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The Contractor is held responsible to be familiar with the provisions contained herein and with other Sections of this Specification as applicable to the completion of the installation.

1.01 SCOPE OF WORK

A. Work covered by this Section shall consist of furnishing labor, equipment, supplies, materials, and testing unless otherwise specified, and in performing the following operations recognized as necessary for the installation, termination, and labeling of all telecommunications infrastructure as described on the Drawings and/or required by these specifications.

1.02 RELATED SECTIONS

A. Division 27, Section 270526 Grounding and Bonding for Communication Systems.
B. Division 27, Section 270528 Pathways for Communication Systems.
C. Division 27, Section 270553 Identification for Communication Systems.
D. Division 27, Section 271116 Communications Cabinets, Frames, Racks, and Enclosures.
E. Division 27, Section 271119 Communications Termination Blocks and Patch Panels.
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J. Division 27, Section 271523 Communications Optical Fiber Horizontal Cabling.
K. Division 27, Section 271533 Communications Coaxial Horizontal Cabling.
L. Division 27, Section 271543 Communications Faceplates and Connectors.

1.03 INTENT OF DRAWINGS AND SPECIFICATIONS

A. These Specifications, together with the Drawings accompanying them, are intended to depict the installation requirements necessary to support this Project. Contractor shall furnish materials shown and/or called for on the Drawings but not mentioned in the Specifications, or vice versa, that are necessary for the installation and support of communications cabling, whether or not specifically called for in both. In addition, Contractor shall provide incidental equipment and materials required for the completion of systems included in this contract whether or not specified or shown on the Drawings.
1.04 DEFINITIONS

A. BDF (Building Distribution Frame) - The BDF is designated as the point where the outside plant cable terminates in the building. This telecommunications room (TR) includes fiber/twisted-pair cabling coming from the nearest campus telephone switch facility (TEL, LAMB, LYNN, ERHT), fiber from the nearest fiber node (TEL, LAMB, LYNN, ERHT), coax from BTV Cable distribution systems.

B. Horizontal Cable - That wiring which extends from a BDF or IDF to the room device outlet or other designated location.

C. IDF (Intermediate Distribution Frame) – A telecommunications room (TR) that connects to the BDF with riser cables and distributes horizontal wiring to the rooms. In some situations, a BDF may serve this function.

D. ISP (Inside Plant) - See definition of Horizontal Cable.

E. OSP (Outside Plant) - All transmission facilities (cabling) used in the distribution of telephone, data, video, and control from the BDF in one building to the distribution point for that particular service, e.g., telephone copper pairs from Telephone Building or Node Buildings, data fiber optic cable from Node fiber hubs, etc.

F. PIC - Purdue Information Connection - The telecommunications connection at the customer end consisting of voice and/or data and/or video.

G. Riser Cable - Telephone, data, video and audio cables extending vertically (or horizontally, in some cases) between the BDF and each area IDF.

H. TR (Telecommunications Room) - A room that is dedicated for the termination and distribution of telecommunications cabling. This can be used as a generic term for a BDF and/or IDF.

PART 2: PRODUCTS

It is Purdue’s expectation that the A/E of Record will work jointly with Purdue’s Telecommunication representatives to address specific technical issues and Owner requirements. All questions, deviations, comments concerning guideline(s) interpretation, content, and/or use must be submitted in writing to the Project Manager for approval. No deviations from these guidelines shall be incorporated into the project without written approval from the Project Manager and Purdue Telecommunications representative.

2.01 PRODUCT STANDARDS

A. All materials shall conform to the current applicable industry standards including, but not limited to:

1. NEMA (National Electrical Manufacturers' Association)
2. ANSI (American National Standards Institute)
3. ASTM (American Society for Testing and Materials)
4. ICEA (Insulated Cable Engineers Association)
5. IEEE (Institute of Electrical and Electronic Engineers)
6. NEC (National Electric Code)
7. NESC (National Electrical Safety Code)

B. In addition, all Material shall be Underwriters Laboratories Listed unless otherwise indicated.

C. All products must be new.

PART 3: EXECUTION

3.01 TELECOMMUNICATIONS INSTALLATION

A. Each Contractor shall be aware of work to be performed by other trades and take necessary steps to integrate and coordinate their work with other trades.

B. The Contractor shall be responsible for furnishing all materials on the drawings or as specified herein for a complete telecommunications system.

C. All telecommunications infrastructure shall be installed in an aesthetically pleasing fashion. All surface raceway in new buildings must be approved by a Purdue IT Infrastructure Services Representative.

D. All telecommunications infrastructure shall be installed for optimal performance.

E. All telecommunications infrastructure shall be installed and clearly labeled for easy moves, adds, and changes in the future.

F. All work performed in occupied spaces shall be in a manner that allows the Owner to operate the existing facilities on a continuous basis.

G. All user outages, including wireless access points, shall be submitted to the Purdue IT Infrastructure Services Department for approval (1) week before starting work that will affect user connectivity.

H. Construction within new TRs must be substantially complete before the installation of telecommunications cabling. This includes but is not limited to the installation of plywood, cable tray, electrical outlets, light fixtures, sprinklers, ductwork, and grounding. All walls shall also be painted before the installation of telecommunications cabling.

I. New TRs must be free from dust, dirt, and other foreign materials before the installation of any termination hardware or the termination of copper or fiber optic cables. The door to the telecommunication rooms must be installed and closed during termination.

3.02 TELECOMMUNICATIONS DEMOLITION

A. Where the relocation of existing PICs is required and the new location will allow the existing cables to reach, the cables may be disconnected and removed back to the hallway raceway system for installation into the new PIC. Where existing cables will not reach, new cables shall be installed to the TR. The new PIC location shall be relabeled. This installation requires a retest of the voice and data cables.
B. Where the removal of existing PICs is required, the contractor shall remove the PIC raceway, conduits, and cables back to the exterior of the TR. Contractor shall notify Purdue IT Infrastructure Services Representative at the time of removal. Owner will remove all items within the TRs. **Removal of existing PICs requires as-built information from the contractor.** Contractors are to supply a copy of the construction floor plan indicating where the PIC was removed and the labeling information on the PIC.

C. PICs scheduled to be relocated shall be tested by the contractor prior to moving. This is to ensure the permanent link meets the category performance set forth by ANSI/TIA. The contractor is responsible for bringing failed tests to the attention of Purdue’s IT Infrastructure Services department before proceeding. After reviewing and verifying the failed results, Purdue’s IT Infrastructure Services department will discuss options for repair. Unless the failed result is over distance, the contractor shall re-terminate the jack and re-test to confirm that the termination was not the cause of the problem.

D. Per the NEC, legacy voice and data systems not used within renovated areas shall be removed as part of the project. The Contractor is responsible to bring legacy systems within the proposed renovated areas not identified on the construction documents to the attention of the Purdue IT Infrastructure Services Department who will verify its usage. Note: Some legacy cabling still contains active circuits which must be verified and relocated in such a manner as to minimize customer disruption.
PART 1: GENERAL
1.01 SCOPE OF WORK
A. Work covered by this Section shall consist of furnishing labor, equipment, supplies, materials, and testing unless otherwise specified, and in performing the following operations recognized as necessary for the installation, termination, and labeling of grounding and bonding infrastructure as described on the Drawings and/or required by these specifications.

1.02 RELATED SECTIONS
A. Division 27, Section 270528 Pathways for Communication Systems.
B. Division 27, Section 270553 Identification for Communication Systems.
C. Division 27, Section 271116 Communications Cabinets, Frames, Racks, and Enclosures.
D. Division 27, Section 271119 Communications Termination Blocks and Patch Panels.
E. Division 27, Section 271313 Communications Copper Backbone Cabling.
F. Division 27, Section 271323 Communications Optical Fiber Backbone Cabling.
G. Division 27, Section 271333 Communications Coaxial Backbone Cabling.
H. Division 27, Section 271513 Communications Copper Horizontal Cabling.
I. Division 27, Section 271523 Communications Optical Fiber Horizontal Cabling.
J. Division 27, Section 271533 Communications Coaxial Horizontal Cabling.
K. Division 27, Section 271543 Communications Faceplates and Connectors.

1.03 DEFINITIONS
A. BC (Bonding Conductor) – Typical bonding conductor installed from any telecommunications grounding bus bar (TMGB or TGB) to telecommunications equipment and/or raceway.
B. Bonding - Refers to the electrical interconnection of conductive parts designed to maintain a common electrical potential. Bonding conductors must be of sufficient gauge to carry anticipated current due to power contact.
C. CBN (Common Bonding Network) – A #2 AWG green insulated conductor that is installed around the perimeter of the room hung from the cable tray and bonded to the TMGB or TGB.
D. EMI (Electromagnetic Interference) - The interference in signal transmission or reception resulting from the radiation of electrical or magnetic fields.
E. Grounding - Refers to the electrical connection of telecommunications hardware to an effective electrical ground. An effective electrical ground can be a power system.
Multi-Grounded Neutral (MGN), a grounded neutral of a secondary power system, or a specially constructed grounding system.

F. Multi-Grounded Neutral (MGN) - A utility power system where the neutral conductor is continuously present along with the phase conductors. The neutral conductor is connected to earth periodically along its path.

G. TBC (Telecommunications Bonding Conductor) - The bonding conductor installed from the building’s grounding electrode system to the TMGB. This bonding conductor shall be sized the same as the TBB.

H. TBB (Telecommunications Bonding Backbone) – Continuous bonding conductor installed from the TMGB to the furthest telecommunications room. All TGBs shall attach to the TBB.

I. TMGB (Telecommunications Main Grounding Busbar) – The main telecommunications grounding bar located where the Outside Plant cables enter the telecommunications room. The TBC and TBB will be terminated at the TMGB.

J. TGB (Telecommunications Grounding Busbar) – The telecommunications grounding bar located in every telecommunications room that does not contain the TMGB.

PART 2: PRODUCTS

It is Purdue’s expectation that the A/E of Record will work jointly with Purdue’s Telecommunication representatives to address specific technical issues and Owner requirements. All questions, deviations, comments concerning guideline(s) interpretation, content, and/or use must be submitted in writing to the Project Manager for approval. No deviations from these guidelines shall be incorporated into the project without written approval from the Project Manager and Purdue Telecommunications representative.

2.01 GROUNDING BUSBARS

A. Telecommunications Main Grounding Busbar (TMGB) shall be approximately 1/4” x 2” x 24” ground busbar comprised of 1/4” and 3/8” stud holes with busbar insulators

B. Telecommunications Grounding Busbar (TGB) shall be approximately 1/4” x 2” x 12” ground busbar comprised of 1/4” and 3/8” stud holes with busbar insulators

2.02 GROUNDING CONNECTIONS

A. Grounding conductor terminations (lugs) shall consist of (2) two-hole long barrel lugs #6AWG with 1/4” hardware and shall be compression type with window lug with a minimum of (2) crimps. Crimp according to manufacturer’s recommendation.

B. Grounding conductor terminations (HTAP) shall be compression type with a minimum of (2) crimps. Crimp according to manufacturer’s recommendation.

C. Screws used in bonding of the cable tray shall be thread-forming 12-24x1/2” (M6 x 12mm) thread-forming screw.
2.03 BONDING CONDUCTORS

A. Cable Tray Bonding Conductor shall be stranded green #6 AWG insulated bonding jumper (12” max) with appropriate two-hole lugs, or manufactured two-holed copper grounding strap.

B. Telecommunications Bonding Conductor (TBC) shall be green insulated copper bonding conductor, size as required by NEC. At a minimum, the TBC shall be the same size as the TBB.

C. Telecommunications Bonding Backbone (TBB)

1. Green insulated copper conductor, minimum size of No. 6 AWG. The TBB shall be sized at 2 kcmil per linear foot of conductor length up to a maximum size of 3/0 AWG. Insulation shall meet fire ratings of its pathway.

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<tr>
<td>14-20</td>
<td>4</td>
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<tr>
<td>21-26</td>
<td>3</td>
</tr>
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<td>53-66</td>
<td>2/0</td>
</tr>
<tr>
<td>Greater than 66</td>
<td>3/0</td>
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D. “L” brackets of proportional size and quantity to fasten over cable tray for routing of the bonding conductors for equipment frame grounding.

2.04 GROUND RODS

A. A copper clad ground rod, minimum of 5/8” in diameter and 10’ in length manufactured in accordance with the American National Standards Institute (ANSI), Underwriter’s Laboratories (UL) 467 specification, and the National Electric Code (NEC).

2.05 CBN (COMMON BONDING NETWORK)

A. Green insulated copper bonding conductor, #2 AWG.

3.01 TELECOMMUNICATIONS INSTALLATION

A. Installation of the TMGB

1. Install the TMGB at the bottom of plywood backboard near the outside plant entrance conduits in the “BDF”.
2. TMGB shall be installed so that the TBC for telecommunications is as short as possible and maintains a horizontal or downward path to the building’s grounding electrode system.

B. Installation of the TBC for Telecommunications

1. TBC shall be installed in continuous PVC conduit. Install in EMT conduit only if the path passes through a plenum area. EMT conduit must be bonded to the TBC at both ends of the conduit.

2. TBC shall maintain a horizontal or downward path from the TMGB to the building’s grounding electrode system. No bend shall form an included angle of more than 90 degrees or have a radius of less than 6”.

C. Installation of the TGB

1. Install the TGB at the bottom of plywood backboard near the TBB.

2. TGB shall be installed so that the bonding conductor connecting the TGB to the TBB is as short as possible and maintains a horizontal or downward path to the TBB.

3. Install a stranded bonding conductor (same size as the TBB) from the TGB to the TBB. This wire shall be terminated on the TGB end with two-holed compression type lug and terminated on the TBB end with the HTAP kit.

D. Installation of the TBB

1. Install Green insulated copper grounding conductor (refer to 2.03.D for conductor size) from the TMGB to the furthest telecommunications room.

2. Conductors shall be installed in continuous 3/4” PVC conduit until it enters a telecommunications room. Where the TBB pathway passes through a plenum area, the installation of EMT conduit is required and must be bonded on each end to the TBB.

3. Paint all conduit fittings, junction boxes and covers “GREEN”.

4. Each TBB shall be continuous to the furthest IDF.

5. The end of the TBB shall be terminated on the TGB of the furthest telecommunications room.

6. TBB shall maintain a horizontal or downward path to the TMGB. No bend shall form an included angle of more than 90 degrees or have a radius of less than 6”.
E. Grounding of Cable Tray
1. Each bonding point of the cable tray shall be sanded down to bare metal to assure continuity between the bonding conductor and the cable tray.
2. Install Green #6 AWG bonding jumper (12” max) with two-hole lugs at each cable tray joint or install manufactured braided copper grounding jumper.
3. Install Green #6 AWG grounding conductor with two-hole lugs from side of cable tray down to TMGB or TGB. Maintain a horizontal or downward path from the cable tray to the TMGB or TGB. Drill and install thread-forming screw on side of cable tray, making sure that bolt does not extend into wire management part of tray.

F. Grounding of Equipment Frame
1. Each equipment frame shall be bonded to the TMGB or TGB using either the CBN (Common Bonding Network) conductor or a #6 AWG conductor directly to the TMGB or TGB. Maintain a horizontal or downward path of the bonding conductor from the CBN (Common Bonding Network) conductor or the individual #6 AWG to the frame. No bend shall form an included angle of more than 90 degrees or have a radius of less than 6”.
   a. Where only one equipment frame is located within a room, install a #6 AWG bonding conductor from the frame to the TMGB or TGB terminated with two-hole lugs.
   b. Where multiple equipment frames are located within a room, install a bonding conductor (same size as the TBB) from the TMGB or TGB to the cable tray above the equipment frames. Route the bonding conductor horizontally on the “L” brackets of the cable tray. Install (1) #6 AWG green bonding conductor from each equipment frame to the CBN (Common Bonding Network) conductor above the equipment frames. Attach the #6 AWG cable to the equipment frame grounding strip using two-hole lugs. Attach opposite end of #6 AWG to the bonding conductor above the equipment frames using HTAP kit.
2. Install “L” brackets on cable tray for routing of the bonding conductors for equipment frame grounding. Install “L” bracket every 12”. Fasten CBN (Common Bonding Network) conductor on each “L” bracket using wire ties.

G. Installation of Bonding Conductors
1. Shall be routed so to minimize bends and length.
2. Shall be a minimum of #6 AWG.
3. Bonding Conductors shall maintain a horizontal or downward path to the TMGB or TGB. No bend shall form an included angle of more than 90 degrees or have a radius of less than 6”.
4. Use HTAP kit to bond the TBB to the TMGB or TGB.
H. Grounding of Direct Buried Cables

1. The distance between ground locations shall not exceed 1000ft.

2. Grounding shall be performed at every other pedestal if no transformer is present.

3. If direct buried cable passes within 50ft of a power station or sub-station, PVC (schedule 40) or double sheathed cables should be utilized to increase dielectric strength of the cable.

4. Whether mounting a pedestal housing on a pedestal stake or at the base of a pole, a ground must be established.

5. In a MGN system, the telecommunications cable shield shall be bonded to the MGN at the beginning and end of the exposure and each 2000ft within the exposure.
PART 1: GENERAL

1.01 SCOPE OF WORK

A. The work required under this section consists of providing conduits, boxes, raceways, etc., for telecommunications wiring included in this project. Telecommunications wiring includes cables for Data, Voice, Video, Audio and future signal requirements.

B. The location at which all new telecommunications wiring will terminate is called a PIC (Purdue Information Connection).

C. Furnish and install skeletal conduits and branch conduits as specified in the Drawings and as specified herein, and in accordance with electrical specifications.

D. Furnish and install raceway and outlet boxes as specified in the Drawings and as specified herein, and in accordance with electrical specifications.

E. Furnish and install conduits through walls and floors for cable routes.

F. Furnish and install raceways in hallways next to ceilings for distribution routes for telecommunications cabling.

1.02 RELATED SECTIONS

A. Division 27, Section 270526 Grounding and Bonding for Communication Systems.

B. Division 27, Section 270553 Identification for Communication Systems.

C. Division 27, Section 271116 Communications Cabinets, Frames, Racks, and Enclosures.

D. Division 27, Section 271119 Communications Termination Blocks and Patch Panels.

E. Division 27, Section 271313 Communications Copper Backbone Cabling.

F. Division 27, Section 271323 Communications Optical Fiber Backbone Cabling.

G. Division 27, Section 271333 Communications Coaxial Backbone Cabling.

H. Division 27, Section 271513 Communications Copper Horizontal Cabling.

I. Division 27, Section 271523 Communications Optical Fiber Horizontal Cabling.

J. Division 27, Section 271533 Communications Coaxial Horizontal Cabling.

K. Division 27, Section 271543 Communications Faceplates and Connectors.

1.03 DEFINITIONS

A. BDF (Building Distribution Frame) - The BDF is designated as the point where the outside plant cable terminates in the building. This telecommunications room (TR) includes fiber/twisted-pair cabling coming from the nearest campus telephone switch facility (TEL, LAMB, LYNN, ERHT), fiber from the nearest fiber node (TEL, LAMB, LYNN, ERHT), coax from BTV Cable distribution systems.

B. Horizontal Raceway - That pathway which extends from a BDF or IDF to the room device outlet or other designated location.
C. IDF (Intermediate Distribution Frame) – A telecommunications room (TR) that connects to the BDF with riser cables and distributes horizontal wiring to the rooms. In some situations, a BDF may serve this function.

D. PIC - Purdue Information Connection - The telecommunications connection at the customer end consisting of voice and/or data and/or video. There are three types of PICs:

1. Standard PIC - The standard telecommunications outlet which consists of unshielded twisted-pair cables, designated for telephone and data devices. Telephone and data devices terminate at floor IDF's, or in such cases where IDF's do not exist, at the BDF. Coaxial cable (video) and fiber (high speed data & video) can be added if necessary. A standard PIC consists of (1) voice jack and (2) data jacks.

2. Data Only PIC - Any outlet designated only for a data device, in such cases where telephone outlets may already exist or the area is being wired only for data (computer) devices that terminate at the floor telecom room. A Data-Only PIC consists of (1) or more data jacks.

3. Voice Only PIC - Any outlet (e.g. wall telephones, convenience telephones, payphones, etc.) designated only for a telephone device that terminates at the telephone BDF or IDF TR. A Voice-Only PIC consists of (1) or more voice jacks.

E. Residence Hall Room PIC - The typical outlets in the Residence Rooms are located within each room and provide a location for data and video connectivity for each resident. Single rooms may only have one location.

F. Riser Raceway - Pathway extending vertically (or horizontally, in some cases) between the BDF and each area IDF.

G. Skeletal Raceway - Pathway consisting of large diameter conduit (3" or larger) where section lengths are 10ft or less with openings 18"-24" in length between sections.

H. Sleeves- Pathway consisting of small sections of conduit or pre-manufactured devices intended for the passage of low-voltage cabling between rooms or walls which may or may not require fire-stopping.

I. TR (Telecommunications Room) - A room that is dedicated for the termination and distribution of telecommunications cabling. This can be used as a generic term for a BDF and/or IDF.

J. Cable Tray (Basket) – Distribution system in corridors used to route low voltage cabling between rooms.

PART 2 : PRODUCTS

It is Purdue’s expectation that the A/E of Record will work jointly with Purdue’s Telecommunication representatives to address specific technical issues and Owner requirements. All questions, deviations, comments concerning guideline(s) interpretation, content, and/or use must be submitted in writing to the Project Manager for approval. No
deviations from these guidelines shall be incorporated into the project without written approval from the Project Manager and Purdue Telecommunications representative.

2.01 PRODUCT STANDARDS
A. Refer to electrical specifications (Division 26) for electrical product requirements. (Conduit, boxes, etc.)
B. Owner approved 4” Conduit Waterfall.
C. Nylon Cable Protectors for conduits 3”- 6”.
D. Nylon Cable Protectors for conduits 2” and 2-1/2”.
E. All raceway products containing telecommunications cabling shall be fiber ready.
F. Manufacturer of insulating bushing on all telecommunication conduits shall be Arlington or Owner approved equal.
G. Owner approved Fire Rated Sleeves for wall penetrations.
H. Owner approved Fire Rated Sleeves for floor penetrations.

PART 3: EXECUTION

3.01 GENERAL REQUIREMENTS
A. The intention of the telecommunications pathways is to provide a route between BDF and IDF rooms, routes from the IDFs throughout building floors to hallways, and routes from hallway distribution systems into rooms to individual PICs for telecommunications cabling.
B. Installation of new pathways shall not interfere with existing pathways in such a way that installation of new cables within the existing pathway is made more difficult.

3.02 SERVICE ENTRANCE CONDUITS
A. A minimum of (2) 4” conduits shall be installed from the nearest utility tunnel or duct bank system as shown on the Drawings. Underground conduits shall either be PVC schedule 40 conduit or HDPE SDR 11 conduit until turning up into BDF room. Transition to GRC before entering the BDF room. Terminate entrance conduits entering BDF rooms from below grade 4” above finished floor. Location of entrance conduits shall be within 12” of room corners.
B. Terminate entrance conduits entering BDF rooms from above ceiling height to extend 4” below finished ceiling or 12” above cable tray.
C. Entrance conduits shall be continuous into the building and to the BDF. Securely fasten all entrance conduits to the building to withstand any cable placing operation. Do not include more than two 90 degree bends between pulling points when installing entrance conduits.
D. On exterior wall penetrations, seal both sides of the wall around outside of conduit with hydraulic cement to prevent 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.
E. Provide grounding bushings on each metallic conduit and terminate to the technology busbar (TMGB) with a minimum #6 AWG grounding conductor.
3.03 PATHWAY REQUIREMENTS FOR ENTRANCE CONDUITS

A. If the entrance conduits exceeds the 180 degree of total bends limitation, an appropriate sized junction box or manhole is required.

B. See attachment at end of this section for sizing of entrance conduit junction boxes.

C. As-built drawings of entrance conduit path required to be submitted to Purdue IT Infrastructure Services before covered with soil.

D. Install cable waterfalls on outside plant conduits entering the room from above where the incoming cable will transition to another raceway more than 6" vertically.

3.04 RISER CONDUITS

A. A minimum of (2) 3” conduits shall be installed between the BDF room and each IDF room as shown on the Drawings.

B. Conduits entering BDF and IDF rooms shall be reamed or bushed and terminated not more than 4” from entrance wall and within 12” of room corners.

C. Conduits entering BDF and IDF rooms from below floor shall be terminated not more than 4” above finished floor.

D. Conduits for riser cables shall be continuous and separate from all skeletal conduit or enclosed raceway systems. Do not include more than two 90 degree bends between pulling points when installing riser conduits. Where junction boxes are required, locate in accessible areas, such as above suspended ceilings in hallways. See attachment at the end of this section for sizing of entrance conduit junction boxes.

E. Conduits shall not be less than 3" trade size and be equipped with a nylon pull cord rated minimum 200 pound test.

F. Provide restorable fire stops inside and around conduits as recommended by UL1479 or ASTM E814 for all conduits penetrating fire-rated construction. Fire-rated construction to be verified with the Owner. All fire stopping penetrations must be labeled with the UL1479 or ASTM E814 reference number, dated, and signed by the technician who installed the fire stopping material.

G. Provide an insulating press fit bushing on all telecommunications riser conduits unless a cable waterfall is used (see below). Bushings must be rated to be used in an environmental air handling space (Plenum).

H. Install a cable waterfall on all 3” and 4” conduits containing cables that transition more than 6” vertically.

I. Riser conduits shall not be used for the distribution of horizontal cabling, departmental cabling, or other low voltage systems not related to telecommunications.

3.05 RISER SLEEVES

A. Where telecommunications rooms are stacked, the installation of fire rated floor assemblies are required.
3.06 HORIZONTAL DISTRIBUTION SYSTEMS

The following are approved distribution systems for telecommunications cabling. Refer to system as specified in the scope and/or as shown on the drawings.

A. Skeletal Conduit System (Renovations only, where skeletal exists)

1. Provide conduits secured to wall above corridor ceilings as shown on the Drawings or as specified herein for installation of telecommunications cables. Any exposed conduit shall be painted except conduit above suspended ceilings or in mechanical, electrical or telecommunication rooms. Color to match that of surface installed upon or as directed by Owner. Coordinate with Owner prior to painting.

2. Corridor conduits shall be 3" or 4" EMT, furnished in 10 foot lengths wherever possible, with no sharp edges, reamed as necessary, supported at 6'-0" spacing. Skeletal conduits shall be sized and quantified to account for handling cables in all PIC conduits at 40% fill back to the IDF and/or BDF rooms. Verify size with Purdue IT Infrastructure Services Representative prior to installation. Bushings and/or connectors on ends of EMT are not required.

3. Conduits shall be interrupted and separated 18"-24" at access points and at obstructions such as pipes, ducts, etc.

4. All skeletal system conduits shall be installed stacked and attached to walls unless conditions exist which prohibit this type of installation. When this condition exists, mount conduits side-by-side supported with 3/8" rod attached to building structure utilizing unistrut channel to form a trapeze. Double nut the top and bottom at the unistrut. Utilize conduit clamp to secure conduits to unistrut.

5. Provide nylon pull cord in each conduit.

6. Grounding of skeletal conduits is not required per NEC #250-33, Exception No. 2.

7. Provide restorable fire stops inside and around conduits as recommended by UL1479 or ASTM E814 for all conduits penetrating fire-rated construction. The use of restorable fire sleeves are an acceptable alternative to conduit sleeves with separate fire stopping material. Fire-rated construction to be verified with Owner. All fire stopping penetrations must be labeled with the UL1479 or ASTM E814 reference number, dated, and signed by the technician who installed the fire stopping material.

8. Install the cable waterfall on all conduits containing cables that transition more than 6" vertically from the conduit down to another raceway (conduit or cable tray). This includes conduit sleeves.

9. Install nylon cable protectors in conduits where cables enter/exit the conduit system creating pressure on the cables on the leading conduit edge. These protectors would not be used on conduits where the cable waterfalls are required (more than 6" of vertical drop).
10. **Provide an insulating press fit bushing on all telecommunications riser conduits unless a cable waterfall is used (see below). Bushings must be rated to be used in an environmental air handling space (Plenum).**

**B. Corridor Cable Tray System**

1. Complete wall mounted or suspended cable basket system and necessary accessories shall be provided as shown on plans. Install entire cable basket system in accordance with manufacturer's minimum installation practices and all local governing codes.

2. Coordinate installation of cable tray with other trades to allow a minimum of 12” above, 6” in front, and 3” below of clearance from piping, conduits, ductwork, etc.

3. Submittal drawings, in the form of 8 1/2” x 11” catalog cut sheets, shall be provided for the following items: cable tray, fittings, accessories and load data.

4. Cable tray shall not be loaded beyond 60% of manufacturer's recommended load capacity.

5. Install wall mounted cable basket on both sides of hallway or shown on drawings and where applicable.

6. Where a new cable basket distribution system encounters a wall, install sufficient 4” EMT sleeves or restorable fire stopping sleeves through the wall so cabling does not exceed 20% fill.

7. Where cable basket is exposed below ceiling, install the appropriate solid bottom inserts to conceal cables.

8. Install cable basket dropouts where large quantities of cables exit the distribution system.

9. Manufacturer of cable basket in corridors shall be WBT, Cablofil, B-Line Systems, or Owner approved equal.

10. Provide factory manufactured tee fittings and 90 degree fittings to maintain the tray performance characteristics. Utilize factory splice connectors to maintain the tray ground integrity.

**C. Sleeves**

1. Install a cable waterfall on all 4” conduit sleeves containing cables that transition more than 6” vertically from the sleeve down to another raceway (conduit or cable tray).

2. Install nylon cable protectors in conduits where large amounts of cables enter/exit the conduit system creating pressure on the cables on the leading conduit edge. These protectors would not be used on conduits where the cable waterfall is required (more than 6” of vertical drop).

3. Where cables must penetrate fire-rated walls between sections of skeletal conduit or cable tray sections, install sufficient 4” EMT sleeves or restorable fire stopping sleeves through the wall so cabling does not exceed 20% fill.
3.07 STATION CONDUITS

A. Provide station conduits from PICs to within 12” of hallway distribution systems of 1” EMT minimum or appropriate size as shown on the Drawings or as specified herein for installation of telecommunications cables.

B. Provide an insulating press fit bushing on all telecommunications conduits including interconnecting nipples and stub to distribution system. To prevent conflicts with other cables, conduits to cable tray or skeletal system shall be stubbed not less than 6” above or below skeletal conduit/ cable tray center line. Where space permits, every effort shall be made to bend station conduits down such that the flow of installed cables promote the minimum length back to the IDF and the least amount of bends in the cables. Bushings must be rated to be used in an environmental air handling space (Plenum).

C. Provide nylon pull cord in each conduit to hallway skeletal or distribution system.

D. Indelibly mark station conduit at hallway distribution end with Room # that conduit serves.

E. Indelibly mark station conduits that directly enter the telecommunications room.

F. The use of pulling LBs is prohibited.

G. Do not include more than two 90 degree bends between pulling points when installing station conduit runs. If the path of the station conduits requires more than 180 degrees of total bends, installation of an appropriate sized junction box or “C type” condulet is required. See attachment at end of this section for junction box requirements.

H. Place an appropriate sized junction box or “C type” condulet in each individual station conduit run that exceeds 100ft in length.

I. The use of a third bend in a conduit is only acceptable if:
   1. The total conduit run does not exceed 33ft.
   2. The conduit size is increased to the next trade size.
   3. One of the bends is located within 12” of the cable feed end.

J. Ceiling grid support wires shall not be used to support telecommunications raceways or cables.

K. Station conduits shall not be used for the distribution of departmental cabling or other low voltage systems not related to telecommunications.

L. Conduits shall be anchored so that they are RIGID to movement.

3.08 JUNCTION BOX REQUIREMENTS FOR STATION CONDUITS

A. If the station conduit route exceeds the 180 degree of total bends limitation, an appropriate sized junction box or “C type” condulet is required within a straight section of the conduit run.

B. Each station conduit run requires a separate junction box or “C type” condulet. The sharing of a junction box by multiple conduits is prohibited.
C. A junction box shall not be used in place of a bend. All junction boxes or “C type” conduit in station conduit paths shall be installed within a straight section of the conduit run.

D. See attachment at end of this section for sizing of station conduit junction boxes.

3.09 PIC (PURDUE INFORMATION CONNECTION)

A. New construction PIC consists of (1) 4-11/16" square by 2 1/8" deep flush mounted box with double gang, square drawn extension or tile ring, raised 1/2". The outlet box shall have a 1" EMT conduit stubbed to within 12" of the hallway skeletal, cable basket, or raceway distribution system.

B. Existing construction PIC typically consists of (1) 10’ section of vertical, surface-mounted Wiremold #V3000 series raceway including base, cover, end fitting, entrance end fitting, and (1) 1" EMT conduit stubbed out top of entrance end fitting to within 12” of the nearest hallway skeletal, cable basket, or raceway distribution system. Use “Fiber Ready” products where available.

C. The intent of the installation of the PICs which consist of the vertical Wiremold #V3000 series raceway is as follows:

1. Where ceilings are accessible, the raceway and entrance end fitting shall extend above the ceiling and the conduits installed above the ceiling in the room to the nearest hallway distribution system.

2. Where ceilings are partially accessible, or if the Drawings and/or Specifications indicate installation of access panels, the raceway shall extend above the ceiling and the conduits installed above the ceiling in the room to the nearest hallway distribution system.

3. Where ceilings are inaccessible or no ceilings exist, the raceway shall extend up as close to the ceiling as practical to allow installation of conduits as high as possible to the nearest hallway distribution system.

D. Telephone Only Outlet:

1. New construction outlet box shall be a 4 11/16" square flush mounted box. Boxes are to be 2 1/8" deep with single gang, square drawn extension or tile ring. Outlet box shall have a 1" EMT conduit to nearest distribution system or as indicated on the Drawings or as specified herein.

2. Flush wall mounted telephones shall be a standard 4 11/16" square flush-mounted box, 2 1/8" deep with single gang tile ring. Box shall have a 1" EMT to nearest distribution system with top of box being at 48".

3. Surface mounted outlets for wall mounted telephones shall have a Wiremold #2448 single gang outlet box mounted at 48” to top of box with surface mounted Wiremold #2400 raceway, entrance end fitting and 1" EMT conduit to nearest hallway skeletal or raceway distribution system. (Note: Single gang Wiremold #2448 box requires raceway to enter from the side).
4. Surface mounted outlet boxes for single desk phone shall be Wiremold #2448 single-gang outlet box with Wiremold #2400 raceway and entrance end fitting and (1) 1" EMT conduit to hallway distribution system.

E. Data Only Outlet:
1. New Construction outlet box shall be a 4 11/16" square flush mounted box. Boxes are to be 2 1/8" deep with single gang, square drawn extension or tile ring. Outlet box shall have a 1" EMT conduit to nearest distribution system or as indicated on the Drawings or as specified herein.
2. Surface-mounted outlet boxes for single data shall be Wiremold #2448 single-gang outlet box with Wiremold #2400 raceway and junction box and (1) 1" EMT conduit to hallway distribution system. (Note: Single gang Wiremold #2448 box requires raceway to enter from the side)

3.10 FIRE STOPS
A. In all buildings, floor/ceiling assemblies, stairs, and elevator penetrations must be sealed with a 2-hour fire stop assembly at a minimum, unless otherwise noted. Non-fire rated walls do not require fire-stopping.
B. Contact Owner to identify walls which are fire-rated construction.
C. Communication pathways requiring fire stopping shall utilize removable/re-usable fire stopping putties for ease of Moves, Adds, and Changes.
D. All fire stopping penetrations shall conform to the recommended practices listed in UL1479 or ASTM E814 and must be labeled with the UL1479 or ASTM E814 reference number, dated, and signed by the technician who installed the fire stopping material.
### Table 1

**JUNCTION BOX REQUIREMENTS FOR STATION CONDUITS**

<table>
<thead>
<tr>
<th>Conduit size</th>
<th>Size of Box width</th>
<th>length</th>
<th>depth</th>
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</thead>
<tbody>
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<td>6&quot;</td>
</tr>
<tr>
<td>2-½”</td>
<td>12&quot;</td>
<td>12&quot;</td>
<td>6&quot;</td>
</tr>
</tbody>
</table>

### Table 2

**JUNCTION BOX REQUIREMENTS FOR RISER CONDUITS**

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<th>Conduit size</th>
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</tr>
<tr>
<td>4&quot;</td>
<td>8&quot;</td>
<td>36&quot;</td>
<td>8&quot;</td>
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### Table 3

**JUNCTION BOX REQUIREMENTS FOR ENTRANCE CONDUITS**

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<th>Conduit size</th>
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<td>Length</td>
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<tr>
<td>4”</td>
<td>15”</td>
<td>60”</td>
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</table>
PART 1: GENERAL

1.01 SCOPE OF WORK:
   A. The work required under this Section consists of providing all primary, secondary, telecommunications/data underground ducts and raceways, including maintenance holes and handholes, for the project as shown on Drawings and/or as specified herein.
   B. The contractor installing the underground telecommunications structures shall have 10yrs experience in the installation of telecommunications underground structures. The contractor shall provide a list of recent installations (similar size and scope) along with Owner contact information of those systems as references.

1.02 RELATED SECTIONS:
   A. Section 310000 – Earthwork (excavation, backfill, compaction, etc.)
   B. Section 020000 – Site Improvements (concrete work, blacktop, etc.)
   C. Section 260533 – Raceways and Fittings

1.03 RELATED PURDUE POLICIES:
   A. Purdue Confined Space Program

PART 2: PRODUCTS

It is Purdue’s expectation that the A/E of Record will work jointly with Purdue’s Telecommunication representatives to address specific technical issues and Owner requirements. All questions, deviations, comments concerning guideline(s) interpretation, content, and/or use must be submitted in writing to the Project Manager for approval. No deviations from these guidelines shall be incorporated into the project without written approval from the Project Manager and Purdue Telecommunications representative.

2.01 GENERAL:
   A. All ducts:
      1. The number, size, raceway duct material and arrangement shall be as indicated on Drawings and/or as specified herein.
      2. May be non-metallic PVC (minimum of schedule 40), heavy wall, galvanized rigid conduit (GRC) as outlined in items B and C below, or HDPE and indicated on Drawings and/or as specified herein.
      3. Shall be capped with manufactured caps (Duct Plugs) when installation is temporarily discontinued or installed for future use.
4. Shall be 4" nominal trade size, unless specifically noted otherwise.

B. Non-metallic Raceways:
   1. PVC Conduits Encased in Concrete
      a. AD Technologies PVC Type DB with concrete encasement.
      b. Plastic duct to meet NEMA TC-6 standards.
      c. Used for all non-metallic conduits except where rigid conduit is required.
      d. Complete with threaded adapter when attached to rigid conduit.
      e. Perfectly circular in shape. Other configurations will not be permitted.
      f. Have joints made with materials provided and installed per manufacturer's directions. Comply with manufacturers requirements for bending and cutting.
   2. HDPE Conduits
      a. Conduit shall be a nonmetallic flexible raceway manufactured from High Density Polyethylene (HDPE) for use in underground applications. It shall be a smooth-walled interior and exterior configuration with wall construction of SDR 13.5. (Note: Directional drilling installations shall utilize SDR 11) Each conduit shall have a one-half inch pre-lubricated, woven, 1130lb. minimum polyester tape made from low friction, high abrasion resistant yarns placed within the conduit and secured at each end. Tape shall be printed with sequential footage markings for accurate measurements. Each conduit shall be black with (3) unique colored stripes, to be specified in the part number to replace the “XX” or as specified on the drawings. (i.e. 3D=3 buff stripes, 3E=3 gray stripes, 3F=3 green strips, 3G=3 lilac stripes).

C. Rigid Heavy Wall Conduit:
   1. Used within excavated portion of building, including any areas where building excavation has been backfilled.
   2. Extended 10’ minimum from building into undisturbed earth.
   3. Used in areas of extended backfill, requiring maximum strength against shear.
   4. Used where crossing under roads, tunnels, or intersections.

D. Concrete Encasement:
   1. Soil sub-grade shall have minimum gross-bearing pressure of 1500 psf.
   2. Mud slab for duct bank shall be 3000 psi with a minimum 3” thickness.
   3. Duct bank shall be 3000 psi, class 2, concrete ready mix per ASTM-94.

E. Backfill:
   1. Per Section Earthwork (excavation, backfill, compaction, etc.).
F. Locate Wire:
   1. Stranded #10 AWG wire with overall green insulation.

G. Pulling Tape:
   1. Polyester measure-pulling tape (1250lbs)

2.02 TELECOMMUNICATIONS MAINTENANCE HOLES:

A. Maintenance holes shall be as follows:
   1. Provided by Electrical or Telecommunications Contractor as described in the drawings and as specified herein.
   2. Be reinforced precast concrete, 4500 psi and designed for truck loading.
   3. Be either:
      a. 10’ long x 5’ wide x 7’ high inside dimensions, unless otherwise specified on the Drawings and/or as specified herein.
      b. 8’-6” long x 5’-6” wide x 7’ high inside dimensions, unless otherwise specified on the Drawings and/or as specified herein.
      c. 8’ long x 4’ wide x 7’ high inside dimensions, unless otherwise specified on the Drawings and/or as specified herein.
   4. Be provided with pulling irons opposite each duct bank.
   5. Be complete with bonding jumper to reinforcing steel in each section.
      a. Pre-cast maintenance holes have reinforcing steel bonded together and do not require an additional ground rod. Install a bonding ribbon horizontally around the top of the maintenance hole and attached to all cable racks, hardware and collar. Continue installation vertically between bonding clamps so both top and bottom halves are bonded together on each side. The bonding ribbon will be used to bond hardware placed within the maintenance hole.
   6. Be complete with cable racks for proper cable support.
   7. All maintenance hole hardware shall have hot dipped galvanized finish.
   8. Provide heavy-duty, cast-iron, frame and cover with nominal 30” opening with pick holes or handles. Lid to be lettered "Communication".
   9. Provide grade ring riser castings as required to elevate cover to approximately 1” above finished grade. Internal diameter of grade rings to be not less than internal diameter of maintenance hole cover frame. Verify with manufacturer on availability. Custom grade rings are acceptable upon prior approval of Owner’s Representative.
10. Set on leveled undisturbed earth with minimum 3" granular fill under entire maintenance hole before setting. If earth is disturbed during excavation, properly compact soil and provide 3" concrete leveling pad under entire maintenance hole before setting. Backfill around maintenance holes per INDOT specifications for Maintenance hole, Inlet and Catch Basins, Section 720.

11. Maintenance hole ladders and corresponding ladder rings are required for all maintenance holes.

12. Maintenance holes shall be equipped with a 14 inch sump pit located directly under the maintenance hole lid per manufacturer specifications.

13. Maintenance hole shall be Type "J" with offset opening, duct entrances as shown on Drawings with properly placed precast knockouts, duct terminators.

14. Tinned copper bonding ribbon equivalent to .0510 x .3750 EPT shall be bonded to all cable racks within the maintenance holes.

15. Align multiple grade rings so that ladder steps line up. Do not cut these off. Be sure to install gasket material between rings and frame. Install per manufacturer’s recommendations.

2.03 CABLE SUPPORTS: (MAINTENANCE HOLES)
A. Supports for Communications maintenance holes shall be equipped with appropriate cable racks to support cabling and splice cases.

2.04 CONDUIT COUPLERS
A. Aluminum threaded conduit couplers to be used to join two segments of smooth-walled conduit together. Non metallic couplers are not acceptable.

2.05 DUCT PLUGS
A. Conduit sealing plugs to be used to seal unused conduit.

2.06 TELECOMMUNICATIONS HANDHOLES
A. Handhole enclosures shall be 30"W x 48"L x 24"D PG style (Stackable) assembly with no base or as specified on drawings.

B. Installation to be per the manufacturer’s specifications.

C. Handhole cover shall be Owner-approved heavy duty pre-cast polymer concrete complete with (2) bolts and “Communications” labeling on the lid.
2.07 TELECOMMUNICATIONS PEDESTALS

A. Pedestals shall be purchased and installed per the construction documents in coordination with telecommunications representative.

2.08 DUCT ADHESIVE

A. Duct adhesive used to connect PVC conduit to HDPE conduit.

1. Polywater “BonDuit®” High Strength Sealant.
PART 3: EXECUTION

All installations mentioned below require a Purdue IT Infrastructure Services Representative to be present.

3.01 DUCTS:

A. All ducts:

1. Shall be checked by pulling a round wood or steel test mandrel, sized for each duct from both directions to remove obstructions.
   a. Mandrel for 4” SDR 13.5 duct shall be a minimum of 3.75” outside diameter.
   b. Mandrel for 4” SDR 11 duct shall be a minimum of 3.25” outside diameter.
   c. Mandrel for 3” SDR 13.5 duct shall be a minimum of 2.75” outside diameter.
   d. Mandrel for 3” SDR 11 duct shall be a minimum of 2.25” outside diameter.
   e. Mandrel for 2” SDR 13.5 duct shall be a minimum of 1.75” outside diameter.
   f. Mandrel for 2” SDR 11 duct shall be a minimum of 1.25” outside diameter.

2. Shall be cleaned by passing a wire brush mandrel and/or rubber duct swab (or approved alternative) of appropriate size back and forth until all foreign materials and water are removed.

3. Shall be installed using long radius sweeps, unless otherwise noted on Drawings and/or specified herein. Use no more than 180 degrees of total bends in continuous sections of conduit to reduce cable installation friction.

4. Shall be installed with minimum of 3” fall per 100’ run toward maintenance holes and away from buildings.

5. Shall be provided with continuous conduit measuring tape in each duct.

6. Shall be approved for correct orientation and support before securing to prevent ducts from floating when concrete is poured.

7. Provide a minimum of 12” separation between electric power and telecommunications/data ducts.

8. A minimum of 2’-6” bury depth (measured from concrete encasement to finished grade) is required. Exceptions may be granted to avoid interference with prior approval from Purdue’s IT Infrastructure Services Representative.

B. Non-metallic Raceways:

1. PVC Conduits Encased in Concrete
   a. Plastic duct with straight couplings and appropriate cement. Couplings to be staggered horizontally and vertically.
b. Protected from deformation during stockpiling.
c. Have joints covered with Scotch #88 tape as temporary concrete seal.
d. Provide with end bells flush with inside wall of maintenance hole or vault.

3.02 CONCRETE ENCASEMENT:
A. Size where shown on drawings, with raceways receiving not less than 3” concrete cover all around and 1-1/2” between raceways.
B. Provided with support piers to undisturbed soil where necessary for permanent bearing.
C. Provided with fine sand cover for initial curing.
D. Rebar reinforcement is required where duct banks will cross roadways.
E. Conduits entering/leaving maintenance holes shall be encased in concrete or flowable fill 5ft beyond maintenance holes. The concrete or flowable fill shall be pinned to the side of the maintenance holes to keep the ducts from shearing.
F. Protected against freezing, etc., as required in General Construction Specification.
G. Installed so no honeycombing occurs and be properly vibrated with small vibrator. Do not vibrate between ducts.
H. Concrete for the duct bank shall be placed in such a way that the duct bank will not be disturbed and that the sides of the trench do not crumble using splash boards, proper placement, etc. The vertical drop of concrete from chute shall not exceed 30”.
I. Concrete shall be poured continuous from maintenance hole to maintenance hole.
J. Interval between base or intermediate spacers shall not exceed 8 feet with a minimum of two supports per length of duct.
K. Make provisions, such as nylon ties, to prevent the ducts from floating when concrete is poured.
L. Color top layer of concrete encasement by using “ORANGE” (for telecommunications) chalk dust (i.e. Strait-Line marking chalk) while still wet.

3.03 CABLE SUPPORTS:
A. In general, all cables in maintenance holes shall be supported on 4'-0” maximum centers for straight runs, within 6” on each side of splices, and within 2'-0” of cable entrances to duct or termination.

3.04 EXCAVATION:
A. Coordinated with other trades.
B. Have elevations and arrangements verified on job.
Information Technology Infrastructure Services

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C. If soil conditions are such that because of the depth or any other reasons the trench/excavation cannot conform to the size of the duct bank, provide forms and bracing as required.

D. Have grade stakes at 5’ intervals in trench bottom.

E. Have trench bottom filled to exact elevation with a 3” concrete grade pad prior to installation of ducts. Ducts are to be installed using 3” chairs and 1-1/2” separation to provide required cover. At Purdue IT Infrastructure Services Representative’s discretion or as directed on Drawings the 3” grade pad may be deleted.

F. Contractor shall open entire length of trench and establish proper grades before beginning installation of any portion of connecting duct runs.

G. Provide per Section 310000 - Earthwork and Section 020000 - Excavation, Backfill, Concrete, Asphalt Repairs and Related Work.

H. Depth of excavation shall be such that the required bury depths (top of concrete encasement) are met. Any deviation from required depths shall be identified and approved by a Purdue IT Infrastructure Services Representative prior to installation.

3.05 LOCATE WIRE

A. Install the locate wire in (1) duct of each conduit run.

B. Terminate locate wire on collar of maintenance holes for easy access.

3.06 REINFORCING:

A. Shall be installed:
   1. Where noted on drawings and/or as specified herein.
   2. Where crossing trenches for other work.
   3. Where connected to buildings and maintenance hole walls, anchored thereto with projecting re-bars provided by this Contractor.
   4. At joints between pours of concrete envelope.
   5. If continuous pour is impractical, provide (4) #4 reinforcing bars extending six feet (6’) into first and second pour.
   6. Where trenches cross roadways.

B. Reinforcing shall be supported from bottom of trench at least one inch.

3.07 MAINTENANCE HOLE TERMINATION:

A. HDPE conduit shall be bonded to PVC conduit within 5ft of maintenance hole with a standard PVC schedule 40 end bell using Polywater “BonDuit” High Strength Sealant. Refer to Manufacturer’s instructions on the installation of the sealant.
B. Seal maintenance hole penetration around PVC using bentonite.
C. Conduits entering/leaving maintenance holes shall be incased in concrete or flowable fill 5ft beyond maintenance holes. The concrete or flowable fill shall be pinned to the side of the maintenance holes to keep the ducts from shearing.
D. Installation crews shall utilize knockouts provided by the manufacturer. Any deviation shall be approved by Purdue’s IT Infrastructure Services Representative.

3.08 BUILDING TERMINATIONS:
A. Conduits entering building walls shall be sealed using a wall penetration seal system.

3.09 BACKFILL:
A. Shall not be installed until after concrete has reached initial set.
B. Per Section Earthwork (excavation, backfill, compaction, etc.).
C. The Owner will do all re-seeding, unless specifically indicated on Drawings and/or as specified herein.
D. Backfill around maintenance holes with select granular material free of broken pavement, rocks, frozen material, etc. Backfill in 6” layers and tamp each layer to ensure complete compaction, especially under pipes and conduit. Place backfill evenly on all sides of maintenance hole to prevent racking or cracking. Backfilling should be completed on the same day the maintenance hole is placed.
E. In unpaved areas, the ground should be sloped away from the maintenance hole frame and cover to provide proper drainage.
F. Where the maintenance hole is to be installed under a paved area, such as a parking lot, the surface of the paving should be graded slightly away from the maintenance hole frame and cover.
G. Where the maintenance hole is to be installed under a concrete sidewalk, slab or pavement, expansion joint material shall be placed between the panel vault frame and concrete. A 2” minimum sand cushion shall be provided between the top surface of the maintenance hole and the bottom of the concrete sidewalk, slab or pavement to prevent stress on the casting during freeze and thaw conditions.
H. Restoration of the area where the maintenance hole structure is installed shall meet the requirements of the Purdue IT Infrastructure Services Representative.

3.10 AS-BUILTS:
A. Contractor shall provide as-built information to Purdue’s IT Infrastructure Services Department prior to final payment for this work. Provide telecommunications underground pathway as-builts within 30 days of pathway being installed in the ground, regardless of the substantial completion date.
B. As-built information shall be in red-lined format on a copy of construction drawings. Indicate location of all underground routes, if different than original drawing.
C. If construction drawings are not utilized, Contractor shall provide all telecommunications location information on an accurate scaled site plan.

D. All as-builts will be marked with the proper XYZ (northing, easting, elevation) coordinates and underground infrastructure depth at a minimum of every 20ft. These coordinates shall be tied to the nearest Purdue University benchmark and other permanent landmarks. Contact Purdue University for the exact location of the benchmarks at least 48 hours prior to starting work.

E. A Registered Land Surveyor is required for producing as-built information.
270553 - Identification

Last Update: April 29th, 2014

PART 1: GENERAL

1.01 SCOPE OF WORK

A. Work covered by this Section shall consist of furnishing labor, equipment, supplies, materials, and testing unless otherwise specified, and in performing the following operations recognized as necessary for the labeling of the telecommunications infrastructure as described on the Drawings and/or required by these specifications.

1.02 RELATED SECTIONS

A. Division 27, Section 270528 Pathways for Communication Systems.
B. Division 27, Section 270553 Identification for Communication Systems.
C. Division 27, Section 271116 Communications Cabinets, Frames, Racks, and Enclosures.
D. Division 27, Section 271119 Communications Termination Blocks and Patch Panels.
E. Division 27, Section 271313 Communications Copper Backbone Cabling.
F. Division 27, Section 271323 Communications Optical Fiber Backbone Cabling.
G. Division 27, Section 271333 Communications Coaxial Backbone Cabling.
H. Division 27, Section 271513 Communications Copper Horizontal Cabling.
I. Division 27, Section 271523 Communications Optical Fiber Horizontal Cabling.
J. Division 27, Section 271533 Communications Coaxial Horizontal Cabling.
K. Division 27, Section 271543 Communications Faceplates and Connectors.

PART 2 – PRODUCTS

It is Purdue’s expectation that the A/E of Record will work jointly with Purdue’s Telecommunication representatives to address specific technical issues and Owner requirements. All questions, deviations, comments concerning guideline(s) interpretation, content, and/or use must be submitted in writing to the Project Manager for approval. No deviations from these guidelines shall be incorporated into the project without written approval from the Project Manager and Purdue Telecommunications representative.

2.01 LABELS

A. Copper, Fiber, and Coax Riser Cable Labels in TRs
   1. Panduit #T050X000VPC-BK, 0.5” height, black lettering on white vinyl tape or Owner approved equal.

B. Copper, Fiber, and Coax Horizontal Cable Labels in TRs and behind faceplates
   1. Panduit #S100X150VAC, 1.0” wide x 1.5” length, white, print-on vinyl label or Owner approved equal.
27 0553 – Identification
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C. Telephone 110-Block Labels in TRs
   1. Panduit #T038X000VPC-BK, 0.38” height, black lettering on white vinyl tape or Owner approved equal.

D. Faceplate Labels at the WO
   1. Panduit #T038X000VPC-BK, 0.38” height, black lettering on white vinyl tape or Owner approved equal.

E. Patch Panel Labels in TRs
   1. Panduit #C061X030FJC, 0.61” wide x 0.30” height, one-port identifier, white, adhesive, polyolefin label or Owner approved equal.

PART 3: EXECUTION

3.01 LABELING INSTALLATION

A. Horizontal Cable Labeling:
   1. All horizontal cables shall be labeled with self-laminating marking tape, Panduit LS8 labeler or Owner approved equal labeling system. Identification shall be as follows:
      a. At the BDF/IDF end, the voice and data horizontal cables shall be labeled with the information indicating termination of the opposite end of the cables. This shall include room location and jack designation. Place label on a visible part of cable within 12” of termination point for ease of identification after termination.
         e.g. At the BDF/IDF end the 4-pair data cables for the 1st location in room 1137 would be labeled: 1137-A and 1137-B
         At the BDF/IDF end the 4-pair voice cable for the 1st location in room 1137 would be labeled: 1137-1
         Size of letters and numbers shall be no less than 5/16” high by 1/8” wide.
      b. At the rooms, the horizontal cables shall be labeled 4” from termination with the following: BDF/IDF TR Room # - Room # - Jack
         e.g. 1106-1137-A, 1106-1137-B, 1106-1137-1. This shall be visible by removing outlet cover plate. For rooms with multiple outlet locations, identification would begin with the first receptacle to the left of the main entrance to the room and continuing clockwise around the room. Size of letters and numbers shall be as indicated above.
      c. At the BDF/IDF end, the fiber horizontal cables shall be labeled with the information indicating termination of the opposite end of the cables. This shall include room location, fiber type ("S" for single-mode, "M" for multimode), and jack designation. Place label on a visible part of cable within 12” of termination point for ease of identification after termination.
27 0553 – Identification

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e.g. At the BDF/IDF end the 2-strand fiber cable for the first location in Room 1137 would be labeled: 1137FOS-A with the “FO” indicating fiber optic cable and the “S” indicating single-mode fiber type. **Note:** Fiber is labeled in pairs. (Blue and Orange strands would be treated as jack “A”)

Size of letters and numbers shall be no less than 5/16” high by 1/8” wide.

d. At the rooms, the horizontal fiber cables shall be labeled 4” from termination with the following: BDF/IDF Telecom Room # - Room # FO(S or M)- Jack
e.g. 1106-1137FOS-A, 1106-1137FOS-B. This shall be visible by removing outlet cover plate. For rooms with multiple outlet locations, identification would begin with the first receptacle to the left of the main entrance to the room and continuing clockwise around the room. Size of letters and numbers shall be as indicated above. **Note:** Fiber is labeled in pairs. (Blue and Orange strands would be treated as jack “A”)

e. At the BDF/IDF, the CATV cables shall be labeled at each end with the information indicating termination of the opposite end of the cables. This shall include Cable system, Room number, and cable number at opposite end. Place label on a visible part of cable 12” from end of cable for ease of identification after termination.
e.g. MRDH has a BDF TR, Room B009A and IDF TR, Room 285S. Room 285S distributes cable to room 236SE. At the IDF end the horizontal cable from the room would be labeled: TV236SE-1.

Size of letters and numbers shall be no less than 5/16” high by 1/8” wide.
f. At the rooms, the CATV cables shall be labeled 4” from termination with the following: BDF/IDF TR Room # - TVRoom # - Jack.
e.g. 285S-TV236SE-1. This shall be visible by removing outlet cover plate. For rooms with multiple outlet locations, identification would begin with the first receptacle to the left of the main entrance to the room and continuing clockwise around the room. Size of letters and numbers shall be as indicated above.

2. Room numbers used for PIC labeling shall only contain preceding zeros when an alpha character precedes the zeros.

a. Example: The PIC in room G002 would be labeled as G002-A/B/1
b. Example: The PIC in room 002 would be labeled as 2-A/B/1

B. Copper Riser Cable Labeling:

1. All riser cables shall be labeled with self-laminating marking tape, Panduit LS8 labeler, Brady TLS2200 labeler, or Owner approved equal labeling system. Identification shall be as follows:
a. At the BDF and IDF, the copper riser cables shall be labeled at each end with the information indicating termination of the opposite end of the cables. This shall include building acronym and cable number and room location. Place label on a visible part of cable close to wiring block for ease of identification after termination.

  e.g. FS has a BDF TR, Room B195D and an IDF TR, Room 1106. At the IDF end the 1st cable would be labeled: FS01-B195D At the BDF end the 1st cable would be labeled: FS01-1106

  Size of letters and numbers shall be no less than 5/16" high by 1/8" wide.

  Note: Multiple riser cables between the BDF and IDFs are to be labeled as the same cable. e.g. Riser cables FS01 consists of (2) 100-pair cables (FS01, 1-100; FS01, 101-200). The cable label along with the pair count shall be labeled at each end of the wiring blocks.

C. Fiber Riser Cable Labeling:

  1. All fiber optic riser cables shall be labeled at each end with the information indicating: 1) Building, 2) Cable number, 3) "FO" indicating a fiber and opposite end of cable. "S" shall be used after the FO to indicate the use of single-mode fiber. "M" shall be used after the FO to indicate the use of multi-mode fiber. Fiber type shall be labeled on the front of the fiber enclosure: SMF for single mode fiber; MMF for multimode fiber. Verify cable number with a Purdue IT Infrastructure Services Representative before labeling.

  e.g. In BDF Room 224, FS (Food Science): FS01-FOM420A = the first 12-strand, multimode fiber riser cable to IDF Room 420A.

  e.g. In BDF Room 224, FS (Food Science): FS01-FOS420A = the first 12-strand, single-mode fiber riser cable to IDF Room 420A.

D. Copper Riser 110-Block Labeling:

  1. At the BDF and IDF, voice riser cables are terminated on their respective 110 blocks. Label only 1st and last pairs on each row of 110 blocks. Place cable number of riser cable on wiring block label in center of label.

E. Coax Riser Labeling (CATV):

  1. At the BDF and IDF, CATV riser cables shall be labeled at each end with the information indicating termination of the opposite end of the cables.

  e.g. At the IDF end the 1st riser cable from the BDF would be labeled: TV01-B009A. At the BDF end the same cable would be labeled: TV01-285SE

F. Horizontal 110-Block Labeling (Telephone):

  1. At the IDF, voice horizontal cables are terminated on their respective S110 blocks, with pairs on the blocks labeled in ascending room number order. All horizontal cables from same room should be terminated in sequential order
on S110 blocks. Single 4-pair cables will be labeled with a room location and a jack designation. e.g. 1113-1 = a single telephone jack in Room 1113.

2. Size of letters and numbers on labels for 110 wiring blocks shall be no less than 3/8” high.

G. Horizontal Patch Panel Labeling (Data):

1. At the IDF, data horizontal cables are terminated on their respective patch panels, with jacks on the panels labeled in ascending room number order. All horizontal cables from same room should be terminated in sequential order at the patch panels.

   e.g. Single 4-pair cables will be labeled with a room location and a jack designation. e.g. 1137-A = a single data jack in Room 1137.

2. Size of letters and numbers on labels for patch panels shall be no less than 3/32” high by 1/16” wide.

H. Faceplate Labeling:

1. At the rooms, the jacks will be labeled on the faceplates using the plastic insert to cover a printed identification tag with room number and proper jack designation as follows:

   a. Jack designation: Data = A through ZZ, Telephone = 1 through 999.

      e.g. 1195-A = 1st data jack in Room 1195, 1195-B = 2nd data jack in Room 1195, ....1195-AA = 27th data jack in Room 1195, 1195-AB = 28th data jack in Room 1195.

      e.g. 1195-1 = 1st voice jack in Room 1195.

      Size of letters and numbers on labels for faceplates shall be no less than 3/8” high.

   b. At the rooms, the fiber jacks will be labeled on the faceplates using the plastic insert to cover a printed identification tag with room number and proper jack designation as follows:

      Jack designation: Fiber = A through ZZ.

      e.g. 1195FOM-A = 1st multimode fiber jack in Room 1195, 1195FOM-B = 2nd multimode fiber jack in Room 1195, 1195FOM-AA = 27th multimode fiber jack in Room 1195, 1195FOM-AB = 28th multimode fiber jack in Room 1195.

   c. At the rooms, the coax jacks will be labeled on the faceplates using the plastic insert to cover a printed identification tag with room number and proper jack designation as follows:

      Jack designation: TVrm#-1

      e.g. TV236SE-1, 1st coax jack in room 236SE

I. Wall Mounted Fiber Box Labeling:
1. All wall mounted fiber termination boxes shall be labeled with cable information on the inside of the fiber termination box door using manufacturer’s label.

J. Equipment Frame Fiber Enclosure Labeling:
1. All equipment frame fiber enclosures shall be labeled with cable information on the labeling panel below the enclosure using manufacturer’s label.
2. All frame labeling shall be coordinated with Purdue IT Infrastructure Services Representative prior to label placement.

K. Wireless Access Point PICs:
1. The PICs installed for wireless access points (APs) shall be labeled as follows:
   a. At the BDF/IDF end, data horizontal cables shall be labeled with the information indicating termination of the opposite end of the cables. This shall include room location and jack designation. Place label on a visible part of cable within 12” of termination point for ease of identification after termination.
      e.g. At the BDF/IDF end the 4-pair data cable for the WAP in room 1137 would be labeled: 1137AP-A and 1137AP-B
      Size of letters and numbers shall be no less than 5/16” high by 1/8” wide.
   b. At the rooms, the horizontal cables shall be labeled 4” from termination with the following: BDF/IDF TR Room # - Room #AP - Jack
   c. Note: The WAP PICs shall be labeled in each room starting from A/B. These PICs do not fall within the alphanumeric order of the normal PICs within the same room.

3.02 SPECIAL LABELING INSTALLATIONS

A. Contractor is responsible for contacting a Purdue IT Infrastructure Services Representative so that Purdue may provide instruction for labeling of elevator phones, fire alarms, ETS phones, Fiber Optic PICs, and other special circuits. Failure to contact a Purdue IT Infrastructure Services Representative to clarify labeling requirements may result in re-labeling at the cost of the contractor. Submission of a RFI is required to document that contact with a Purdue IT Infrastructure Services Representative was made.

B. Departmental cables where data is distribute within the same room and not from the BDF or IDF shall be labeled as follows:
   a. At the remote equipment cabinet or enclosure, data horizontal cables are terminated on their respective patch panels, with jacks on the panels labeled in alphabetic order.
   b. At the outlets, identification would begin with the first receptacle to the left of the main entrance to the room and continuing clockwise around the room.
e.g. Single 4-pair cable will be labeled with a jack designation. DPT-A = a single data jack within the room. DPT-B = next jack within the room. Place label on visible part of the cable within 4” of the termination.

C. Departmental cables shall be labeled differently than cables distributed from the telecom room so they can easily be identified.

D. Above Ceiling PICs for applications other than wireless access points shall be labeled as Room #AC - Jack and Room # - Jack

  e.g. At the BDF/IDF end the 4-pair data cable for the above ceiling data PIC in room 1137 would be labeled: 1137AC-A and 1137AC-B

  Note: The above ceiling PICs shall be labeled in each room starting from A/B. These PICs do not fall within the alphanumeric order of the normal PICs within the same room.

3.03 PIC RELABELING

A. Contractor is responsible for re-labeling all existing PICs that are moved or changed. This includes but is not limited to any PICs with rooms in which the room number has changed as part of the construction project. This also includes all termination hardware (110 blocks, patch panels, cables, and faceplates). All PIC relabeling shall follow the guidelines within this section. Existing identification shall be recorded and submitted with as-built documentation. Old labels shall be completely removed and replaced with new labels when PICs require re-labeling.
PART 1: GENERAL

The Contractor is held responsible to be familiar with the provisions contained herein and with other Sections of this Specification as applicable to the completion of the installation.

1.01 SCOPE OF WORK

A. Work covered by this Section shall consist of furnishing labor, equipment, supplies, and materials unless otherwise specified, and in performing the following operations recognized as necessary for the installation, termination, and labeling of all telecommunications infrastructure as described on the Drawings and/or required by these specifications.

1.02 RELATED SECTIONS

A. Division 27, Section 270526 Grounding and Bonding for Communication Systems.
B. Division 27, Section 270528 Pathways for Communication Systems.
C. Division 27, Section 270553 Identification for Communication Systems.
D. Division 27, Section 271116 Communications Cabinets, Frames, Racks, and Enclosures.
E. Division 27, Section 271119 Communications Termination Blocks and Patch Panels.
F. Division 27, Section 271313 Communications Copper Backbone Cabling.
G. Division 27, Section 271323 Communications Optical Fiber Backbone Cabling.
H. Division 27, Section 271333 Communications Coaxial Backbone Cabling.
I. Division 27, Section 271513 Communications Copper Horizontal Cabling.
J. Division 27, Section 271523 Communications Optical Fiber Horizontal Cabling.
K. Division 27, Section 271533 Communications Coaxial Horizontal Cabling.
L. Division 27, Section 271543 Communications Faceplates and Connectors.

1.03 INTENT OF DRAWINGS AND SPECIFICATIONS

A. These Specifications, together with the Drawings accompanying them, are intended to depict the installation requirements necessary to support this Project. Contractor shall furnish materials shown and/or called for on the Drawings but not mentioned in the Specifications, or vice versa, that are necessary for the installation and support of communications cabling, whether or not specifically called for in both. In addition, Contractor shall provide incidental equipment and materials required for the completion of systems included in this contract whether or not specified or shown on the Drawings.
PART 2: PRODUCTS

It is Purdue’s expectation that the A/E of Record will work jointly with Purdue’s Telecommunication representatives to address specific technical issues and Owner requirements. All questions, deviations, comments concerning guideline(s) interpretation, content, and/or use must be submitted in writing to the Project Manager for approval. No deviations from these guidelines shall be incorporated into the project without written approval from the Project Manager and Purdue Telecommunications representative.

Except as otherwise indicated, provide metal cable trays, of types, classes and sizes indicated; with splice plates, bolts, nuts and washers for connecting units. Construct units with rounded edges and smooth surfaces; in compliance with applicable standards; and with the following additional construction features.

2.01 PRODUCT STANDARDS

A. All materials shall conform with the current applicable industry standards including, but not limited to:

1. NEMA (National Electrical Manufacturers’ Association)
2. ANSI (American National Standards Institute)
3. ASTM (American Society for Testing and Materials)
4. ICEA (Insulated Cable Engineers Association)
5. IEEE (Institute of Electrical and Electronic Engineers)
6. NESC (National Electrical Safety Code)
7. NEC (National Electrical Code)

B. In addition, all Material shall be Underwriters Laboratories Listed unless otherwise indicated.

C. All products must be new.

2.02 TELECOMMUNICATIONS ROOM PLYWOOD

A. 3/4” fire retardant plywood, grade B-B.

2.03 TELECOMMUNICATIONS ROOM CABLE TRAY

A. Ladder type trays shall consist of two longitudinal members (side rails) with transverse members (rungs) welded to the side rails. Rungs shall be spaced 12 inches on center. Spacing in radiused fittings shall be 9 inches and measured at the center of the tray’s width. Rungs shall have a minimum cable-bearing surface of 7/8 inch with radiused edges. No portion of the rungs shall protrude below the bottom plane of the side rails. Each rung must be capable of supporting the maximum cable load, with a safety factor of 1.5 and a 200 pound concentrated load when tested in accordance with NEMA VE-1, section 5.4.

B. Owner approved butt-splice straight clamp kit for 1 ½” runway height single stringer straight splices.

C. Owner approved 90-degree junction splice clamp kit for 1 ½” runway height.
D. Owner approved 1x7¼ ground strap to bond each section of cable tray together.

E. Owner approved adjustable corner support kit for 1½” runway

F. Owner approved drop-out (waterfall) for 12” cable tray to maintain proper bending radius for cables exiting/entering tray.

G. Owner approved wall angle support kit for terminating end of 12” cable tray to wall or Owner approved equal.

H. Owner approved wall support kit for mounting 12” cable tray to wall.

I. Owner approved runway support clip for hanging 12” cable tray using threaded rod.

J. Owner approved runway hold-down clamp kit for surface mounting 1 ½” cable tray to wall.

K. Owner approved relay rack support junction plate to attach 12” horizontal cable tray to equipment frames.

L. Owner approved 4 ¼”, 3/8”-16 thread J-bolt assemblies for mounting cable tray to shelf brackets and wall angle assemblies.

M. Owner approved cable runway feet for 1 ½” runway height with 9/16” hole in order to secure cable tray to floor.

2.04 TELECOMMUNICATIONS ROOM D-RINGS

A. Panduit #CMVDR1, plastic vertical d-rings for Owner furnished cross-connects.

B. Panduit #CMVDR2, plastic vertical d-rings for horizontal cable management on plywood.

PART 3: EXECUTION

3.01 TELECOMMUNICATIONS ROOM FINISHES

A. New TRs must be free from dust, dirt, and other foreign materials before the installation of any termination hardware or the termination of copper or fiber optic cables. The door to the telecommunication rooms must be permanently installed and closed during termination.

B. Each Contractor shall be knowledgeable of work to be performed by other trades and take necessary steps to integrate and coordinate their work with other trades.

C. The Contractor shall be responsible for furnishing all materials on the drawings or as specified herein for a complete telecommunications system.

D. All telecommunications infrastructure shall be installed utilizing BICSI installation practices in an aesthetically pleasing and organized fashion. All surface raceway in new buildings must be approved by a Purdue IT Infrastructure Services Representative.

E. All telecommunications infrastructure shall be installed for optimal performance.

F. All telecommunications infrastructure shall be installed to accommodate future moves,
adds, and changes.

G. All work performed in occupied spaces shall be in a manner that allows the Owner to operate the existing facilities on a continuous basis.

H. All user outages, including wireless access points, shall be submitted to the Purdue Infrastructure Services Department for approval (1) week before starting work that will affect user connectivity.

3.02 BACKBOARDS

A. Install 3/4" fire-retardant plywood horizontally on all walls from 2'-0" to 6'-0"AFF. Plywood shall not be painted.

B. No mechanical/electrical equipment or conduits shall be installed on or across the plywood or impair the routing of telecommunication cables.

C. Fire-retardant stamp to be visible.

3.03 CABLE TRAY

A. Install cable tray around entire perimeter of telecommunications room.

B. Install cable tray above all equipment frames and securely attach both ends of cable tray to perimeter cable tray around room. Cable tray and equipment frame shall be secured to each other so that the top of the equipment frame cannot move.

C. Install horizontal cable tray at 7' 2" AFF to the bottom of the tray. Contact a Purdue Infrastructure Services Representative if there are conflicts in mounting heights.

D. Install additional horizontal and vertical sections of cable tray on walls where OSP cables, riser cables, and large bundles of horizontal cables route from conduits entering/exiting the room. Provide waterfall devices at the transition from horizontal to vertical cable routing.

E. Horizontal cable tray routed around perimeter of the BDF room shall be installed in such a way that the route for future “unprotected” OSP cabling does not pass through, on, or in front of the cable tray containing “unprotected” UTP cabling.

3.04 ELECTRICAL OUTLETS

A. Affix thermal label to all electrical outlet covers indicating circuit number and panel of origin.

B. Electrical outlets designated for UPS units located behind equipment frames shall have thermal label indicating reading “UPS only” and contain the circuit number and panel of origin.

C. Electrical outlets designated for service use shall have thermal label indicating reading “Service Use” and contain the circuit number and panel of origin.

D. Each circuit serving the telecommunication room shall have a critical circuit tag affixed adjacent to breaker/switch. Panel schedules/directories shall be labeled to indicate the outlets within the telecommunications room.

3.05 WIRE MANAGEMENT

A. Install D-rings on plywood as specified herein or shown on drawings.
B. Install D-rings horizontally and vertically on plywood backboard to manage horizontal cabling from the cable tray to the 110 blocks for voice.

C. Install D-rings horizontally and vertically on plywood backboard to manage Owner furnished and installed voice cross-connects.

D. Install D-rings horizontally and vertically on plywood backboard to manage horizontal cables that enter the telecommunications room from below up to the cable tray. Route these horizontal cables to the nearest corner of the room to maximize wall space.
PART 1: GENERAL

1.01 SCOPE OF WORK

A. Work covered by this Section shall consist of furnishing labor, equipment, supplies, and materials unless otherwise specified, and in performing the following operations recognized as necessary for the installation, termination, and labeling of telecommunications cabinets, racks, frames, and enclosures as described on the Drawings and/or required by these specifications.

1.02 RELATED SECTIONS

A. Division 27, Section 271119 Communications Termination Blocks and Patch Panels.
B. Division 27, Section 271323 Communications Optical Fiber Backbone Cabling.
C. Division 27, Section 271513 Communications Copper Horizontal Cabling.
D. Division 27, Section 271523 Communications Optical Fiber Horizontal Cabling.

PART 2: PRODUCTS

It is Purdue’s expectation that the A/E of Record will work jointly with Purdue’s Telecommunication representatives to address specific technical issues and Owner requirements. All questions, deviations, comments concerning guideline(s) interpretation, content, and/or use must be submitted in writing to the Project Manager for approval. No deviations from these guidelines shall be incorporated into the project without written approval from the Project Manager and Purdue Telecommunications representative.

2.01 EQUIPMENT FRAMES

A. Equipment Frames shall be owner-approved 19” wide x 7’-0” high, aluminum construction powder coated black.
B. Junction plate at top of equipment frame shall be able to accommodate runway in parallel or perpendicular arrangement and shall provide adequate support to stabilize the frame.

2.02 REMOTE EQUIPMENT CABINETS FOR DEPARTMENTAL CABLING

A. Remote equipment cabinets shall be Hubbell #RE2 or Owner approved equal for data connections under 24 ports/outlets.
B. Remote equipment cabinets shall be Hubbell #RE4 or Owner approved equal for data connections between 25-72 ports/outlets.

2.03 REMOTE EQUIPMENT CABINETS FOR SMALL TELECOM ROOM (ITAP)

A. Remote equipment cabinets shall be Hubbell #RE4X or Owner approved equal for voice and/or data connections between 25-72 ports/outlets.
PART 3: EXECUTION

3.01 EQUIPMENT FRAME INSTALLATION

A. Provide equipment racks as needed to mount patch panels, equipment, etc. as specified herein.

B. Provide a junction plate at top of equipment rack and required cable runway to attach rack to cable runway around the perimeter of the telecom room.

C. The completed equipment frame will be affixed to the floor using drop-in anchors and 5/8-inch zinc-plated hex bolts, split and flat washers. Place the equipment frame in the telecom room to ensure that it is aligned with existing equipment frames, or such that the “front” mounting holes on the channels of the equipment frame are installed with the long axis 4 feet from the parallel wall, and space allowing, 3 feet from any adjacent wall. This is to ensure at least 36 inches of clearance completely around the equipment frame once termination and electronics are installed in the equipment frame.

D. Install the junction plates above all equipment racks and attach to cable runway that is installed around the perimeter of the telecom room. Junction plate must be fastened to frame without using “J” bolts so that no equipment space is lost.

E. Confirm equipment frame location with Purdue’s IT Infrastructure Services Representative prior to installation unless exact location is shown on the drawings.

3.02 REMOTE EQUIPMENT CABINETS

A. Provide remote equipment cabinets as needed to mount patch panels, equipment, etc. as specified herein or as shown on drawings.

B. Remote equipment cabinets shall contain horizontal cable management for patch panels similar to frame mounted installations.

C. Cabling distributed from a remote equipment cabinet within a room shall not leave the room.
PART 1: GENERAL

1.01 SCOPE OF WORK

A. Work covered by this Section shall consist of furnishing labor, equipment, supplies, materials, and testing unless otherwise specified, and in performing the following operations recognized as necessary for the installation, termination, and labeling of termination blocks and patch panels as described on the Drawings and/or required by these specifications.

1.02 RELATED SECTIONS

A. Division 27, Section 270553 Identification for Communication Systems.
B. Division 27, Section 271116 Communications Cabinets, Frames, Racks, and Enclosures.
C. Division 27, Section 271413 Communications Copper Riser Cabling.
D. Division 27, Section 271423 Communications Optical Fiber Riser Cabling.
E. Division 27, Section 271513 Communications Copper Horizontal Cabling.
F. Division 27, Section 271523 Communications Optical Fiber Horizontal Cabling.

PART 2: PRODUCTS

It is Purdue’s expectation that the A/E of Record will work jointly with Purdue’s Telecommunication representatives to address specific technical issues and Owner requirements. All questions, deviations, comments concerning guideline(s) interpretation, content, and/or use must be submitted in writing to the Project Manager for approval. No deviations from these guidelines shall be incorporated into the project without written approval from the Project Manager and Purdue Telecommunications representative.

2.01 PANDUIT 110 BLOCKS

A. 110 Termination Blocks for Copper Riser Cables
   1. Panduit #P110KB1005Y, field termination kit
      a. Field termination kit includes wiring block, (20) 5-pair connector blocks, and labels.
   2. Panduit #P110BW100-X, 110 Block
   3. Panduit #P110CB5-XY, 5-pair 110 Connecting Block
   4. Panduit #P110LH, Designation Label Holder
   5. Panduit #DSL110, 110 Designation Labels
27 1119 – Termination Blocks and Patch Panels

D. 110 Termination Blocks for Copper Horizontal Cables
   a. Panduit #P110KB1004Y, field termination kit
      i. Field termination kit includes wiring block, (20) 4-pair connector blocks, (4) 5-pair connector block, and labels.
   b. Panduit #P110BW100-X, 110 Block
   c. Panduit #P110CB4-XY, 4-pair 110 Connecting Block
   d. Panduit #P110LH, Designation Label Holder
   e. Panduit #DSL110, 110 Designation Labels

2.02 PANDUIT PATCH PANELS
   A. Where Category 6 cabling is required:
      1. Panduit #DP24688TGY, Category 6, T568B wired patch panel, with 24 Panduit #CIDGD-C/N, gold icons.
   B. Where Category 5e cabling is required:
      1. Panduit #DP245E88TGY, Category 5E, T568B wired patch panel.

2.03 WALL MOUNT BRACKET FOR PATCH PANELS
   A. Panduit #WBH3 or owner-approved hinged 3 RU and 6” deep minimum wall mounted bracket

2.04 WIRE MANAGEMENT FOR EQUIPMENT FRAMES
   A. Horizontal Wire Management for copper
      1. Panduit #WMPH2E
   B. Vertical Wire Management
      1. Panduit #WMPVHC45E wire management
      2. Panduit #WMPVCBE bracket kit required for wire management between adjacent frames

2.05 TELECOMMUNICATIONS WIRE MANAGEMENT
   A. Panduit #CMVDR1, Plastic D-rings for Owner furnished cross connects.
   B. Panduit #CMVDR2, Plastic D-rings for Horizontal Cable Management on plywood.

2.06 FIBER ENCLOSURES
   A. Wall Mounted Fiber Enclosures
      1. Corning Cable Systems #WIC-02P fiber enclosure
      2. Corning #CCH-CP12-E7, 12-port duplex SC style LO multimode panels
      3. Corning #CCH-CP12-59, 12-port duplex SC style single-mode panels
   B. Frame Mounted Fiber Enclosures for Riser and Horizontal Fiber
      1. Corning Cable Systems #CCH-02U fiber enclosure for 2-48 fiber strands
2. Corning Cable Systems #CCH-03U fiber enclosure for 49-72 fiber strands
3. Corning Cable Systems #CCH-04U fiber enclosure for 73-144 fiber strands
4. Corning #CCH-CP12-E7, 12-port duplex SC style LO multimode panels
5. Corning #CCH-CP12-59, 12-port duplex SC style single-mode panels
C. Provide the appropriate quantity of 12-port panels to match the fiber strand count that will be supplied to each fiber enclosure.

PART 3: EXECUTION

3.01 110-BLOCK INSTALLATION
A. The telecommunications rooms shall contain wiring blocks as required to terminate all incoming pairs and all outgoing pairs.
B. Locate telephone wiring blocks on fire-treated plywood backboards as specified on the Drawings or as specified herein.
C. BDF block labeling for riser cables shall designate the corresponding destination IDF wiring block.
D. BDF/IDF terminal boards shall be equipped with “D” rings for horizontal and vertical wire management as directed by Purdue’s IT Infrastructure Services Representative.
E. Horizontally separate 110 blocks 12” apart for horizontal cable by floor. Start 110 blocks 6” from the top of the backboard. In the BDF, horizontally separate 110 blocks 12” away from entrance protectors. If entrance protectors are not installed, leave enough space as specified above (protector dimension= 14.75” width by 11” height). See 3.01 Attachment #1.
F. Horizontal cables shall enter new 110 blocks from the left side. Cables shall not be routed behind 110 blocks. In cases where existing cables have been routed behind the 110 blocks, contact Purdue’s IT Infrastructure Services Representative before proceeding with new cable installation.
G. Telecommunication rooms feeding multiple floors
   1. Install 110 blocks for each floor in a separate vertical row with each row separated 12” apart horizontally. See 3.01 Attachment #1.
H. When terminating new cabling on existing 110 blocks, PICs in the same room shall be punched down on adjacent 4-pair connecting blocks and the rooms shall be in as close to numerical order as practical.

3.02 PATCH PANEL INSTALLATION
A. Each telecom room shall contain patch panels as required to terminate all pairs on its respective floor or floors served.
B. Locate data patch panels in 19” equipment frames as specified on the drawings or as specified herein.
C. Patch panels and wire management to be mounted in equipment frames no higher than 6’-0” A.F.F. and no lower than 3’-6” (42”) A.F.F.
D. Alternate (2) patch panels with horizontal wire management panels in equipment frame.

E. Where additional equipment frames are required, separate the frames using one vertical cable management device.

F. Include vertical cable management on both sides of every equipment frame.

G. Patch panels for buildings with a telecom room too small for an equipment frame shall utilize hinged, wall mountable brackets to mount the horizontal wire management and patch panels.

H. Patch panels shall match the category of cabling installed on the project. This may require the contractor to purchase additional patch panels.

3.03 FIBER PANEL INSTALLATION

A. Wall Mounted Installations
   1. Mount fiber enclosures on the wall adjacent or next to equipment frame where applicable. Verify WIC box use and location with Purdue’s IT Infrastructure Services Representative unless otherwise shown on the drawings.
   2. Enclosures for multimode fiber to be complete with multimode SC connector panels.
   3. Enclosures for single-mode fiber to be complete with single-mode SC connector panels.
   4. Wall mounted fiber enclosure installations are only to be used when the telecommunications room does not have adequate space for an equipment frame. Consult with Purdue’s IT Infrastructure Services Representative before installing wall mounted fiber enclosures.

B. Equipment Frame Installations
   1. Install frame mounted fiber enclosures at the top of the equipment frames where applicable. Verify frame mounted fiber enclosure use and location with Purdue’s IT Infrastructure Services Representative unless otherwise shown on the drawings.
   2. Install horizontal fiber management panel for every frame mounted fiber enclosure used. Alternate fiber enclosure panels with the fiber management panels.
   3. Allow 8 inches at the top of the mountable portion of the BDF equipment frame when outside plant fiber has not yet been installed.
   4. In the BDF, install:
      a. (1) Corning Cable Systems #CCH-02U for buildings containing (1-2) IDFs.
      b. (1) Corning Cable Systems #CCH-03U for buildings containing (3) IDFs.
      c. (1) Corning Cable Systems #CCH-04U for buildings containing (4-6) IDFs. Additional CCH-04U housings would be needed for buildings containing over six IDFs.
5. Enclosures for multimode fiber to utilize (1) Corning 12-port duplex SC style MM panels per 12-strand multimode fiber. Enclosures for single-mode fiber to utilize (1) Corning 12-port duplex SC style SM panels per 12-strand single-mode fiber. Single-mode fiber to be installed on the left side of all CCH panels while multimode fiber is to be installed on the right hand side of the panels. Verify frame mounted fiber enclosure layout with Purdue’s IT Infrastructure Services Representative unless otherwise shown on the drawings.

6. In the IDF’s, install:
   a. (1) Corning Cable Systems horizontal fiber wire management at the top of the equipment frame.
   b. (1) Corning Cable Systems #CCH-02U for single-mode and multimode fiber terminations. Enclosures for multimode fiber to utilize (1) Corning 12-port duplex SC style MM panels per 12-strand multimode fiber. Enclosures for single-mode fiber to utilize (1) Corning 12-port duplex SC style SM panels per 12-strand single-mode fiber. Single-mode fiber to be installed on the left side of all CCH panels while multimode fiber is to be installed on the right hand side of the panels.

7. Purdue’s IT Infrastructure Services Representative shall provide location for mounting enclosures if not shown on drawings. Typically Multi-mode fiber and Single-mode fiber is always terminated in a frame mounted CCH panel in every telecommunications room unless an equipment frame is not present within the room.
TYPICAL BDF LAYOUT

- 1st floor risers
- 2nd floor risers
- horizontal cables distributed from BDF if specified
- entrance protectors
- backboard
- D-rings
PART 1: GENERAL

The Contractor is held responsible to be familiar with the provisions contained herein and with other Sections of this Specification as applicable to the completion of the installation.

1.01 SCOPE OF WORK

A. Work covered by this Section shall consist of furnishing labor, equipment, supplies, materials, and testing unless otherwise specified, and in performing the following operations recognized as necessary for the installation, termination, and labeling of copper riser infrastructure as described on the Drawings and/or required by these specifications.

1.02 RELATED SECTIONS

A. Division 27, Section 270528 Pathways for Communication Systems.
B. Division 27, Section 270553 Identification for Communication Systems.
C. Division 27, Section 271116 Communications Cabinets, Racks, Frames, and Enclosures.
D. Division 27, Section 271119 Communications Termination Blocks and Patch Panels.
E. Division 27, Section 271313 Communications Copper Backbone Cabling.
F. Division 27, Section 271323 Communications Optical Fiber Backbone Cabling.
G. Division 27, Section 271333 Communications Coaxial Backbone Cabling.
H. Division 27, Section 271423 Communications Optical Fiber Riser Cabling.
I. Division 27, Section 271433 Communications Coaxial Riser Cabling.
J. Division 27, Section 271523 Communications Optical Fiber Horizontal Cabling.
K. Division 27, Section 271533 Communications Coaxial Horizontal Cabling.
L. Division 27, Section 271543 Communications Faceplates and Connectors.

PART 2: PRODUCTS

It is Purdue’s expectation that the A/E of Record will work jointly with Purdue’s Telecommunication representatives to address specific technical issues and Owner requirements. All questions, deviations, comments concerning guideline(s) interpretation, content, and/or use must be submitted in writing to the Project Manager for approval. No deviations from these guidelines shall be incorporated into the project without written approval from the Project Manager and Purdue Telecommunications representative.

2.01 COPPER RISER CABLING

A. Riser Cable (Voice) - Provide riser cables from the BDF to each IDF as indicated on Drawings or as indicated herein.
   1. Riser cables shall consist of twenty-five, and/or fifty, and/or one hundred unshielded twisted pairs, 24 gauge, solid copper, S-R PVC insulated
PART 3: EXECUTION

3.01 TELECOMMUNICATIONS INSTALLATION

A. General:

1. This Section describes the installation locations for the products and materials, as well as methods and Owner’s Standards associated with the Telecommunications Installation portions of the Project. These Specifications, along with the drawings and other Owner supplied specifications shall be followed during the course of the installation.

2. The Contractor is instructed to coordinate his efforts with the other tradesmen who may be working within the same vicinity to avoid conflict and lost time.

3. The Contractor is required to supply all necessary tools, equipment, accessories, safety equipment, protective clothing, etc., as customary for the craft and necessary for the installation.

4. The Contractor shall verify space requirements and locations with Purdue IT Infrastructure Services Representative before starting cable installations and terminations.

5. The Contractor shall verify the cable type and jacket rating required with a Purdue IT Infrastructure Services Representative before starting riser cable installation.

6. The Contractor shall verify existing cable fill in riser conduit before installation of additional cables so as not to exceed 40% cable fill. Contractor will be responsible for installation of additional riser conduit, where additional cables to be added will exceed the 40% cable fill.

3.02 RISER CONDUITS

A. Provide a nylon pull cord in each empty conduit to facilitate future installation of cables.

B. Communication pathways requiring fire stopping shall utilize removable/re-usable fire stopping putties for ease of moves, adds, and changes.

C. All fire stopping penetrations shall conform to the recommended practices listed in UL1479 or ASTM E814 and must be labeled with the UL1479 or ASTM E814 reference number, dated, and signed by the technician who installed the fire stopping material.

3.03 COPPER RISER CABLING

A. The copper riser cabling will be terminated at the BDF and IDFs on S110 type wiring blocks.

B. Horizontal cabling shall be terminated such that wire pair twists are maintained as...
closely as possible to the point of mechanical termination. (No greater than 0.5” for category 5E.)

C. Maximum strip length shall be 1.0” or less. Maintain cable sheath to leading edge of connector block.

D. Contractor is responsible to obtain and follow installation instructions for Panduit products for correct termination and wire management of cables on respective products.

E. Owner to provide future cross-connect terminations to Campus switch.

F. ARMM cable shall be bonded to the grounding busbar within the telecommunications room at each end of the cable with a #6 AWG. Provide Preformed Line Products #8000745 Morey shield connector or Owner approved equal to make connection to the cable shielding.

3.04 WIRING COLOR CODES

A. Wiring Color Code - Unshielded Data Riser Cable and telephone trunk cable.  
   Note: Riser cables greater than 25 pair have same color code with different binder ribbon for each 25 pair group.

B. Wire to ANSI/TIA/EIA standards.

3.05 GENERAL CABLE INSTALLATION

A. Cable bends shall not be greater than recommended by the manufacturer of the cable.

B. Care shall be taken so as not to damage cable during the installation process and that manufacturer's pull tension specification is not exceeded.

C. Provide a minimum 8'-0” and maximum 10'-0” of slack. Loop at the TRs to be contained in the cable tray. Smaller slack loops may be required at BDF cabinets due to space constraints.

D. Within TRs, cables shall be snugly wrapped using Velcro reusable cable ties, a minimum of every 3'-0” for cable organization. Wire ties shall be tightened so as not to deform cable jackets and thus affect cable performance. Plastic cable tie wraps shall not be used.

E. Cable fill capacity in riser conduits shall not exceed 40% cable fill.

F. New TRs must be free from dust, dirt, and other foreign materials before the installation of any termination hardware or the termination of copper or fiber optic cables. The door to the telecommunication rooms must be installed and closed during termination.

3.06 CABLE TESTING

A. A 100% verification by Purdue personnel of all copper riser cable tests is required. Contractor shall notify the Purdue Information Technology Telecommunications Representative before the start of testing. Contractor may request Purdue personnel to accompany them in the testing of cables to ensure proper information entry into the Fluke DTX cable analyzer. If Purdue personnel accompany the Contractor on testing, verification shall not be performed.
B. The vertical multiple pair copper riser cables shall be tested utilizing an Independent Technologies, Inc. Test-All IV, Model ITC-302, Independent Technologies, Inc. Test-All 25, or Purdue IT Telecommunications approved equal, 4-pair or 25-pair communications and data network tester that enables the user to test 4-pair or 25-pair simultaneously. This should have attachments to enable direct testing of 110 wiring blocks. Cable Test Results shall be submitted in Fluke Linkware (.flw) format on a CD at the end of the project. These are to consist of individual wiremap tests. Purdue IT Infrastructure Services Department will expedite activation of service before substantial completion if test results are submitted electronically via email. Purdue IT Infrastructure Services Department will perform 100% verification testing as part of acceptance of copper riser tests.

3.07 EQUIPMENT INSTALLATION AND CABLE TERMINATIONS

A. All equipment shall be installed in a neat and workmanlike manner, arranged for convenient operation, testing and future maintenance.

B. All paired cables shall be installed and terminated by technicians experienced in the termination of cables on connector blocks.

C. The Contractor shall employ certified system installation technicians and have at least 5 years experience in the installation of similar and equivalent systems.

D. The Contractor shall supply verification of experience, for this type of work, to the Architect for approval before performing any work.

3.08 AS-BUILT INFORMATION

A. Contractor shall provide as-built information and all test result information to the Purdue IT Infrastructure Services Department.

B. As-built information shall be in red-lined format on a copy of construction drawings. Indicate location of all riser conduit routes, distribution cable trays, junction boxes, and all additions and deletions pertaining to telecommunications. Include riser labeling next to all telecom symbols.

C. If construction drawings are not utilized, Contractor shall provide all telecommunications location information on an accurate scaled floor plan.

D. Contractor shall perform all labeling requirements and provide testing documentation for verification as described herein.

E. Contractor shall submit cable records to reflect all moves, adds, and changes.

F. Contractor shall provide floor plans showing locations of all telecommunication outlets and spaces.
PART 1: GENERAL

1.01 SCOPE OF WORK

A. Work covered by this Section shall consist of furnishing labor, equipment, supplies, materials, and testing unless otherwise specified, and in performing the following operations recognized as necessary for the installation, termination, and labeling of optic fiber riser infrastructure as described on the Drawings and/or required by these specifications.

1.02 RELATED SECTIONS

A. Division 27, Section 270528 Pathways for Communication Systems.
B. Division 27, Section 270553 Identification for Communication Systems.
C. Division 27, Section 271116 Communications Cabinets, Frames, Racks, and Enclosures.
D. Division 27, Section 271119 Communications Termination Blocks and Patch Panels.
E. Division 27, Section 271313 Communications Copper Backbone Cabling.
F. Division 27, Section 271323 Communications Optical Fiber Backbone Cabling.
G. Division 27, Section 271333 Communications Coaxial Backbone Cabling.
H. Division 27, Section 271413 Communications Copper Riser Cabling.
I. Division 27, Section 271433 Communications Coaxial Riser Cabling.
J. Division 27, Section 271523 Communications Optical Fiber Horizontal Cabling.
K. Division 27, Section 271533 Communications Coaxial Horizontal Cabling.
L. Division 27, Section 271543 Communications Faceplates and Connectors.

PART 2: PRODUCTS

It is Purdue’s expectation that the A/E of Record will work jointly with Purdue’s Telecommunication representatives to address specific technical issues and Owner requirements. All questions, deviations, comments concerning guideline(s) interpretation, content, and/or use must be submitted in writing to the Project Manager for approval. No deviations from these guidelines shall be incorporated into the project without written approval from the Project Manager and Purdue Telecommunications representative.

2.01 FIBER OPTIC RISER CABLING

A. Multimode Fiber Optic Riser Cable (Data) - Provide backbone cables from the BDF to each data IDF as indicated on Drawings.
   1. General:
a. The optical fiber cable construction shall consist of 50/125 \( \mu \text{m} \) laser-optimized multimode optical fibers, typically formed into groups of 6 or 12 fibers each. These groups and individual fibers shall be identifiable in accordance with ANSI/EIA/TIA-598. These groups consist of individually jacketed 900\( \mu \text{m} \) tight buffered fiber strands around a dielectric central member with a flame-retardant outer jacket to form a protective sheath.

b. The function of optical fiber cables is to provide a compact, low loss, broad bandwidth transmission medium suitable for the transmission of voice, video, and high-speed data signals under adverse electrical and environmental conditions.

2. Optical Specifications:
   a. Attenuation:
      (1) The maximum attenuation of each multimode optical fiber within a cable, when normalized to a length of 1 kilometer, shall conform with the following attenuation:
      \[
      \begin{align*}
      &\leq 3.0 \text{ dB/km} @ 850 \text{ nm} \\
      &\leq 1.0 \text{ dB/km} @ 1300 \text{ nm}
      \end{align*}
      \]
      (2) Attenuation values and method of determining attenuation of each fiber shall be provided by cable manufacture and supplied with cable.
   b. Bandwidth:

<table>
<thead>
<tr>
<th>Wavelength (nm)</th>
<th>Maximum Attenuation (dB/km)</th>
<th>Transmission Capacity (MHz-km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>850</td>
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<td>1500</td>
</tr>
<tr>
<td>1300</td>
<td>1.0</td>
<td>500</td>
</tr>
</tbody>
</table>

   Note: Bandwidth values and method of determining bandwidth of each fiber shall be provided by cable manufacture and supplied with cable.

c. Core Diameter: The core diameter shall be 50\( \mu \text{m} \).

d. Numerical Aperture: The numeric aperture (far-field radiation pattern) shall be 0.20 ± 0.015.

3. Mechanical Specifications:
   a. The minimum tensile force over the entire length of the fiber shall be equivalent to 100kpsi (0.7 GN/m2).

4. Environmental Requirements:
a. The cable shall be expected to operate and be stored under the following conditions:

(1) Storage temperature range:
   a) Non-plenum: -40° F to +158° F

(2) Installation temperature range:
   a) Non-plenum: +14° F to +140° F
   b) Plenum: +32° F to +140° F

(3) Operating temperature range:
   a) Non-plenum: -4° F to +158° F
   b) Plenum: +32° F to +158° F

5. Each cable shall contain 12 strands.

6. Cable shall be listed as OFNR, Type OM4 fiber.

7. Manufacturer shall be Corning Cable Systems part #012T61-31380-24.

8. Where plenum cable is required, utilize Corning Cable Systems part #012T68-31380-29 listed as OFNP.

B. Single-mode Fiber Optic Riser Cable (Data) - Provide backbone cables from the BDF to each data IDF as indicated on Drawings.

1. General:
   a. The optical fiber cable construction shall consist of 8/125 µm single-mode optical fibers, typically formed into groups of 6 or 12 fibers each. These groups and individual fibers shall be identifiable in accordance with ANSI/EIA/TIA-492CAAA. These groups consist of individually jacketed 900um tight buffered fiber strands around a dielectric central member with a flame-retardant outer jacket to form a protective sheath.
   b. The function of optical fiber cables is to provide a compact, low loss, broad bandwidth transmission medium suitable for the transmission of voice, video, and high-speed data signals under adverse electrical and environmental conditions.

2. Optical Specifications:
   a. Attenuation:
      (1) The maximum attenuation of each single-mode optical fiber within a cable, when normalized to a length of 1 kilometer, shall conform with the following attenuation:
         \[ \leq 1 \text{ dB/km @ 1310 nm} \]
         \[ \leq .75 \text{ dB/km @ 1550 nm} \]
      (2) Attenuation values and method of determining attenuation of each fiber shall be provided by cable manufacture and supplied with cable.

3. Mechanical Specifications:
a. The minimum tensile force over the entire length of the fiber shall be equivalent to 35.1 kg/mm² (50 kpsi).

4. Environmental Requirements:
   a. The cable shall be expected to operate and be stored under the following conditions:
      (1) Storage temperature range:
          a) Non-plenum: -40° F to +158° F
      (2) Installation temperature range:
          a) Non-plenum: +14° F to +140° F
          b) Plenum: +32° F to +140° F
      (3) Operating temperature range:
          a) Non-plenum: -4° F to +158° F
          b) Plenum: +32° F to +158° F

5. Each cable shall contain 12 strands.
6. Cable shall be listed as OFNR.
7. Manufacturer shall be Corning Cable Systems part #012E61-31331-24.
8. Where plenum cable is required, utilize Corning Cable Systems Part #012E68-31331-29 listed as OFNP.

PART 3: EXECUTION

3.01 TELECOMMUNICATIONS INSTALLATION

A. General:
   1. This Section describes the installation locations for the products and materials, as well as methods and Owner’s Standards associated with the Telecommunications Installation portions of the Project. These Specifications, along with the drawings and other Owner supplied specifications shall be followed during the course of the installation.
   2. The Contractor is instructed to coordinate his efforts with the other tradesmen who may be working within the same vicinity to avoid conflict and lost time.
   3. The Contractor is required to supply all necessary tools, equipment, accessories, safety equipment, protective clothing, etc., as customary for the craft and necessary for the installation.
   4. The Contractor shall verify space requirements and locations with a Purdue IT Infrastructure Services Representative before starting cable installations and terminations.
5. The Contractor shall verify the cable type and jacket rating required with a Purdue Information Technology Telecommunications Representative before starting riser cable installation.

6. The Contractor shall verify existing cable fill in riser conduit before installation of additional cables so as not to exceed 40% cable fill. Contractor will be responsible for installation of additional riser conduit, where additional cables to be added will exceed the 40% cable fill.

3.02 RISER CONDUITS

A. Provide a nylon pull cord in each empty conduit to facilitate future installation of cables.

B. Communication pathways requiring fire stopping shall utilize removable/re-usable fire stopping putties for ease of Moves, Adds, and Changes.

C. All fire stopping penetrations shall conform to the recommended practices listed in UL1479 or ASTM E814 and must be labeled with the UL1479 or ASTM E814 reference number, dated, and signed by the technician who installed the fire stopping material.

3.03 RISER FIBER OPTIC CABLING

A. The fiber optic riser cabling will be terminated on either wall mountable fiber enclosures on in frame mountable fiber enclosures. Verify termination type and location with a Purdue IT Telecommunications Representative.

B. Contractor is responsible to obtain and follow installation instructions for fiber products for correct termination and wire management of cables on respective products.

C. Owner to provide future fiber patch cords connections to network equipment.

3.04 FIBER COLOR CODES

A. Fiber Color Code –

Note: Riser cables greater than 12-strand have same color code with different colored tube for each 12-strand group. Tube colors use same color scheme.

<table>
<thead>
<tr>
<th>Table 2</th>
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<tbody>
<tr>
<td>Fiber Color Code</td>
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</tbody>
</table>
3.05 GENERAL CABLE INSTALLATION

A. Cable bends shall not be greater than that recommended by the manufacturer of the cable.

B. Care shall be taken so as not to damage cable during the installation process and that manufacturer's pull tension specification is not exceeded.

C. Provide a minimum 8'-0" and maximum 10'-0" of slack outside the fiber enclosure. Loop at the TRs to be contained on the bottom side of the horizontal cable tray. Additional slack of (4'-6") of 900um is required within the fiber enclosures.

D. Within TRs, cables shall be snugly wrapped using Velcro reusable cable ties, a minimum of every 3'-0" for cable organization. Velcro ties shall be tightened so as not to deform cable jackets and thus affect cable performance. Plastic cable tie wraps shall not be used.

E. Cable fill in riser conduits shall not exceed 40% cable fill.

F. New TRs must be free from dust, dirt, and other foreign materials before the installation of any termination hardware or the termination of fiber optic cables. The door to the telecommunication rooms must be installed and closed during termination.

3.06 CABLE TESTING

A. A 100% verification by Purdue personnel of all fiber riser cable tests is required. Contractor shall notify the Purdue Information Technology Telecommunications Representative before the start of testing. Contractor may request Purdue personnel to accompany them in the testing of cables to ensure proper operation of the light meter. If Purdue personnel accompany the Contractor on testing, verification shall not be performed.

B. The fiber optic cables shall be tested utilizing a power meter and stabilized light source capable of testing at 850 nm and 1300 nm for multimode and 1310nm and 1550nm for single-mode. Contractor shall complete a fiber optic post installation report at the time of testing containing meter readings at both 850 nm and 1300 nm for multimode and 1310nm and 1550nm for single-mode from both directions on each fiber, actual loss and other pertinent data regarding the cables tested, including model and serial number of test equipment, cable part #, installed fiber length, building span loss at 850 nm and 1300 nm for multimode and 1310nm and 1550nm for single-mode and date tested. Testing required is 100%. Place in a 3-ring binder, preceded by a tabbed divider and label as “fiber risers”. Span loss calculations are required on the final test sheet for loss at 850 nm and 1300 nm for multimode and 1310nm and 1550nm for single-mode.

\[(D \times L) + (C \times \# \text{ connectors})\]
The Purdue IT Infrastructure Services Department will perform 100% verification testing as part of acceptance of all fiber optic cable testing.

3.07 EQUIPMENT INSTALLATION AND CABLE TERMINATIONS

A. All equipment shall be installed in a neat and workmanlike manner, arranged for convenient operation, testing and future maintenance.

B. All fiber cables shall be installed and terminated by technicians experienced in the termination of fiber.

C. The Contractor shall employ certified system installation technicians and have at least 5 years experience in the installation of similar and equivalent systems.

D. The Contractor shall supply verification of experience, for this type of work, to the Architect for approval before performing any work.

3.08 AS-BUILT INFORMATION

A. Contractor shall provide as-built information with all test result information to the Purdue IT Infrastructure Services Department.

B. As-built information shall be in red-lined format on a copy of construction drawings. Indicate location of all riser conduit routes, distribution cable trays, junction boxes, and all additions and deletions pertaining to telecommunications. Include riser labeling next to all telecom symbols.

C. If construction drawings are not utilized, Contractor shall provide all telecommunications location information on an accurate scaled floor plan.

D. Contractor shall perform all labeling requirements and provide testing documentation for verification as described herein.

E. Contractor shall submit cable records to reflect all moves, adds, and changes.

F. Contractor shall provide floor plans showing locations of all telecommunication outlets and spaces.
27.1433 – Coaxial Riser Cabling

LAST UPDATE: August 15th, 2014

PART 1: GENERAL

1.01 SCOPE OF WORK

A. Work covered by this Section shall consist of furnishing labor, equipment, supplies, materials, and testing unless otherwise specified, and in performing the following operations recognized as necessary for the installation, termination, and labeling of coaxial riser infrastructure as described on the Drawings and/or required by these specifications.

1.02 RELATED SECTIONS

A. Division 27, Section 270528 Pathways for Communication Systems.
B. Division 27, Section 27053 Identification for Communication Systems.
C. Division 27, Section 271116 Communications Cabinets, Frames, Racks and Enclosures.
D. Division 27, Section 271119 Communications Termination Blocks and Patch Panels.
E. Division 27, Section 271313 Communications Copper Backbone Cabling.
F. Division 27, Section 271323 Communications Optical Fiber Backbone Cabling.
G. Division 27, Section 271333 Communications Coaxial Backbone Cabling.
H. Division 27, Section 271413 Communications Copper Riser Cabling.
I. Division 27, Section 271423 Communications Optical Fiber Riser Cabling.
J. Division 27, Section 271523 Communications Optical Fiber Horizontal Cabling.
K. Division 27, Section 271533 Communications Coaxial Horizontal Cabling.
L. Division 27, Section 271543 Communications Faceplates and Connectors.

PART 2: PRODUCTS

It is Purdue’s expectation that the A/E of Record will work jointly with Purdue’s Telecommunication representatives to address specific technical issues and Owner requirements. All questions, deviations, comments concerning guideline(s) interpretation, content, and/or use must be submitted in writing to the Project Manager for approval. No deviations from these guidelines shall be incorporated into the project without written approval from the Project Manager and Purdue Telecommunications representative.

2.01 COAX RISER CABLEING

A. Riser Cables (CATV) - Provide CATV riser cables from the BDF to each IDF where CATV is to be distributed from.

1. Riser cables shall be Type RG-11, 14 gauge, solid copper center conductor. Plenum-rated.
   b. The manufacturer shall be Belden 1153A.
PART 3: EXECUTION

3.01 TELECOMMUNICATIONS INSTALLATION

A. General:

1. This Section describes the installation locations for the products and materials, as well as methods and Owner’s Standards associated with the Telecommunications Installation portions of the Project. These Specifications, along with the drawings and other Owner supplied specifications shall be followed during the course of the installation.

2. The Contractor is instructed to coordinate his efforts with the other tradesmen who may be working within the same vicinity to avoid conflict and lost time.

3. The Contractor is required to supply all necessary tools, equipment, accessories, safety equipment, protective clothing, etc., as customary for the craft and necessary for the installation.

4. The Contractor shall verify space requirements and locations with a Purdue IT Infrastructure Services Representative before starting cable installations and terminations.

5. The Contractor shall verify the cable type and jacket rating required with a Purdue Information Technology Telecommunications Representative before starting riser cable installation.

6. The Contractor shall verify existing cable fill in riser conduit before installation of additional cables so as not to exceed 40% cable fill. Contractor will be responsible for installation of additional riser conduit, where additional cables to be added will exceed the 40% cable fill.

3.02 RISER CONDUITS

A. Provide a nylon pull cord in each empty conduit to facilitate future installation of cables.

B. Communication pathways requiring fire stopping shall utilize removable/re-usable fire stopping putties for ease of moves, adds, and changes.

C. All fire stopping penetrations shall conform to the recommended practices listed in UL1479 or ASTM E814 and must be labeled with the UL1479 or ASTM E814 reference number, dated, and signed by the technician who installed the fire stopping material.

3.03 RISER COAX CABLEING

A. The riser coax cabling will be terminated at the IDF or BDF on a wall designated by a Purdue IT Telecommunications Representative.

B. Contractor is responsible to obtain and follow installation instructions for Belden products for correct installation and termination of coax cables on respective products.

C. Owner to provide future taps, splitters, and amplifiers.

3.04 GENERAL CABLE INSTALLATION
A. Cable bends shall not be greater than that recommended by the manufacturer of the cable.

B. Care shall be taken so as not to damage cable during the installation process and that manufacturer's pull tension specification is not exceeded.

C. Provide a minimum 8'-0" and maximum 10'-0" of slack. Loop at the TRs to be contained in the cable tray.

D. Within TRs, cables shall be snugly wrapped using Velcro reusable cable ties, a minimum of every 3'-0" for cable organization. Wire ties shall be tightened so as not to deform cable jackets and thus affect cable performance. Plastic cable tie wraps shall not be used.

E. Cable fill in station conduits, skeletal conduits, raceway, and cable tray shall not exceed 40% cable fill.

F. New TRs must be free from dust, dirt, and other foreign materials before the installation of any termination hardware or the termination of copper or fiber optic cables. The door to the telecommunication rooms must be installed and closed during termination.

3.05 CABLE TESTING

A. The vertical CATV riser cables shall be tested utilizing a Fluke DTX or DSX scanner. Test unit shall be set up using RG-6 or RG-11 cable selected, depending on type of cable used. Testing required is 100%. Cable Test Results shall be submitted in Fluke Linkware (.flw) format on a CD at the end of the project. Purdue IT Infrastructure Services Department will expedite activation of service before substantial completion if test results are submitted electronically via email.

3.06 EQUIPMENT INSTALLATION AND CABLE TERMINATIONS

A. All equipment shall be installed in a neat and workmanlike manner, arranged for convenient operation, testing and future maintenance.

B. All coax cables shall be installed and terminated by technicians experienced in the termination of coax cables.

C. The Contractor shall employ certified system installation technicians and have at least 5 years experience in the installation of similar and equivalent systems.

D. The Contractor shall supply verification of experience, for this type of work, to the Architect for approval before performing any work.

3.07 AS-BUILT INFORMATION

A. Contractor shall provide as-built information along with all test result information to the Purdue IT Infrastructure Services Department.

B. As-built information shall be in red-lined format on a copy of construction drawings. Indicate location of all riser conduit routes, distribution cable trays, junction boxes, and all additions and deletions pertaining to telecommunications. Include riser labeling next to all telecom symbols.

C. If construction drawings are not utilized, Contractor shall provide all telecommunications location information on an accurate scaled floor plan.

D. Contractor shall perform all labeling requirements and provide testing documentation...
for verification as described herein.

E. Contractor shall submit cable records to reflect all moves, adds, and changes.

F. Contractor shall provide floor plans showing locations of all telecommunication outlets and spaces.
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PART 1: GENERAL

1.01 SCOPE OF WORK

A. Work covered by this Section shall consist of furnishing labor, equipment, supplies, materials, and testing unless otherwise specified, and in performing the following operations recognized as necessary for the installation, termination, and labeling of copper horizontal cabling infrastructure as described on the Drawings and/or required by these specifications.

1.02 RELATED SECTIONS

A. Division 27, Section 270528 Pathways for Communication Systems.
B. Division 27, Section 270543 Underground Ducts and Raceways for Communication Systems.
C. Division 27, Section 270553 Identification for Communication Systems.
D. Division 27, Section 271116 Communications Cabinets, Frames, Racks, and Enclosures.
E. Division 27, Section 271119 Communications Termination Blocks and Patch Panels.
F. Division 27, Section 271313 Communications Copper Backbone Cabling.
G. Division 27, Section 271323 Communications Optical Fiber Backbone Cabling.
H. Division 27, Section 271333 Communications Coaxial Backbone Cabling.
I. Division 27, Section 271523 Communications Optical Fiber Horizontal Cabling.
J. Division 27, Section 271533 Communications Coaxial Horizontal Cabling.
K. Division 27, Section 271543 Communications Faceplates and Connectors.

PART 2: PRODUCTS

It is Purdue’s expectation that the A/E of Record will work jointly with Purdue’s Telecommunication representatives to address specific technical issues and Owner requirements. All questions, deviations, comments concerning guideline(s) interpretation, content, and/or use must be submitted in writing to the Project Manager for approval. No deviations from these guidelines shall be incorporated into the project without written approval from the Project Manager and Purdue Telecommunications representative.

2.01 GENERAL

A. The materials and products specified herein reflect the minimum acceptable standards of fabrication and manufacture. All materials and products supplied by the Contractor and specified herein are to be new, unused, of first quality and in original packaging or shipping containers or as shown on drawings and described in Item 3.01.
B. New buildings and major renovations will be treated differently than existing buildings. Existing buildings will utilize category 5E cabling and termination hardware for voice and data. New building construction and Owner approved large-scale renovations will utilize category 5E cabling and termination hardware for voice and category 6 cabling and termination hardware for data. Contact Purdue Information Technology Telecommunications Department Representative for approval of cabling systems before installation.

2.02 DATA CABLING

A. Buildings requiring Category 6 cabling:

1. Owner-approved single 4-pair, category 6, unshielded twisted pairs, 24 gauge, bare copper, polyethylene insulated conductors, with overall green PVC flame retardant jacket, plenum rated.
   a. Approved manufacturer part numbers include:
      I. Belden 3613 Enhanced Cat 6 cable item numbers: 3613 0051000 (1,000 feet) or 3613 0052500 (2,500 feet)
      II. Berk-Tek LANmark-1000 Plenum Enhanced Cat 6 cable item number: 10032096
      III. CommScope UltraMedia 7504 item number: 4766984/30
      IV. General Cable 6000e item number: 7131966
      V. Mohawk Cat 6 LAN Plus item number: M58915 (reel required)
      VI. Panduit TX6000 Enhanced Cat 6 item number: PUP6004GR-Uy
      VII. Superior Essex DataGain Category 6+ item number: 66-272-5B

B. Buildings requiring Category 5e cabling:

1. Owner-approved single 4-pair, category 5E, unshielded twisted pairs, 24 gauge, bare copper, polyethylene insulated conductors, with overall blue PVC jacket, plenum rated.
   a. Approved manufacturers include:
      I. Belden 1585A Cat 5e cable item numbers: 1585A D151000 (1,000 feet) or 1585A D153000 (3,000 feet)
      II. Berk-Tek HyperPlus 5e item number: 10032226
      III. CommScope Datapipe 5E55 item number: 4759004/10
      IV. General Cable GenSpeed 5000 item number: 5131282E
      V. Mohawk Cat 5e LAN item number: M57546 (reel required)
      VI. Panduit TX5500 Premium Cat 5e item number: PUP5504BU-Uy
      VII. Superior Essex Marathon LAN Category 5e item number: 51-220-28 (1,000 feet) or 51-273-28 (2,500 feet)
2.03 VOICE CABLING

A. Owner-approved single 4-pair, category 5E, unshielded twisted pairs, 24 gauge, bare copper, polyethylene insulated conductors, with overall gray PVC jacket, plenum rated.

1. Approved manufacturers include:
   a. Belden 1585A Cat 5e cable item number: 1585A 0081000
   b. Berk-Tek HyperPlus 5e item number: 10032206
   c. CommScope Datapipe 5E55 item number: 4759204/10
   d. General Cable GenSPEED item number: 5131475E
   e. Mohawk Cat 5e LAN item number: M57545 (reel required)
   f. Panduit TX5500 Cat 5e item number: PUP5504IG-UY
   g. Superior Essex Marathon LAN Category 5e item number: 51-220-38 (1,000 feet) or 51-273-38 (2,500 feet)

PART 3: EXECUTION

3.01 TELECOMMUNICATIONS INSTALLATION

A. General:

1. This Section describes the installation locations for the products and materials, as well as methods and Owner’s Standards associated with the Telecommunications Installation portions of the Project. These Specifications, along with the drawings and other Owner supplied specifications shall be followed during the course of the installation.

2. The Contractor is required to be currently listed as either a BICSI Certified Installer or a registered Panduit Certified Installer and provide personnel for telecommunications installations who are verifiably certified.

3. The Contractor is instructed to coordinate his efforts with the other tradesmen who may be working within the same vicinity to avoid conflict and lost time.

4. The Contractor is required to supply all necessary tools, equipment, accessories, safety equipment, protective clothing, etc., as customary for the craft and necessary for the installation.

5. The Contractor shall verify space requirements and locations with Owner before starting cable installations and terminations.

6. The Contractor shall verify the category and jacket rating required with the Purdue IT Infrastructure Services Department before starting cable installation.

7. The Contractor shall verify existing cable fill in skeletal conduit, raceway or cable tray system before installation of additional cables so as not to exceed 40% cable fill. Contractor will be responsible for installation of additional
skeletal conduit, raceway or cable tray where additional cables to be added will exceed the 40% cable fill. See cable fill attachments on Tables 1 and 2 at the end of this section.

3.02 SKELETAL, CABLE TRAY, AND STATION CONDUITS
A. Provide a nylon pull cord in each conduit to facilitate future installation of cables.
B. Provide a nylon pull cord in each conduit and extended in raceway to openings for PIC faceplates to facilitate future installation of cables.
C. Provide a nylon pull cord in each straight section of cable tray. Pull cord shall be continuous from each end of the straight section of tray.

3.03 HORIZONTAL COPPER CABELING
A. The copper telephone horizontal cabling will be terminated at the IDF or BDF on S110 type wiring blocks.
B. The copper data horizontal cabling will be terminated at the IDF or BDF on patch panels as described herein. Where patch panels are mounted in equipment frames, equally distribute cables on each side, down the vertical wire management, and into the horizontal wire management so as not to exceed wire management fill.
C. Horizontal cabling shall be terminated such that wire pair twists are maintained as closely as possible to the point of mechanical termination. (No greater than 0.5” for category 5E or 6 cables.)
D. Maximum strip length shall be 1.0” or less. Maintain cable sheath to leading edge of connector block.
E. Contractor is responsible to obtain and follow installation instructions from the manufacturer for correct termination and wire management of cables on respective products.
F. Owner to provide future cross terminations to Campus switch.
G. Horizontal cables shall be terminated in the telecom room serving that floor unless otherwise noted. Exceptions would include telecom rooms serving multiple floors.

3.04 RELOCATION AND REMOVAL OF EXISTING TELECOMMUNICATION OUTLETS
A. Where the relocation of existing PICs is required and the new location will allow the existing cables to reach, the cables may be disconnected and removed back to the hallway skeletal or raceway system for installation into the new PIC. Where existing cables will not reach, new cables shall be installed to the TR. The new PIC location shall be relabeled. This installation requires a retest of the voice and data cables.
B. Where the removal of existing PICs is required, the contractor shall remove the PIC raceway, conduits, and cables back to the exterior of the TR. Contractor shall notify Owner’s Representative at the time of removal. Owner will remove all items within the TRs. Removal of existing PICs requires as-built information from the contractor prior to removal. Contractors are to supply a copy of the construction floor plan indicating where the PIC was removed and the labeling information on the PIC to the Purdue IT Infrastructure Services Department.
C. PICs scheduled to be relocated shall be tested by the contractor prior to moving. This is to ensure the permanent link meets the category performance set forth by ANSI/TIA. The contractor is responsible for bringing failed tests to the attention of Purdue IT Infrastructure Services Department before proceeding. After reviewing and verifying the failed results, Purdue IT Infrastructure Services Department will discuss options for repair.

D. Per the NEC, cabling for legacy voice and data systems that will not be used within renovated areas shall be removed as part of the project. The Contractor is responsible to bring legacy systems within the proposed renovated areas not identified on the construction documents to the attention of the Purdue IT Infrastructure Services Department who will verify it’s usage. Note: Some legacy cabling still contains active circuits which must be verified and relocated in such a manner as to minimize customer disruption.

3.05 WIRING CONFIGURATION

A. Wire all jacks according to ANSI/TIA/EIA T568-B configuration.

3.06 GENERAL CABLE INSTALLATION

A. Cable lengths within boxes shall be adequate to permit installation and removal of device for inspection without damage to cable or connections (minimum of 12”).

B. Cable bends shall not be greater than that recommended by the manufacturer of the cable.

C. Care shall be taken so as not to damage cable during the installation process and that manufacturer’s pull tension specification is not exceeded.

D. Route cables so that no horizontal cable exceeds 90 meters between TR termination and device jack termination. Contact the Purdue IT Infrastructure Services Department if this is not probable with TR location.

E. Provide a minimum 8’-0” and maximum 10’-0” of slack. Slack in the TRs to be contained on the cable tray so that the cables lay flat and do not cross over themselves (no coils). Smaller slack loops may be required in TR cabinets.

F. Within TRs, cables shall be snugly wrapped using Velcro reusable cable ties, a minimum of every 3’-0” for cable organization. Velcro ties shall be tightened so as not to deform cable jackets and thus affect cable performance. Plastic cable tie wraps shall not be used.

G. Velcro cable ties and tie wraps shall not be used in cable trays and skeletal systems outside of the TR.

H. Cable fill in station conduits, skeletal conduits, raceway, and cable tray shall not exceed 40% cable fill.

I. All telecom rooms must be free from dust, dirt, and other foreign materials before the installation of any termination hardware or the termination of copper or fiber optic cables. The door to the telecommunication rooms must be installed and closed during termination.

J. Contractor is responsible for the protection of all telecommunications equipment in existing telecom rooms. Contractor shall contact the Purdue IT Infrastructure Services Department before starting any work in an existing telecom room that might cause dust and debris from harming network equipment.
3.07 CABLE TESTING

A. A 20% verification by the Purdue IT Infrastructure Services Department of all horizontal voice and data cable tests will be performed. A 100% verification by the Purdue IT Infrastructure Services Department of all wireless access point installations will be performed. Contractor performing the telecommunications testing shall schedule a meeting with a Purdue IT Infrastructure Services Representative before the start of testing. Contractor may request Purdue personnel to accompany them in the testing of cables to ensure proper information entry into the Tester. If Purdue personnel accompany the Contractor on testing, verification testing shall not be required.

B. The horizontal cabling consisting of single 4-pair cable runs for voice shall be tested for Category 5E compliance utilizing a Fluke DTX or Fluke DSX series tester. Test unit shall be set up using: 1) cat. 5E permanent link test, 2) actual cable # installed (e.g. CommScope #5EN5 or 5E55), 3) Project field containing building acronym, “VOICE”, BDF or IDF, and telecom room number (e.g. MATH VOICE IDF 619). Cable Test Results shall be submitted in Fluke Linkware (.flw) format on a CD at the end of the project. Purdue IT Infrastructure Services Department will expedite activation of service before substantial completion if test results are submitted electronically via email. Testing required is 100%. The Purdue IT Infrastructure Services Department will perform random verification testing as part of acceptance of all copper voice cable testing.

C. The horizontal cabling consisting of single 4-pair cable runs for data shall be tested for Category 5E compliance using CommScope #5EN5, #5E55 or Category 6 compliance using CommScope #75N4, #7504 utilizing a Fluke DTX or Fluke DSX. Test unit shall be set up using: 1) cat. 5E or 6 permanent link (draft 10 for Category 6) test depending on cable used, 2) actual cable # installed (e.g., CommScope #5EN5, #5E55, #75N4, or 7504) 3) Project field containing building acronym, “DATA”, BDF or IDF, and telecom room number (e.g. MATH DATA IDF 619). Cable Test Results shall be submitted in Fluke Linkware (.flw) format on a CD at the end of the project. Purdue IT Infrastructure Services Department will expedite activation of service before substantial completion if test results are submitted electronically via email. Testing required is 100%. The Purdue IT Infrastructure Services Department will perform random verification testing as part of acceptance of all copper data cable testing.

3.08 EQUIPMENT INSTALLATION AND CABLE TERMINATIONS

A. All equipment shall be installed in a neat and workmanlike manner, arranged for convenient operation, testing and future maintenance.

B. All paired cables shall be installed and terminated by technicians experienced in the termination of cables on connector blocks.

C. The Contractor shall employ certified system installation technicians and have at least 5 years experience in the installation of similar and equivalent systems.

D. The Contractor shall supply verification of experience, for this type of work, to the Architect for approval before performing any work.

3.09 AS-BUILT INFORMATION

A. Contractor shall provide as-built information along with all test result information to the Purdue IT Infrastructure Services Department.
B. As-built information shall be in red-lined format on a copy of construction drawings. Indicate location of all PICs, skeletal and riser conduit routes, distribution cable trays, junction boxes, and all additions and deletions pertaining to telecommunications. Include correct PIC labeling next to all telecom symbols.

C. If construction drawings are not utilized, Contractor shall provide all telecommunications location information on an accurate scaled floor plan.

D. Contractor shall perform all labeling requirements and provide testing documentation for verification as described herein.

E. Contractor shall submit cable records to reflect all moves, adds, and changes.

F. Contractor shall provide floor plans showing locations of all telecommunication outlets and spaces.

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<tr>
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Please note 20% fill for Wiremold.

*4-pr.cable = CommScope #5EN5, Cat 5E or equivalent
.200” = O.D. of Cat 5E cable

** 4-pr cable = CommScope #75N4, Cat 6 or equivalent
.240” = O.D. of Cat 6 cable
Contact Owner’s Representative for riser cable or entrance cable fill information

* Count fiber optic cables in fill as an equivalent to category 6 cables. .23” = O.D. of 2-strand fiber
PART 1: GENERAL

1.01 SCOPE OF WORK

A. Work covered by this Section shall consist of furnishing labor, equipment, supplies, materials, and testing unless otherwise specified, and in performing the following operations recognized as necessary for the installation, termination, and labeling of horizontal optical fiber infrastructure as described on the Drawings and/or required by these specifications.

1.02 RELATED SECTIONS

A. Division 27, Section 270528 Pathways for Communication Systems.
B. Division 27, Section 270543 Underground Ducts and Raceways for Communication Systems.
C. Division 27, Section 270553 Identification for Communication Systems.
D. Division 27, Section 271116 Communications Cabinets, Frames, Racks, and Enclosures.
E. Division 27, Section 271119 Communications Termination Blocks and Patch Panels.
F. Division 27, Section 271313 Communications Copper Backbone Cabling.
G. Division 27, Section 271323 Communications Optical Fiber Backbone Cabling.
H. Division 27, Section 271333 Communications Coaxial Backbone Cabling.
I. Division 27, Section 271513 Communications Copper Horizontal Cabling.
J. Division 27, Section 271533 Communications Coaxial Horizontal Cabling.
K. Division 27, Section 271543 Communications Faceplates and Connectors.

PART 2: PRODUCTS

2.01 FIBER CABLING

A. Single-mode Fiber Optic Outlet Cable - Provide horizontal fiber optic cable from outlet through conduits to skeletal or cable tray then through skeletal or cable tray to IDF or BDF.

1. Each single-mode fiber optic cable shall be plenum-rated MIC type tight buffered fiber. Typical fiber outlets consist of a two-strand fiber, Corning part #002E81-31131-24 for non-plenum installations and Corning part #002E88-31131-29 for plenum installations. Number of strands may vary depending on project.

2. Fiber-optic glass must be manufactured by Corning Cable Systems

B. Multimode Fiber Optic Outlet Cable - Provide horizontal fiber optic cable from outlet through conduits to skeletal or cable tray then through skeletal or cable tray to IDF or BDF.
1. Each multimode fiber optic cable shall be plenum-rated OM3, MIC type tight buffered fiber. Typical fiber outlets consist of a two-strand fiber, Corning part #002T81-31180-24 for non-plenum installations and Corning part #002T88-31180-29 for plenum installations. Number of strands may vary depending on project.

2. Fiber-optic glass shall be manufactured by Corning Cable Systems.

PART 3: EXECUTION

3.01 TELECOMMUNICATIONS INSTALLATION

A. General:

1. This Section describes the installation locations for the products and materials, as well as methods and Owner’s Standards associated with the Telecommunications Installation portions of the Project. These Specifications, along with the drawings and other Owner supplied specifications shall be followed during the course of the installation.

2. The Contractor is instructed to coordinate his efforts with the other tradesmen who may be working within the same vicinity to avoid conflict and lost time.

3. The Contractor is required to supply all necessary tools, equipment, accessories, safety equipment, protective clothing, etc., as customary for the craft and necessary for the installation.

4. The Contractor shall verify space requirements and locations with the Purdue IT Infrastructure Services Department before starting cable installations and terminations.

5. The Contractor shall verify the cable type and jacket rating required with the Purdue IT Infrastructure Services Department before starting fiber installation.

6. The Contractor shall verify existing cable fill in skeletal conduit, raceway or cable tray system before installation of additional cables so as not to exceed 40% cable fill. Contractor will be responsible for installation of additional skeletal conduit, raceway or cable tray where additional cables to be added will exceed the 40% cable fill. See cable fill attachment, 3.01 Attachment #1.

3.02 SKELETAL AND EMPTY STATION CONDUITS

A. Provide a nylon pull cord in each empty conduit to facilitate future installation of cables.

B. Provide a nylon pull cord in each empty conduit and extended in raceway to openings for PIC faceplates to facilitate future installation of cables.

3.03 HORIZONTAL FIBER CABLING

A. The horizontal fiber cabling will be terminated at the telecom room in either a wall mountable enclosure or frame mountable enclosure.

B. Contractor is responsible to obtain and follow installation instructions for Corning products for correct termination and fiber management of cables on respective products.
C. Owner to provide future cross terminations to network equipment.

3.05 FIBER COLOR CODES

A. Fiber Color Code -

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3.06 GENERAL FIBER INSTALLATION

A. Cable lengths within boxes shall be adequate to permit installation and removal of device for inspection without damage to cable or connections (minimum of 12”).

B. Cable bends shall not be greater than that recommended by the manufacturer of the cable.

C. Care shall be taken so as not to damage cable during the installation process and that manufacturer’s pull tension specification is not exceeded.

D. Route cables so that no horizontal cable exceeds 90 meters between TR termination and device jack termination. Contact the Purdue IT Infrastructure Services Department if this is not probable with TR location.

E. Provide a minimum 8’-0” and maximum 10’-0” of slack on telecom room cable tray.

F. Within TRs, cables shall be snugly wrapped using Velcro reusable cable ties, a minimum of every 3’-0” for cable organization. Wire ties shall be tightened so as not to deform cable jackets and thus affect cable performance.

G. Cable fill in station conduits, skeletal conduits, raceway, and cable tray shall not exceed 40% cable fill.

H. Telecom rooms must be free from dust, dirt, and other foreign materials before the installation of any termination hardware or the termination of copper or fiber optic
cables. The door to the telecommunication rooms must be installed and closed during termination.

3.07 CABLE TESTING

A. A 100% verification by the Purdue IT Infrastructure Services Department of all horizontal fiber cable tests will be performed. Contractor shall notify the Purdue IT Infrastructure Services Department before the start of testing. Contractor may request Purdue personnel to accompany them in the testing of cables to ensure proper information entry into the Fluke DTX cable analyzer. If Purdue personnel accompany the Contractor on testing, verification shall not be performed.

B. The fiber optic cables shall be tested utilizing a power meter and stabilized light source capable of testing at 850 nm and 1300 nm for multimode and 1310 nm and 1550 nm for single-mode. Contractor shall complete a fiber optic post installation report at the time of testing containing meter readings at both 850 nm and 1300 nm for multimode and 1310 nm and 1550 nm for single-mode in one direction (TR to outlet) on each fiber, actual loss and other pertinent data regarding the cables tested, including model and serial number of test equipment, cable part #, installed fiber length, building span loss at 850 nm and 1300 nm for multimode and 1310 nm and 1550 nm for single-mode and date tested. The fiber optic post installation report shall be in Fluke Linkware (.flw) format. A CD with the electronic Fluke file is required at the end of the project. Span loss calculations may be verified for loss at 850 nm and 1300 nm for multimode and 1310 nm and 1550 nm for single-mode via the formula below.

\[(D \times L) + (C \times \# \text{ connectors})\]

\[D = \text{Length}; \ L = \text{Loss}; \ C = \text{Connector loss (Max 0.75 dB)}\]

1 ft. = .0003048 km.

Owner will perform 100% verification testing as part of acceptance of all fiber optic cable testing.

3.08 EQUIPMENT INSTALLATION AND CABLE TERMINATIONS

A. All equipment shall be installed in a neat and workmanlike manner, arranged for convenient operation, testing and future maintenance.

B. All fiber cables shall be installed and terminated by technicians experienced in the installation and termination of fiber cables.

C. The Contractor shall employ certified system installation technicians and have at least 5 years experience in the installation of similar and equivalent systems.

D. The Contractor shall supply verification of experience, for this type of work, to the Architect for approval before performing any work.

3.09 AS-BUILT INFORMATION

A. Contractor shall provide as-built information along with all test result information to the Purdue IT Infrastructure Services Department.

B. As-built information shall be in red-lined format on a copy of construction drawings. Indicate location of all PICs, skeletal and riser conduit routes, distribution cable trays,
junction boxes, and all additions and deletions pertaining to telecommunications. Include correct PIC labeling next to all telecom symbols.

C. If construction drawings are not utilized, Contractor shall provide all telecommunications location information on an accurate scaled floor plan.

D. Contractor shall perform all labeling requirements and provide testing documentation for verification as described herein.

E. Contractor shall submit cable records to reflect all moves, adds, and changes.

F. Contractor shall provide floor plans showing locations of all telecommunication outlets and spaces.
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Please note 20% fill for Wiremold.

*4-pr. cable = CommScope #5EN5, Cat 5E or equivalent
**4-pr. cable = CommScope #75N4, Cat 6 or equivalent

Contact Owner’s Representative for riser cable or entrance cable fill information.

* Count fiber optic cables in fill as an equivalent to category 6 cables. .23” = O.D. of 2-strand fiber
PART 1: GENERAL

1.01 SCOPE OF WORK

A. Work covered by this Section shall consist of furnishing labor, equipment, supplies, materials, and testing unless otherwise specified, and in performing the following operations recognized as necessary for the installation, termination, and labeling of horizontal coax infrastructure as described on the Drawings and/or required by these specifications.

1.02 RELATED SECTIONS

A. Division 27, Section 270528 Pathways for Communication Systems.

B. Division 27, Section 270543 Underground Ducts and Raceways for Communication Systems.

C. Division 27, Section 270553 Identification for Communication Systems.

D. Division 27, Section 271116 Communications Cabinets, Frames, Racks, and Enclosures.

E. Division 27, Section 271119 Communications Termination Blocks and Patch Panels.

F. Division 27, Section 271313 Communications Copper Backbone Cabling.

G. Division 27, Section 271323 Communications Optical Fiber Backbone Cabling.

H. Division 27, Section 271333 Communications Coaxial Backbone Cabling.

I. Division 27, Section 271513 Communications Copper Horizontal Cabling.

J. Division 27, Section 271523 Communications Optical Fiber Horizontal Cabling.

K. Division 27, Section 271543 Communications Faceplates and Connectors.

PART 2: PRODUCTS

It is Purdue’s expectation that the A/E of record will work jointly with Purdue’s Telecommunication representatives to address specific technical issues and Owner requirements. All questions, deviations, comments concerning guideline(s) interpretation, content, and/or use must be submitted in writing to the Project Manager for approval. No deviations from these guidelines shall be incorporated into the project without written approval from the Project Manager and Purdue Telecommunications representative.

2.01 COAX CABLES

A. Horizontal Cables (CATV) - Provide CATV cables from PIC outlets in rooms through conduits to skeletal then through skeletal to IDF or BDF.

1. Each CATV cable shall be Type RG-6, 18 gauge, solid copper center conductor, with overall Black PVC jacket, CMR rated.

2. Manufacturer shall be Belden #9116R.

3. Where plenum CATV cable is required use Belden #9116P with overall
natural Flamarrest jacket, CMP rated.

4. New buildings shall utilize plenum cabling in the entire building.

PART 3: EXECUTION

3.01 TELECOMMUNICATIONS INSTALLATION

A. General:
1. This Section describes the installation locations for the products and materials, as well as methods and Owner’s Standards associated with the Telecommunications Installation portions of the Project. These Specifications, along with the drawings and other Owner supplied specifications shall be followed during the course of the installation.

2. The Contractor is instructed to coordinate his efforts with the other tradesmen who may be working within the same vicinity to avoid conflict and lost time.

3. The Contractor is required to supply all necessary tools, equipment, accessories, safety equipment, protective clothing, etc., as customary for the craft and necessary for the installation.

4. The Contractor shall verify space requirements and locations with the Purdue IT Infrastructure Services Department before starting cable installations and terminations.

5. The Contractor shall verify the cable type and jacket rating required with the Purdue IT Infrastructure Services Department before starting coax installation.

6. The Contractor shall verify existing cable fill in skeletal conduit, raceway or cable tray system before installation of additional cables so as not to exceed 40% cable fill. Contractor will be responsible for installation of additional skeletal conduit, raceway or cable tray where additional cables to be added will exceed the 40% cable fill. See cable fill attachment, 3.01 Attachment #1.

3.02 SKELETAL AND EMPTY STATION CONDUITS

A. Provide a nylon pull cord in each empty conduit to facilitate future installation of cables.

B. Provide a nylon pull cord in each empty conduit and extended in raceway to openings for PIC faceplates to facilitate future installation of cables.

3.03 HORIZONTAL COAX CABLING

A. The horizontal coax cabling will be terminated at the telecom room on a wall designated by a Purdue IT Infrastructure Services Representative.

B. Contractor is responsible to obtain and follow installation instructions for Belden products for correct termination and coax management of cables on respective products.

C. Owner to provide future taps, splitters, and amplifiers.

D. All coax terminations shall be done with compression style coax connectors.
3.04 GENERAL COAX INSTALLATION

A. Cable lengths within boxes shall be adequate to permit installation and removal of device for inspection without damage to cable or connections (minimum of 6”).

B. Cable bends shall not be greater than that recommended by the manufacturer of the cable.

C. Care shall be taken so as not to damage cable during the installation process and that manufacturer’s pull tension specification is not exceeded.

D. Route cables so that no horizontal cable exceeds 90 meters between TR termination and device jack termination. Contact the Purdue IT Infrastructure Services Department if this is not probable with TR location.

E. Provide a minimum 8’-0” and maximum 10’-0” of slack. Loop at the TRs to be contained in the cable tray.

F. Within TRs, cables shall be snugly wrapped using Velcro reusable cable ties, a minimum of every 3’-0” for cable organization. Wire ties shall be tightened so as not to deform cable jackets and thus affect cable performance.

G. Cable fill in station conduits, skeletal conduits, raceway, and cable tray shall not exceed 40% cable fill.

H. Telecom rooms must be free from dust, dirt, and other foreign materials before the installation of any termination hardware or the termination of copper or fiber optic cables. The door to the telecommunication rooms must be installed and closed during termination.

3.05 CABLE TESTING

A. The CATV horizontal station cabling consisting of RG-6 shall be tested for length utilizing a Fluke DTX or Fluke DSX tester. Test unit shall be set up using RG-6 cable selected. All tests shall be conducted at the opposite end from the BDF\IDF. Contractor shall provide electronic test results and summary report in Fluke Linkware (.flw) format for each CATV outlet. Testing required is 100%. Contractor shall provide the test results on a CD at the end of the project. Purdue IT Infrastructure Services Department will expedite activation of service before substantial completion if test results are submitted electronically via email. Purdue IT Infrastructure Services Department will perform random verification testing as part of acceptance of all CATV cable testing. Summary report shall have additional information on the sheet to indicate building and the telecom room.

3.06 EQUIPMENT INSTALLATION AND CABLE TERMINATIONS

A. All equipment shall be installed in a neat and workmanlike manner, arranged for convenient operation, testing and future maintenance.

B. All coax cables shall be installed and terminated by technicians experienced in the installation and termination of coax cables.

C. The Contractor shall employ certified system installation technicians and have at least 5 years experience in the installation of similar and equivalent systems.

D. The Contractor shall supply verification of experience, for this type of work, to the Architect for approval before performing any work.
3.07 AS-BUILT INFORMATION

A. Contractor shall provide as-built information along with all test result information to the Purdue IT Infrastructure Services Department.

B. As-built information shall be in red-lined format on a copy of construction drawings. Indicate location of all PICs, skeletal and riser conduit routes, distribution cable trays, junction boxes, and all additions and deletions pertaining to telecommunications. Include correct PIC labeling next to all telecom symbols.

C. If construction drawings are not utilized, Contractor shall provide all telecommunications location information on an accurate scaled floor plan.

D. Contractor shall perform all labeling requirements and provide testing documentation for verification as described herein.

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<tr>
<td>9116P**</td>
<td>4</td>
<td>7</td>
<td>13</td>
<td>18</td>
<td>30</td>
<td>81</td>
<td>136</td>
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</tbody>
</table>

### Table 2

<table>
<thead>
<tr>
<th>Wiremold size</th>
<th>2400</th>
<th>3000</th>
<th>4000</th>
<th>6000</th>
</tr>
</thead>
<tbody>
<tr>
<td>9116R*</td>
<td>3</td>
<td>14</td>
<td>34</td>
<td>70</td>
</tr>
<tr>
<td>9116P**</td>
<td>4</td>
<td>18</td>
<td>37</td>
<td>80</td>
</tr>
</tbody>
</table>

Please note 20% fill for Wiremold.

*RG-6 = Belden #9116R (riser rated)  .270” = O.D.
** RG-6 = Belden #9116P (plenum rated)   .235” = O.D.

Contact Owner’s Representative for riser cable or entrance cable fill information.
27.1543 – Faceplates and Connectors

27.1543 – Faceplates and Connectors

Last Update: April 29th, 2014

PART 1: GENERAL

1.01 SCOPE OF WORK

A. Work covered by this Section shall consist of furnishing labor, equipment, supplies, materials, and testing unless otherwise specified, and in performing the following operations recognized as necessary for the installation, termination, and labeling of faceplates and connectors as described on the Drawings and/or required by these specifications.

1.02 RELATED SECTIONS

A. Division 27, Section 270528 Pathways for Communication Systems.
B. Division 27, Section 270553 Identification for Communication Systems.
C. Division 27, Section 271116 Communications Cabinets, Frames, Racks, and Enclosures.
D. Division 27, Section 271119 Communications Termination Blocks and Patch Panels.
E. Division 27, Section 271313 Communications Copper Backbone Cabling.
F. Division 27, Section 271323 Communications Optical Fiber Backbone Cabling.
G. Division 27, Section 271333 Communications Coaxial Backbone Cabling.
H. Division 27, Section 271513 Communications Copper Horizontal Cabling.
I. Division 27, Section 271523 Communications Optical Fiber Horizontal Cabling.
J. Division 27, Section 271533 Communications Coaxial Horizontal Cabling.

PART 2: PRODUCTS

It is Purdue’s expectation that the A/E of Record will work jointly with Purdue’s Telecommunication representatives to address specific technical issues and Owner requirements. All questions, deviations, comments concerning guideline(s) interpretation, content, and/or use must be submitted in writing to the Project Manager for approval. No deviations from these guidelines shall be incorporated into the project without written approval from the Project Manager and Purdue Telecommunications representative.

2.01 CONDUIT AND OUTLET BOXES

A. See Section 270528 – Pathways for Communication Systems
B. See Section 250513 – Conductors and Cables for Integrated Operation

2.02 TELECOMMUNICATIONS INSTALLATION

A. General: The materials and products specified herein reflect the minimum acceptable standards of fabrication and manufacture. All materials and products supplied by the Contractor and specified herein are to be new, unused, of first quality and in original packaging or shipping containers or as shown on drawings and described in Item
3.01.

B. New buildings and major renovations will be treated differently than existing buildings. Existing buildings will utilize plenum-rated category 5E cabling and termination hardware for voice and data. New building construction and Owner approved large-scale renovations will utilize plenum-rated category 5E cabling and termination hardware for voice and plenum-rated category 6 cabling and termination hardware for data. Contact the Purdue IT Infrastructure Services Representative for approval of cabling systems before installation.

C. Standard PIC Room Outlet Devices in Flush Mounted Devices:

1. Voice device shall consist of (1) Panduit #CJ5E88TGIW, Office White, Category 5E, T568B wiring standard, 8 conductor jacks.

2. Data device shall consist of either:
   a. (2) Panduit #CJ688TGGD/N, Gold, Category 6, T568B wiring standard, 8 conductor jacks, where Category 6 is required.
   b. (2) Panduit #CJ5E88TGBL, Black, Category 5E, T568B wiring standard, 8 conductor jacks, where Category 5E is required.

3. Cover plate shall be (1) Panduit #CBEIW-2GY, Office White, 2-gang, double opening wall plate with (2) Panduit #CHF2IW-X, Flat, Office White snap-in modules located in the top faceplate openings, (1) Panduit #CMBIW-X blank module in the right jack opening of the right flat module, and (2) Panduit #CHB2IW-X blank modules in the bottom faceplate openings. See 2.02 Attachment #1 for jack configuration.

D. Standard PIC Room Outlet Devices in Surface Mounted Raceway:

1. Voice device shall consist of (1) Panduit #CJ5E88TGIW, Office White, Category 5E, T568B wiring standard, 8 conductor jacks.

2. Data device shall consist of either:
   a. (2) Panduit #CJ688TGGD/N, Gold, Category 6, T568B wiring standard, 8 conductor jacks, where Category 6 is required.
   b. (2) Panduit #CJ5E88TGBL, Black, Category 5E, T568B wiring standard, 8 conductor jacks, where Category 5E is required.

3. Cover plate shall be (1) Panduit #CBEIWWY, Office White, single-gang, double opening wall plate with (2) Panduit #CHF2IW-X, Flat, Office White snap-in modules, (1) Panduit #CMBIW-X blank module in the right jack opening of the right flat module. See 2.02 Attachment #1 for jack configuration.

E. Residence Hall Room Outlet Device:

1. Voice device shall consist of (1) Panduit #CJ5E88TGIW, Office White, Category 5E, T568B wiring standard, 8 conductor jacks.

2. Data device shall consist of either:
   a. (2) Panduit #CJ688TGGD/N, Gold, Category 6, T568B wiring standard, 8 conductor jacks, where Category 6 is required.
b. (2) Panduit #CJ5E88TGBL, Black, Category 5E, T568B wiring standard, 8 conductor jacks, where Category 5E is required.

3. Cover plate shall be (1) Panduit #CBEIWY, Office White, single-gang, double opening wall plate with (2) Panduit #CHF2IW-X, Flat, Office White snap-in modules, (1) Panduit #CMBIW-X blank module in the right jack opening of the bottom flat module. See 2.02 Attachment #1 for jack configuration.

F. Single Voice Outlet Device:

1. Telephone device shall consist of (1) Panduit #CJ5E88TGIW, Office White, Category 5E, T568B wiring standard, 8 conductor jack.

2. Cover plate shall be (1) Panduit #CBEIWY, Office White, single gang, single opening wall plate with (1) Panduit #CHF2IW-X, Office White snap-in module in top of opening, and (1) Panduit #CHB2IW-X, Office White, blank fittings in bottom opening. Place (1) Panduit #CMBIW-X blank module in the right side of the top module. See 2.02 Attachment #2 for jack configuration.

3. When installing the faceplate horizontally, install the modules and jack as if it were mounted vertically.

4. Wall phone outlets shall utilize an Allen-Tel #AT630B-8, stainless steel phone plate.

G. Data Only Outlet Device:

1. Data device shall consist of either:
   a. (2) Panduit #CJ688TGGD/N, Gold, Category 6, T568B wiring standard, 8 conductor jacks, where Category 6 is required.
   b. (2) Panduit #CJ5E88TGBL, Black, Category 5E, T568B wiring standard, 8 conductor jacks, where Category 5E is required.

2. Cover plate shall be (1) Panduit #CBEIWY, Office White, single gang, single opening wall plate with (1) Panduit #CHF2IW-X, Office White snap-in module in top of opening, and (1) Panduit #CHB2IW-X, Office White, blank fittings in bottom opening. See 2.02 Attachment #2 for jack configuration.

3. When installing the faceplate horizontally, install the modules and jack as if it were mounted vertically.

H. Fiber Only Outlet Device:

1. Multimode fiber device shall consist of (1) Panduit #CMDAQSCIW, Office White, SC Laser Optimized multimode fiber optic adapter module.

2. Single-mode fiber device shall consist of (1) Panduit #CMDBUSCZIW, Office White, SC single-mode fiber optic adapter module.

3. Cover plate shall be (1) Panduit #CBEIWY, Office White, single gang, single opening wall plate with (1) Panduit #CHS2IW-X, Office White, sloped snap-in module in bottom opening, and (1) Panduit #CHB2IW-X, Office White, blank fittings in top opening. See 2.02 Attachment #3 for jack configuration.
I. Fiber Terminations
   1. Each multimode fiber shall be terminated with (1) Corning Cable Systems #95-050-41-X, Laser Optimized SC UniCam fiber optic connector.
   2. Each single-mode fiber shall be terminated with (1) Corning Cable Systems #95-200-42, SC UniCam Ultra PC Polish fiber optic connector.

J. Existing PIC Locations:
   1. Where new jacks are being installed in existing PIC locations with Hubbell faceplates, utilize Panduit #KJ588IW office white keystone jacks for voice and Panduit #KJ5E88TPBL black keystone jacks for Category 5E data installations.
   2. Large renovations where category 6 data outlets are being installed shall utilize new Panduit faceplates with new Panduit jacks.

K. PIC Locations in Divided Raceways
   1. Where jacks are being installed in a divided 4000 Wiremold raceway for telecommunications and power, utilize Wiremold #V4047C-1 one-gang device plates for the mounting of the Panduit #CBEIWY, Office White, single gang, single opening wall plate. Electrical devices shall utilize a separate Wiremold #V4048B duplex receptacle device.

L. CATV Terminations
   1. Type 6 (RG-6) Cable Installations
      a. Terminate all RG-6 cable with Belden #FSNS6U compression connectors.
   2. Type 11 (RG-11) Cable Installations
      a. Terminate all RG-11 non-plenum cable with Belden #SNS1P11 compression type connectors.
   3. CATV outlet within a PIC shall utilize (1) Panduit #CMFIW F-type module.

PART 3: EXECUTION

3.01 TELECOMMUNICATIONS INSTALLATION

A. General:
   1. This Section describes the installation locations for the products and materials, as well as methods and Owner’s Standards associated with the Telecommunications Installation portions of the Project. These Specifications, along with the drawings and other Owner supplied specifications shall be followed during the course of the installation.
   2. The Contractor is instructed to coordinate his efforts with the other tradesmen who may be working within the same vicinity to avoid conflict and lost time.
3. The Contractor is required to supply all necessary tools, equipment, accessories, safety equipment, protective clothing, etc., as customary for the craft and necessary for the installation.

4. The Contractor shall verify space requirements and locations with the Purdue IT Infrastructure Services Department before starting cable installations and terminations.

5. The Contractor shall verify the category of the data jacks required with the Purdue IT Infrastructure Services Department before starting termination.

3.02 CATV TERMINATION

A. CATV Cable Termination:

1. All RG-6 CATV cable shall be terminated as follows:
   a. Strip off 7/16” of outer jacket without disturbing braided shield underneath.
   b. Bend braided shield back over the outer jacket.
   c. Cut dielectric without scoring center conductor to obtain 3/16” of dielectric left.
   d. Slide RG-6 connector down cable until dielectric is flush with inner surface and bottoms out.
   e. Compress fitting using appropriate compression tool.

2. All RG-11 CATV cable shall be terminated as follows:
   a. Strip off 1/2” of outer jacket without disturbing braided shield underneath.
   b. Bend braided shield back over the outer jacket.
   c. Cut dielectric without scoring center conductor to obtain 3/16” of dielectric left.
   d. Slide RG-11 connector down cable until dielectric is flush with inner surface and bottoms out.
   e. Crimp using HEX type crimp tool.

3.03 EQUIPMENT INSTALLATION AND CABLE TERMINATIONS

A. All equipment shall be installed in a neat and workmanlike manner, arranged for convenient operation, testing and future maintenance.

B. All telecommunications cables, faceplates, and connectors shall be installed and terminated by technicians experienced in the installation and termination of telecommunications items listed herein.

C. The Contractor shall employ certified system installation technicians and have at least 5 years experience in the installation of similar and equivalent systems.

D. The Contractor shall supply verification of experience, for this type of work, to the Architect for approval before performing any work.
3.04 AS-BUILT INFORMATION

A. Contractor shall provide as-built information and all test result information to the Purdue IT Infrastructure Services Department.

B. As-built information shall be in red-lined format on a copy of construction drawings. Indicate location of all PICs, skeletal and riser conduit routes, distribution cable trays, junction boxes, and all additions and deletions pertaining to telecommunications. Include correct PIC labeling next to all telecom symbols.

C. If construction drawings are not utilized, Contractor shall provide all telecommunications location information on an accurate scaled floor plan.

D. Contractor shall perform all labeling requirements and provide testing documentation for verification as described herein.

E. Contractor shall submit cable records to reflect all moves, adds, and changes.

F. Contractor shall provide floor plans showing locations of all telecommunication outlets and spaces. Electronic versions of as-builts are preferred.
Standard PIC Faceplate Configuration:
Standard PIC Faceplate Configuration with CATV:

Room # - A/B/1

DATA 1  DATA 2  VOICE 1

CATV1

TV Room # - 1
Telephone Only Faceplate Configuration:

```
Room # - 1

VOICE 1
```
Data Only Faceplate Configuration:

Room # - A/B

DATA 1  DATA 2
Single Mode Fiber PIC Faceplate Configuration:

![Diagram]

Room #FOS – A
Standard PIC with Fiber Faceplate Configuration:
PART 1: GENERAL

1.01 SCOPE OF WORK

A. The work required under this section consists of providing telecommunications infrastructure for wireless access points along with associated equipment for a complete wireless network.

B. Some projects may exclude the purchase and/or installation of the Wireless Access Points (WAPs) and antennas.

1.02 RELATED SECTIONS

A. Section 26 0529 – ELEC Conduit Supports and Hangers
   Section 26 0534 – ELEC Surface Raceways
   Section 27 0528 – Section 270528 Pathways for Communication Systems
   Section 27 1513 – Communications Copper Horizontal Cabling
   Section 27 1543 – Communications Faceplates and Connectors

1.03 INTENT OF DRAWINGS AND SPECIFICATIONS

A. These Specifications, together with the Drawings accompanying them, are intended to depict the installation requirements necessary to support this Project. Contractor shall furnish materials shown and/or called for on the Drawings but not mentioned in the Specifications, or vice versa, that are necessary for the installation and support of communications cabling, whether or not specifically called for in both. In addition, Contractor shall provide incidental equipment and materials required for the completion of systems included in this contract whether or not specified or shown on the Drawings.

1.04 DEFINITIONS

A. Data-Only PIC (Purdue Information Connection) - The telecommunications connection at the customer end consisting of (2) data jacks.

B. WAP (Wireless Access Point) - A radio device that connects to antennas to facilitate communications that form a wireless network. The WAP connects to a wired network, and relays data between wireless devices and wired devices.

C. Omni-directional - An antenna system which radiates power uniformly in one plane with a directive pattern shape in a perpendicular plane. This pattern is often described as "donut shaped".

D. Dipoles - An antenna with a center-fed driven element for transmitting or receiving radio frequency energy.

E. Directional antennas - An antenna which radiates greater power in one or more directions allowing for increased performance on transmit and receive and reduced interference from unwanted sources. Directional antennas like yagi antennas provide increased performance over dipole antennas when a greater concentration of radiation in a certain direction is desired.
F. Diversity wall mount bracket - A bracket specifically designed to aim a directional antenna toward a specific area. These brackets are made and supplied by Owner.

G. Site Survey - The process of planning and designing a wireless network to provide a wireless solution that will deliver the required wireless coverage, data rates, network capacity, roaming capability and Quality of Service (QoS).

H. IEEE 802.11a standard - Uses the same core protocol as the original standard (802.11), operates in 5 GHz band, and uses a 52-subcarrier orthogonal frequency-division multiplexing (OFDM) with a maximum raw data rate of 54 Mbit/s, which yields realistic net achievable throughput in the mid-20 Mbit/s.

I. IEEE 802.11b/g standard - Uses the same core protocol as the original standard (802.11), operates in 2.4 GHz band, and uses a 52-subcarrier orthogonal frequency-division multiplexing (OFDM) with a maximum raw data rate of 54 Mbit/s, which yields realistic net achievable throughput around 19 Mbit/s.

J. dB (Décibel) - A logarithmic unit of measurement that expresses the magnitude of a physical quantity (usually power or intensity) relative to a specified or implied reference level. Its logarithmic nature allows very large or very small ratios to be represented by a convenient number, in a similar manner to scientific notation. Since it expresses a ratio of two (same unit) quantities, it is a dimensionless unit.

K. dBi (Décibel isotropic) - The forward gain of an antenna compared to the hypothetical isotropic antenna, which uniformly distributes energy in all directions.

L. PoE (Power over Ethernet/IEEE 802.3af standard) - A system that transmits electrical power, along with data, to remote devices over standard twisted-pair cable in an Ethernet network. This technology is useful for powering WAPs and other appliances where it would be inconvenient, expensive or infeasible to supply power separately.

M. Mid-Span Power Injector - Power injectors that stand between a regular Ethernet switch and the powered device, injecting power without affecting the data. Mid-spans are only used when PoE capable Ethernet switches are not available in the telecommunications room.

N. IEEE 802.11n standard – Uses the same core protocol as the original standard (802.11). This standard can operate in the 2.4GHz and 5GHz band by adding MIMO (Multiple-Input, Multiple Output) and 40MHz channels on the physical layer, and frame aggregation to the MAC layer. Uses (3) antennas per radio band.

PART 2 – PRODUCTS

It is Purdue’s expectation that the A/E of Record will work jointly with Purdue’s Telecommunication representatives to address specific technical issues and Owner requirements. All questions, deviations, comments concerning guideline(s) interpretation, content, and/or use must be submitted in writing to the Project Manager for approval. No deviations from these guidelines shall be incorporated into the project without written approval from the Project Manager and Purdue Telecommunications representative.

2.01 WIRELESS ACCESS POINTS (AP)

A. Provide Wireless Access Points as shown on drawings, scope of work, or herein.

2.02 WIRELESS ACCESS POINT ANTENNAS
A. Provide Wireless Access Point Antennas as shown on drawings, scope of work, or herein.

2.03 WIRELESS ACCESS POINT ENCLOSURES
A. Provide Wireless Access Point Enclosures as shown on drawings, scope of work, or herein.

2.04 PATCHORDS
A. Cat 5e, 3ft pink plenum patch cord or Owner approved equal.
B. Cat 6, 3ft purple plenum patch cord or Owner approved equal.

2.05 MISCELLANEOUS HARDWARE
A. Wiremold #2448-2 or Owner approved equal, Ivory Box
B. Top Mount T-Bar Fastener or Owner approved equal
C. Panduit #LD3, Surface Raceway for managing antenna cables and jumpers through T-Grid

2.06 LABELING
A. Copper, Fiber, and Coax Horizontal Cable Labels
   2. Panduit #S100X150VAC, 1.0" wide x 1.5" length, white vinyl label or Owner approved equal.
B. Patch Panel Labels in TRs
   1. Panduit #C061X030FJC, 0.61" wide x 0.30" height, one-port identifier or Owner approved equal.
C. Faceplate Labels
   1. Panduit #T038X000VPC-BK, 0.38" height, black lettering on white vinyl tape or Owner approved equal.

PART 3: EXECUTION
3.01 GENERAL REQUIREMENTS
A. Installation of Data-Only PICs
   1. Locations shall be installed as shown on drawings.
   2. New construction outlet box shall be a 4 11/16" square flush mounted box. Boxes are to be 2 1/8" deep with double gang, square drawn extension or tile ring. Outlet box shall have a 1" EMT conduit to nearest distribution system or as indicated on the Drawings or as specified herein.
   3. PICs above ceilings in existing construction and within 18"-24" of a skeletal opening or cable tray system will not require conduit, unless the PIC is on the other side of the wall from the distribution system.
   4. PICs in existing construction and above ceilings further than 24" from a skeletal opening or cable tray system shall have 1" EMT installed from a 4-11/16" square box with double gang, square drawn extension or tile ring to within 18"-24" of skeletal openings or cable tray systems.
   5. PICs in areas without a ceiling shall be installed 8'-0" to 10'-0" AFF.
   6. PICs in areas with a ceiling lower than or equal to 10'-0" shall be installed above the ceiling.
7. PICs in areas with a ceiling higher than 10'-0" shall be installed 8'-10' AFF.
8. Deviations from specified locations shall be submitted for approval to the Purdue IT Infrastructure Services Department.
9. Data-only PICs shall be tested, verified, and approved prior to WAP activation.
10. All PICs shall be installed so there is 1'-0" clearance in front of the faceplate for maintenance.
11. Label PIC as specified herein.

B. Installation of WAP brackets
1. Contractor shall obtain WAP brackets from Purdue’s IT Infrastructure Services Department.
2. Install WAP brackets as shown on drawings or as described herein.
3. Installation of WAP bracket shall be mounted within 30° of the data-only PIC and secured to wall or independently supported by building structure.

C. Installation of WAPs
1. WAPs shall be installed in corresponding PIC location.
2. Access points must be mounted at least 3'-0" away from any metal obstructions, as described in the installation of antenna section below.
3. Access points to be mounted 8'-0" to 10'-0" AFF, if ceiling is not present, or the ceiling exceeds 10'-0" in height.
4. Access points to be mounted approximately 1'-0" above ceiling level, when grid is present. This allows for antenna movement and positioning, as well as, access to the AP unit.
5. Do not mount the access points on building perimeter walls unless outside coverage is required on drawings or specified herein.
6. Access point to be installed with 2 plenum patch cords as required by the building. Patch cord shall run from Ethernet port to Jack A, and second cord shall run from console port to Jack B. Patch cords are not to exceed 3ft.

D. Installation of Antennas
1. Keep the antenna at least 24" away from metal obstructions such as heating and air-conditioning ducts, large ceiling trusses, building superstructures, and major power cabling runs.
2. Orient the access point 2-GHz and 5-GHz antennas so that they are pointing downward when mounted horizontally. When mounting access point vertically, 2-GHz and 5-GHz dipolar antennas should be perpendicular to floor.
3. The 5-GHz antennas and antenna cables have a blue dot or blue label. Connect only antennas or antenna cables with blue dots or labels to the access point's 5-GHz antenna connectors.

E. Installation of WAP Enclosures
1. WAP enclosures shall be used when a diversity antenna mount is installed on the opposite side of a wall from the WAP and the WAP is installed below the ceiling.

F. Installation of data patch cords
1. Patch cords shall be rated (plenum/non-plenum) to match the horizontal cabling. Patch cords shall be plenum rated when installed in a building's
environmental air space in accordance with Section 300-22(C) of the National Electrical Code (NEC).

3.02 LABELING FOR APs

A. Horizontal Cable Labeling:
   1. All horizontal cables shall be labeled with self-laminating marking tape, Panduit LS8 labeler, or Owner approved equal. Identification shall be as follows:
      a. At the BDF or IDF end, the data horizontal cables shall be labeled with the information indicating termination of the opposite end of the cables. This shall include room/hallway location and jack designation. Data jacks specifically used for WAPs shall include an "AP" acronym directly behind the room number. Place label on a visible part of cable within 12” of termination point for ease of identification after termination.
         e.g. At the BDF or IDF end the 4-pair data cable for the 1st location in room 1137 would be labeled: 1137AP-A and 1137AP-B
         e.g. At the BDF or IDF end the 4-pair data cable for the 1st location in hallway 1H01 would be labeled: 1H01AP-A and 1H01AP-B
         Size of letters and numbers shall be no less than 5/16” high by 1/8” wide.
      b. At the rooms or hallway locations, the horizontal cables shall be labeled 4” from termination with the following: BDF/IDF TR Room # - Room # - Jack
         e.g. 1106-1137AP-A, 1106-1137AP-B. This shall be visible by removing outlet cover plate. For rooms with multiple outlet locations, identification would begin with the first receptacle to the left of the main entrance to the room and continuing clockwise around the room. Size of letters and numbers shall be as indicated above.

B. Horizontal Patch Panel Labeling (Data):
   1. At the BDF or IDF, data horizontal cables are terminated on their respective patch panels, with ports on the panels labeled in ascending room number order. All horizontal cables from same room should be terminated in sequential order at the patch panels.
      e.g. Single 4-pair cables will be labeled with a room location and a jack designation. e.g. 1137AP-A = the first data jack for a WAP in Room 1137, 1137AP-B = the second data jack for a WAP in Room 1137.
   2. Size of letters and numbers on labels for patch panels shall be no less than 3/32” high by 1/16” wide.
C. Faceplate Labeling:

1. At the rooms, the jacks will be labeled on the faceplates using the plastic insert to cover a printed identification tag with room number and proper jack designation as follows:
   a. Jack designation: Data = A through Z.
      e.g. 1195AP-A = 1st data jack for WAP in Room 1195, 1195AP-B = 2nd data jack for WAP in Room 1195.

2. Size of letters and numbers on labels for faceplates shall be no less than 3/8" high.

D. Note: The WAP PICs shall be labeled in each room starting from A/B. These PICs do not fall within the alphanumeric order of the normal PICs within the same room.

3.03 ACTIVATING NEW APs

A. Warning: In order to comply with FCC radio frequency (RF) exposure limits, indoor antennas should be located at a minimum of 7.9 inches (20 cm) or more from the body of all persons.