.
1. Data Labeling:
 - a. [Oakland + Bldg.-Id]-[Telecom Room ID]-[Data-Patch Panel Port Number] (0000-0999)
 - b. Example: oeh-eh110f-0001
 2. Voice Labeling:
 - a. [Oakland + Bldg.-Id]-[Telecom Room ID]-[Voice Patch Panel Port Number + V] (0000-0999)
 - b. Example: oeh-eh110f-0001V
 3. ISD Data Labeling:
 - a. [Oakland + Bldg.-Id]-[Telecom Room ID]-[ISD Data -Patch Panel Port Number] (1000-1999)
 - b. Example: oeh-eh110f-1001
 4. Wireless Data Labeling:
 - a. [Oakland + Bldg.-Id]-[Telecom Room ID]-[Wireless Patch Panel Port Number] (2000-2999)
 - b. Example: oeh-eh110f-2001
 5. BAS Data Labeling:
 - a. [Oakland + Bldg.-Id]-[Telecom Room ID]-[BAS Patch Panel Port Number] (3000-3999)
 - b. Example: oeh-eh110f-3001
- D. Install the patch panel plumb and level. Terminate cables on their designated patch panel in order by room number. Label the front of the faceplate, the ends of each cable, and the front of the patch panel.
- E. Fiber Optic Labeling:
- F. The University of Pittsburgh Fiber Patch panel labels will include additional information subpanel id on every adapter panel, cable type, near-end telecommunications space name, and far-end telecommunications space name.
- G. The port identifiers include the subpanel name on every adapter panel.
1. Fiber Patch Panel ID Labeling:
 - a. [Telecom Room ID] - [Row] - [Rack] - [Patch Panel Location in rack]
 - b. Example: eh110f-R1-1-1
 - c. Place the Fiber Panel ID label on the right front and back of the fiber enclosure.
 2. Fiber Location Labeling
 - a. [Fiber Type]-[Subpanel ID]-[Strand Count]-[Far End Patch Panel Location with Subpanel ID and Strand Count]
 - b. Example: SM-A-01-12 / eh423-R1-1-1:A-01-12
 - c. Place the fiber location information on the index card provided by the manufacturer or on the right front if no card is provided for the fiber enclosure.

- H. Supply labeling compliant with ANSI/TIA/EIA-606. Handwritten labels are not acceptable.
 - 1. Provide logical and legible cable wiring label permanently affixed for easy identification.
 - 2. Labels on cables to be adhesive strip type covered with clear heat-shrink tubing. Factory stamped heat shrink tubing may be used instead of the adhesive strip style.
 - 3. The wiring designator is to be unique for each cable.
 - 4. Place the cable designator at the start and destination of each circuit within three inches from the termination or connection.
- I. Before final acceptance, the contractor shall furnish to FM and PITT IT Pencil copy of the as-built drawing, a comma-separated value (CSV) file or spreadsheet containing the wire number, cable type, room number, cubicle number, or general location of the station of the data cables installed per university current labeling scheme.
- J. The contractor shall also provide The University of Pittsburgh Information Technology (PITT IT) with an as-built drawing identifying wire numbers by room.
- K. Mark up a clean set of specifications to indicate approved substitutions, change orders, and actual equipment and materials used

3.5 EMI & RFI PREVENTION

- A. To prevent electromagnetic interference (EMI), route the cables in such a way as to maintain the following minimum distance from sources of EMI.
- B. Three inches from power lines of 2 KVA or unless installed in conduits or grounded flexible metallic raceway in ceilings and below access floors.
- C. Ensure the data cables are three inches from fluorescent fixtures with remotely installed ballasts.
- D. Make sure the data cables are at least five inches away from power lines with a rating of 2 KVA or less.
- E. Assure the data cables are twelve inches away from the power lines (2 KVA to 5 KVA).
- F. Confirm the data cables are Twelve inches from high voltage lighting, including fluorescent lighting.
- G. Verify that the data cables are four feet from transformers or motors.
- H. Maintain a minimum twelve-inch separation between telecommunications cables exposed in ceiling or floor spaces and parallel electrical cables/conduits.
- I. Telecommunication cables that must cross electrical cables/conduits only at 90-degree angles. radio frequency interference

3.6 HORIZONTAL WIRING AND COMPONENTS

- A. General: Provide proper cabling, connections, and terminations.
 - 1. Take precautions to prevent and guard against electromagnetic and electrostatic interference. For example, cables are unevenly staggered in Laboratories and do not run in a straight line.
 - 2. Avoid cable stress due to cable twists during pulling or installation. The tension in suspended cable runs and tightly cinched cable ties.
 - 3. Isolate cables and wires of different signals or levels; separate, organize, and route to restrict channel crosstalk or feedback oscillation.
 - 4. Make connections with approved mechanical connectors properly applied with proper tooling.
 - 5. Cover edges of cable and wire pass-through holes in chassis, housings, boxes with rubber grommets, nylon grommets, or waterfall-type fittings.
 - 6. Provide splice-free wiring and cabling from origination to destination.
- B. UTP Connector Terminations:
 - 1. Pair twist is to be maintained as close as possible to the point of termination to lessen near-end crosstalk. (NEXT)
 - 2. Untwisting pairs are not to exceed 13mm (1/2 inch) for Category 6A cable.
 - 3. Install connecting hardware to provide a well-organized installation with cable management and manufacturer guidelines.
 - 4. Stripping of wire jackets shall not exceed 13mm (1/2 inch) to terminate individual pairs.
- C. Patch Panels - UTP
 - 1. Install the Patch Panels to provide minimal signal impairment by preserving wire pair twists as closely as possible to the point of mechanical termination. The amount of untwisting in a pair resulting from termination to the patch panel shall be no greater than 0.5 inches (13 mm).
 - 2. Stripping of wire jackets shall not exceed 13mm (1/2 inch) to terminate individual pairs.
 - 3. Panels shall be installed according to the manufacturer's instructions and properly mounted to a rack, cabinet, bracket, or other appropriate mounting devices
 - 4. Install the Patch Panels such that cables terminated to the panel can maintain a minimum bend radius of at least four times the cable diameter into the IDC contacts.
 - 5. Terminate Cables on the panels such that there is no tension on the conductors in the termination contacts.

D. Horizontal UTP Cabling:

1. Horizontal cable shall be no greater than 292 ft. (90 meters), including the slack, from the outlet to the horizontal cross-connect. The length of jumpers, patch cords, and equipment cables in the MDF/IDF rooms shall not exceed twenty feet (10 meters).
2. Prevent near-end crosstalk (NEXT) by keeping the number of untwisting pairs to a minimum when terminating the connecting hardware.
3. Install cable so that the pulling tension applied to the cable does not exceed 25ftlb or the manufacturer's guidelines, whichever is lesser.
4. Install cable to maintain a radius bend of no less than four (4) times the cable outside diameter.

E. Wireless Access Point UTP Cabling:

1. A quantity of two (2) Green Category 6A (500 MHz) plenum cables run, each with a ten-foot. A cable coil must be installed to each identified Access Point (AP) location. See drawings for locations.
2. Install The green wireless cables directly to AP locations from IDF closets identified by PITT_IT. Cables will be installed horizontally along with the floor cable tray through existing drop ceilings and hard wall ceilings and vertically through existing riser shafts. The cable runs must comply with current electrical, telecommunications, and fire codes. Cable lengths must not exceed 290' per Category 6A standards.
3. Terminate Access Points' primary and secondary station category 6A cables on a Panduit 24 port patch panel in the IDF relay rack. (Provided by PITT_IT, installed by the contractor). Install the category 6A cables per Panduit and University guidelines. To terminate the green wireless category 6A cables at the access point sites and patch panel locations, PITT_IT requires green category 6A modular jacks.
4. Mount the green modular jacks in Panduit dual-port surface boxes (CBX2IW-A) at each AP location.
5. The primary station cable and secondary station cable are to be terminated, tested, and labeled; The Contractor will provide testing results to PITT_IT per University telecommunications infrastructure specifications.
6. The required wall and floor/ceiling penetrations must be per current electrical, telecommunications, and fire codes. University telecommunications infrastructure specifications require cable support hardware for horizontal and vertical cabling.
7. Label both cables and access points per the University's designated labeling scheme.
8. PITT_IT will provide wireless access points and peripherals per current University requirements. Contractors will install mounting brackets and access points at predetermined locations identified on the construction drawing. The contractor will install Two (2) 3' White Category 6A patch cords from Panduit dual-port surface box jacks to the access point for each access point.

9. Access Point antennas, if required, will be provided by PITT_IT. Per the manufacturer's instructions, the contractor will perform the installation and mount it to access points, walls, or acoustic ceilings.
10. If specified by Facilities Management, exposed access points and antennae may require painting to match the finishes in the mounting location. The painting access points will void the warranty, and PITT_IT strongly advises against painting access points.
11. The customer will assume the costs of replacing the Wireless access point if the unit fails or does not produce an adequate RF signal due to the flawed or improper painting process.
12. Before painting access points, inform PITT_IT to ensure that the parties charged with painting the Cisco units know the proper Cisco painting procedures. Rather than applying paint, PITT_IT's preferred solution to painting would be to use colored plastic covers, known as "skins."

F. ISD Camara UTP Cabling:

1. The Yellow Category 6A (500 MHz) plenum for the ISD Security camera location must have a cable coil length of ten feet. See drawings for locations.
2. The data cable will terminate in a closed IDF on the floor and must not exceed 290 feet in length from the mount location to the termination point.
3. Please coordinate Data cable installation with the Integrated Security Department (ISD) and the University of Pittsburgh Information Technology (PITT IT).

G. BAS UTP Cabling:

1. Purple Category 6A (500 MHz) plenum must have a cable coil length of ten feet for the BAS system location. See drawings for locations.
2. The data cable will terminate in a closed IDF on the floor and must not exceed 290 feet in length from the mount location to the termination point.
3. Please coordinate Data cable installation with Facilities Management AVC and the University of Pittsburgh Information Technology (PITT IT).

3.7 TESTING

- A. Notify the Owner/Owner representative ten (10) business days before testing. The owner has the right to witness the field testing.
- B. Install and test UTP Category 6A cable, optical fiber, and coaxial cables per applicable regulations and manufacturer's specifications.
- C. The installed cabling must meet or exceed the field-test requirements of relevant standards for the application. (For example, ANSI/TIA-568-D.2, ANSI/TIA-568-D.3, ISO/IEC 11801, EN 50174-1) The measurement reported by the field tester shall have a specified accuracy (level III).
- D. Record and submit to PITT_IT Network Engineering/Telecommunications a soft and hard copy of the test results. Failure to notify the owner of testing will result in the contractor re-testing the cables before final acceptance.
- E. The contractor shall perform a field-tested for all horizontal links. The cable, which fails the test, must be removed, replaced, and re-tested at no additional cost to the owner. Final test results must include data, voice and wireless jack ID, and room number.

1. Primary Field Test Parameters for Category 6A include, but are not limited to the following:
 - a. Wire Map
 - b. Characteristic Impedance
 - c. DC Loop Resistance
 - d. Length
 - e. Propagation Delay
 - f. NEXT, NEXT @ Remote
 - g. Return Loss (RL), RL @ Remote
 - h. Delay Skew
 - i. Attenuation
 - j. Attenuation-to-Crosstalk Ratio (ACR), ACR @ Remote
 - k. ELFEXT, ELFEXT @ Remote
 - l. Power Sum ACR, PSACR @ Remote
 - m. Power Sum ELFEXT, PSELFEXT @ Remote
 - n. Average Noise
 - o. Power Sum NEXT, PSNEXT @ Remote
- F. No later than two (2) weeks upon completion of testing. The contractor shall forward a certification statement to the engineer/owner for approval.

3.8 FINAL INSPECTION

- A. Upon completion of installation, initial adjustments, tests, and measurements specified in Part 3, and submission and review of the results, a final inspection and test will be observed by the Owner, Owner's Representative, or Architect no earlier than two weeks after receipt of the written results.
- B. Provide a minimum of one person for inspection and two persons for testing familiar with aspects of the system to assist at no additional cost to the contract.
- C. At his own expense, the contractor shall perform the tests directed by an inspection authority, Engineer, or as required by the manufacturer.
- D. The process of testing the system may necessitate moving and adjusting specific components.
- E. In the event of the need for further adjustment or work becomes evident during testing. In that case, the contractor shall continue his work until the system is acceptable at no addition to the contract price. If approval is delayed because of defective equipment or failure of equipment or installation to meet these specifications' requirements, the extension of the inspection and testing period is required. In that case, the contract price would be decreased by the standard rate in place to account for the owner's extra time and expenses.

END OF SECTION – 27 15 00