

## **Division 27 Communications**

### **1.1 270110 - OPERATION AND MAINTENANCE OF STRUCTURED CABLING**

- A. Cable Administration Drawings: Show building floor plans with cable administration point labeling. Identify labeling convention and show labels for telecommunications closets, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606. Furnish electronic record of drawings, in software and format selected by Owner.
- B. Record Drawings:
  - 1. Maintain current documents at the construction site. Submit with Operation and Maintenance manuals.
  - 2. Include information required for shop drawings.
  - 3. Include revisions to construction documents (addenda and field changes.)
  - 4. Include as-built drawings with outlet labeling shown for each outlet.

### **1.2 270526 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS**

- A. Quality Assurance:
  - 1. Comply with NFPA 70.
  - 2. Comply with TIA/EIA-607 for telecommunications grounding.
- B. Products:
  - 1. Grounding Conductors: Insulated with green-colored insulation.
  - 2. Grounding Bus: Bare, annealed copper bars or electro tin plated rectangular cross section, with insulators. EIA/TIA TMGB and TGB hole patterns are required on telecommunications ground bars. Manufacturers: Panduit, Erico, Harger or Chatsworth.
  - 3. Connector Products:
    - a. Comply with UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
    - b. Bolted Connectors: Bolted-pressure-type connectors, or compression type.
    - c. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.
    - d. High-Pressure Compression Connectors: Burndy Hyground System or Panduit Structured Ground System.
  - 4. Grounding Electrodes:
    - a. Ground Rods: Copper-clad steel; size: 5/8inch diameter by 120 inches long.
- C. Application:

1. High-Pressure Compression Connections: Use for grounding conductors which interconnect grounding busbars and at ground rods.
2. Compression Type Bolted Connections: Use for grounding conductors between telecommunications enclosures, including racks and cabinets, and grounding busbars. For #4 AWG and larger, use two-hole lugs. For #6 AWG and smaller, use one-hole lugs.
3. Connection at Grounding Conductor Including Connections at TBC and TBB: High-pressure compression type connectors. Grounding conductor shall not be spliced or broken.
4. Connection at Cable Tray: Bolted-pressure type mechanical connectors. When cable tray is painted, remove paint to expose bare metal or use paint piercing washers and bolts to make contact with the tray.
5. Other Connections: Compression type connectors.

D. Installation:

1. Ground Rods: Install rods spaced at a minimum 10 feet apart.
  - a. Drive ground rods until tops are 2 inches below finished floor or final grade.
  - b. Interconnect ground rods with grounding electrode conductors. Use high-pressure compression connections. Make connections without exposing steel or damaging copper coating.
2. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
3. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment.

E. Connections:

1. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
2. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
3. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use compression-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
4. High-Pressure Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible

indication that a connector has been adequately compressed on grounding conductor.

5. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

F. Telecommunications Grounding:

1. The main entrance facility/equipment room in each building shall be equipped with a telecommunications main grounding bus bar (TMGB). Each TR shall be provided with a telecommunications ground bus bar (TGB). The TMGB shall be connected to the building electrical entrance grounding facility. The intent of this system is to provide a grounding system that is equal in potential to the building electrical ground system. Therefore, ground loop current potential is minimized between telecommunications equipment and the electrical system to which it is attached.
2. Install exterior grounding electrode conductors with a minimum bending radius of 12 inches.
3. Install interior grounding conductors with a minimum bending radius of 8 inches.
4. Install TBC and TBB grounding conductors in conduit. Bond each end of the conduit to the grounding conductor using an appropriate grounding bushing.
5. When present, bond the following to the TMGB or TGB:
  - a. Metallic equipment racks.
  - b. Cable shields.
  - c. Metal raceways and cable trays for telecommunications cabling extending from the same room or space where the TMGB or TGB is located.
  - d. Telecommunications panelboards: ACEG.
  - e. Metallic equipment racks.
  - f. Building steel.
  - g. Building entrance protectors.
6. Labeling: Label ground conductors and ground bars per TIA/EIA-607 and TIA/EIA-606 standards.
7. Wires used for telecommunications grounding purposes shall be identified with a green insulation. Non-insulated wires shall be identified at each termination point with a wrap of green tape. Cables and bus bars shall be identified and labeled in accordance with EIA/TIA standards.
8. Testing: After installation of the grounding system is complete, the Contractor must test the system for continuity and ground resistance.

### 1.3 270528 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

A. Submittals:

1. Product Data: For surface raceways, wireways and fittings, hinged-cover enclosures, and cable trays.

B. Quality Assurance:

1. Comply with NFPA 70.
2. Telecommunications Pathways: Comply with TIA/EIA and BICSI standards.

C. Coordination:

1. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.
2. Coordinate layout and installation of raceways and boxes with other construction elements to ensure adequate headroom, working clearance, and access. Do not install exposed raceways on floor surfaces. Do not support from floor surfaces in a manner which impedes access to spaces or equipment or which creates a tripping hazard.
3. Pathway conduits, trays, sleeves, ducts, pull boxes, etc., shall be sized to accommodate proper cable bend radii, current cable counts, maintenance, future growth, and adequate firestopping where needed.
4. Penetrations shall be sleeved with metallic conduit or equivalent. Sleeves shall be reamed, have a grounding bushing installed on each end, and extend 4 inches beyond the wall or ceiling on each side. Sleeves shall be of sufficient size to accommodate cabling and firestopping, plus 40% spare capacity to allow for growth.
5. Cable pathway shall be accessible and follow the corridors of the building. Where basket tray or conduit is not specified, a continuous pathway of independent cable supports shall be provided. These supports must be Category 5 J-hooks or straps. The distance between supports shall not exceed 48 inches and shall be fastened to the building structure.

D. Metal Wireways:

1. Material and Construction: Sheet metal, NEMA 1 unless otherwise indicated.
2. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
3. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.
4. Wireway Covers: Screw-cover type unless otherwise indicated.

E. Surface Raceways:

1. Surface Metal Raceways: Steel with snap-on covers.

2. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.
3. Raceways shall be metallic and sized to accommodate the number of cables specified for installation with proper cable bend radii and room for additional fill. Split or dual channel raceway shall be specified for installations that require both power and telecommunication services to share raceway.

F. Boxes and Enclosures:

1. Boxes shall be manufactured by Raco, Steel City, or equivalent.
2. Interior boxes shall be hot-dipped galvanized steel.
3. Exterior boxes shall be cast boxes with threaded hubs and gasketed cover.
4. Boxes for Communications Outlets:
  - a. Recess: Hot dip galvanized sheet steel, 4-inch square, minimum, 2-5/8-inch deep. Provide with single gang trim ring.
5. Sheet Metal Pull and Junction Boxes: Galvanized or painted sheet metal with a removable cover on the largest side of the box. Include cable supports if any dimension of the box is greater than 48 inches.
6. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
  - a. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

G. Factory Finishes:

1. Finish: For raceway, wireway, enclosure, or cabinet components, provide manufacturer's standard paint applied to factory-assembled surface raceways, enclosures, and cabinets before shipping.
2. Finish: For surface raceway components, provide ivory, unless otherwise indicated.

H. Installation:

1. Install raceways, boxes, and enclosures as indicated, according to manufacturer's written instructions. Securely fasten each component to the surface on which it is mounted.
2. Where a box is attached on one side to a metal stud, provide a support bracket on the side of the box opposite the stud to prevent the box from twisting. Orient each box located above an accessible ceiling so the box opening faces down or to one side.
3. Keep telecommunications raceways at least 5 inches away from light fixtures, transformers, panelboards, and feeders. Keep non-metallic telecommunications raceways at least 24 inches away from electrical equipment, feeders, and services. Install horizontal raceway runs above water and steam piping.

4. Make bends and offsets so inside diameter is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.
5. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
  - a. Run concealed raceways parallel and perpendicular to structural members of the building.
6. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.
  - a. Run parallel or banked raceways together on common supports.
7. Join raceways with fittings designed and approved for that purpose and make joints tight.
  - a. Provide expansion joints for conduits crossing building expansion joints and for conduits connected to two separate structures.
8. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 18 inches of slack at each end of pull wire.
9. Install raceways in maximum lengths of 100 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.
10. Pull or junction boxes installed for telecommunications cable shall not function as a corner.
11. Use EMT conduit for interior penetration sleeves. Provide bushing at each end of penetration sleeve.
12. Mechanically secure penetration sleeve conduits.
13. Firestop penetrations after installation of cables with a UL listed sealant. Seal penetrations with intumescent caulk or putty. Firestopping shall be adequate to maintain the fire rating of the wall penetrated.
14. Surfaces affected by installation of penetrations shall be refinished to match adjacent surfaces.
15. Backbone (Riser) Pathways: Use a minimum of three (3) 4-inch trade size conduits or sleeves for cabling between TRs. Upon completion, there shall be a minimum of one (1) spare conduit or sleeve for future use. Where possible, a riser pathway should extend to the roof to accommodate future cabling needs. Vertical cable ladder tray shall be installed from floor to ceiling to establish a cable pathway between riser sleeves.
16. Sleeves: Install steel sleeves between stacked TRs. Sleeves shall extend 4 inches AFF and 4 inches below the deck. A minimum of three (3) 4-inch sleeves is required. Coordinate with DoIT Engineering for verification of quantity and placement in the TR. Sleeves must be fire caulked and sealed. Initial fire caulking is the responsibility of the Contractor installing the sleeves.

I. Cleaning:

1. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

J. Cable Trays for Communications Systems:

1. Manufacturers:

- a. Solid Bottom Tray:
  - 1) GS Metals / Globe.
  - 2) Square D.
- b. Cable Management Tray:
  - 1) Cablofil.
  - 2) GS Metals Corp.

2. Materials and Finishes:

- a. Protect steel hardware against corrosion by galvanizing according to ASTM B 633 or cadmium plating according to ASTM B 766.
- b. Fabricate cable tray products with rounded edges and smooth surfaces.
- c. Sizes and Configurations: Where multiple types of cable tray are specified below, refer to drawings for specific requirements for types, materials, sizes, and configurations.
  - 1) Solid Bottom Tray shall be steel with continuous steel tray cover:
    - a) Cover shall be flanged to match and mate with tray.
    - b) Cover lengths shall correspond and fit continuously between interrupting supports spaced nominal 4 feet 6 inches apart. See mounting support details on the Drawings. Verify cover lengths with field measurements.
    - c) Cover shall have 2-inch x 2-inch notch at cover edge every 24-inch minimum, with three (3) notches minimum per 4 feet 6-inch section. Notches shall have smooth edges and allow cover to be installed and removed without disturbing communications cabling entering and leaving tray through notches.
    - d) Fasten cover to tray with wrap-around clamps and bolts. Sheet metal screws shall not be allowed. Clamps shall secure each end of cover.
  - 2) Tray width: as indicated on drawings.
  - 3) Bend radius: 12 inches.
  - 4) Loading depth: 4 inches, unless otherwise indicated on Drawings.
  - 5) Wall mount brackets or trapeze hangers as indicated.
  - 6) Finish: Tray, covers, brackets, wrap-around clamps, and hardware shall be factory painted, custom color; confirm color with Owner to insure aesthetic match to interior as determined by Owner. A different custom color will be required at each building where solid bottom tray is installed.
  - 7) Loading rating: comply with NEMA 8C.
- d. Cable Management Tray:

- 1) Steel.
- 2) 2-inch x 4-inch mesh pattern.
- 3) Depth: 4 inches, unless otherwise indicated on Drawings.
- 4) Width: as indicated on drawings. Widths not commercially available shall be custom fabricated or increased in width to the next commercially available size at the Contractor's option.
- 5) Hangers: side rail hangers or trapeze hangers as indicated.
- 6) Finish:
  - a) Black Flex-E-Coat or equal inside telecommunications room and exposed areas.
  - b) Electroplated zinc galvanized above ceilings and in concealed areas.

K. Cable Tray Accessories:

1. Fittings: Tees, crosses, risers, elbows, drop outs, covers, and other fittings as indicated, of same materials and finishes as cable tray.
2. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.
3. Cutter: Utilize factory recommended flush-cutting bolt cutters for fabricating and installing Cable Management Tray.

L. Examination:

1. Examine substrates, areas, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

M. Cable Tray Installation:

1. Remove burrs and sharp edges from cable trays.
2. Fasten cable tray supports securely to building structure as specified in Division 16 Section "Basic Electrical Materials and Methods," unless otherwise indicated.
3. Install expansion connectors where cable tray crosses building expansion joint. Space connectors and set gaps according to NEMA VE 1.
4. Make changes in direction and elevation using standard and factory fittings. Custom fittings shall be required and factory fabricated.
5. Make cable tray connections using standard and factory fittings. Custom fittings shall be required and factory fabricated.
6. Locate cable tray to allow access for future cable additions and changes.
7. Seal and firestop penetrations through fire and smoke barriers.
8. Workspace: Install cable trays with sufficient space to permit access for installing cables, 6-inch minimum.
9. Locate cable tray to allow access for future cable additions and changes.

10. Workspace: Install cable trays with sufficient space to permit access for installing cables.
11. Where physical discontinuity is necessary, cables shall be mechanically supported over the discontinuity by alternate means (including hangers, brackets, hooks, distribution rings, etc.) Support cable on 2 foot centers at a minimum, and at intersections, and transitions. The supporting mechanisms shall be sufficiently spaced to support the weight of the cable. The ends of the cable tray or rack shall be electrically bonded using manufacturer-specified hardware between any physical discontinuities.
12. System shall be grounded in accordance with the NEC. Where manufacturer's hardware is not available, bonding shall be accomplished utilizing a #6 AWG green insulated bonding conductor attached with paint-penetrating threaded screw and lug to each end of the cable tray.
13. Provide an end plate fitting at each free end of a cable tray run.
14. Cable tray shall be trapeze-hung from threaded rod to structure according to detail drawings. Cable tray wall-hung may be allowed where necessary and shall utilize factory wall-mount brackets if required. See Drawings for other mounting requirements.
15. Mount vertical wall mounted cable management tray to plywood walls utilizing manufacturer provided wall-angle brackets. Modify brackets as required to provide 4-inch spacing of cable ladder from plywood wall. Touch-up any marks on the cable ladder from plywood wall. Touch-up any marks on the cable ladder with matching paint. Refer to detail drawings for mounting heights.

N. Connection:

1. Ground cable trays according to manufacturer's written instructions.
2. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

#### **1.4 270543 - UNDERGROUND DUCTS AND RACEWAYS FOR COMMUNICATIONS SYSTEMS**

A. Service Entrance Conduit:

1. Service entrance conduit sizing and quantities between buildings shall be determined by DoIT. Minimum requirements are outlined in the following paragraphs.
2. When conduits pass through exterior concrete walls of any facility, the entrance shall be watertight. Wall sleeves at service entrance points must be sized to provide a minimum of 1/2" clearance around the conduit to allow for proper sealing of the penetration.
3. Campus buildings shall be connected to the nearest manhole or new manhole if one (1) is to be installed.

B. Allowable Conduit Types:

1. Gas pipe and water pipe shall not be used for conduit under any circumstances. Two (2) types of conduit are accepted for underground conduit systems.
2. Rigid galvanized steel with threaded fittings.
3. High density Polyethylene conduit (HDPH). This type of conduit is preferred. It must be orange in color and toneable. Wall type must be SDR11 or better.

C. Minimum Requirements:

1. New facilities or major renovations must meet minimum requirements. Minimum voice, data, and video conduit required to each building is three (3) conduits and must follow the following guidelines:
2. Three (3) 4" conduits.
3. No more than the equivalent of two (2) 90° sweeps is allowed in a run, including offsets. Absolutely no "LB's" (elbows) allowed in any conduit route inside or outside plant.
4. Some buildings may require connection to each other in addition to the service entrance conduit requirement.
5. Buildings larger than 100,000 square feet shall have two (2) means of access to the campus underground conduit system. Refer to Telecom Utility Master Plan for placement.

D. Underground Duct Banks:

1. The following are general requirements for underground duct banks:
  - a. The layout of duct banks shall be parallel and perpendicular to property and building lines.
  - b. Conduit and ducts must be terminated with bell ends at the manhole, facility, or other termination point.
  - c. A nylon pull-string will be installed and tied off in each conduit.
  - d. Communications ducts shall be a minimum of 12" from power duct banks or cables.
  - e. Communications ducts shall also be a minimum of 24" from steam pipes and condensate lines if crossing perpendicular.
  - f. When communication ducts run parallel to steam lines, a minimum of a 6' separation is required to avoid conduction of heat.
  - g. Other duct separations must comply with the National Electric Code.
  - h. Rigid steel conduit encased in reinforced concrete, shall be used in any location subject to unbalanced pressure, such as under slabs, roadways, driveways, or foundations.
  - i. Necessary precautions shall be taken by the Contractor during construction to prevent the lodging of dirt, plaster, or trash in conduit, tubing, fittings, and boxes.

- j. Conduits in floors, concrete or below grade shall be swabbed free of debris and moisture before wires are pulled.

E. Marking Requirements:

1. Utility markers shall identify conduit and duct bank routes. The type of marker and manufacturer shall be obtained from DoIT and/or Creighton University Capital Project Management. Utility markers shall conform to Capital Project Management's Legend for Utility Markers. Prior approval and coordination with DoIT, Facilities Manager of Utilities, and other concerned parties is necessary when the situation requires any modification to the conduit system.
2. Damages incurred to any conduit are the responsibility of the party involved. Damages shall be reported to DoIT and Facilities Manager of Utilities immediately.

F. Vaults:

1. Minimum vault interior dimensions shall be 3 feet wide x 4 feet long x 3 feet high. Refer to Appendix for specific dimensions and additional requirements.
2. The maximum depth of vaults shall be 3 feet deep unless otherwise approved by DoIT.
3. Vaults shall be cast with the word "COMMUNICATIONS" and the manhole number assigned by DoIT.
4. Vault covers are to have recessed handles that pull out when needed for removal or indented pick points. Double sealed vault covers with handles shall be used in areas with the potential of vandalism and/or flooding.
5. Telecommunications vaults shall not be adjacent to nor share any walls with electrical manholes.
6. The maximum distance between manholes connected in any one (1) run is 400' unless otherwise approved by DoIT. The quantity of 4-inch conduits and innerducts between vaults will be determined by DoIT.
7. Interiors:
  - a. Materials used in a vault shall be resistant to corrosion.
  - b. Vault racking equipment and cable supports are mandatory for vaults. Racks in vaults shall be galvanized or zinc-coated.
  - c. Conduits entering a vault will be sealed from the outside of the vault prior to backfilling.
  - d. Conduits must be extended into the vault 4 inches and be clearly marked and labeled. Label must contain the origin of conduit or the closest point of access of conduit. Conduits and innerducts that pass through the vault must also be labeled with the above-mentioned information.
  - e. Any joints in vaults are required to be watertight.

- A. Submittals: System labeling schedules, including electronic copy of labeling schedules as specified in Part 3 of this Section, in software and format selected by Owner.
- B. Quality Assurance:
  - 1. Comply with ANSI/TIA/EIA-606 Administration Standard for the Telecommunications Infrastructure at Commercial Buildings.
  - 2. Comply with BICSI Telecommunications Distribution Methods Manual, current edition.
- C. Identification Products:
  - 1. Comply with the following:
    - a. Cable Labels: Self-adhesive vinyl or vinyl-cloth wraparound tape markers, machine printed with alphanumeric cable designations.
    - b. Label Maker: Brady I.D. Pro or approved equivalent.
- D. Identification and Labeling:
  - 1. General Label Requirements:
    - a. Mechanically print and install labels per drawing details.
    - b. Format: Select font size to be readable and to fit information required without overlap of text. Recommended font: Helvetica, Bold.
    - c. Use capital letters.
    - d. Clean surfaces prior to attachment of any label. Follow manufacturer's recommendations for cleaning and affixing labels.
  - 2. Telecommunications Outlets:
    - a. Station Outlet Faceplate Labeling:
      - 1) Label Location: On the top of the faceplate in the outlet location window. The manufacturer's paper label strip fits behind the clear plastic window.
      - 2) Label Information: Outlet numbers are unique to building. Label must include the following information:
        - a) Cable type.
        - b) Floor number.
        - c) Patch panel number.
        - d) Part number.
      - 3) Method: Use manufacturer's white paper inserts or approved equal. Utilize commercial software to print the information on an adhesive label and affix the label to the paper insert or type the information on the strip. Do not affix labels to the clear plastic window.
      - 4) Example: **V-4-01-01**
  - 3. Patch Panels:
    - a. Label Locations: Centered over each patch panel jack location.

- b. Label Information: Room number, cable type, faceplate position number.
  - c. Method: Use manufacturer's recommended labels.
  - d. Example: Room 401 - **D-4-01**
4. Coaxial Cable:
- a. Label Location: 2 inches from each end of the cable and on trunk jack modules
  - b. Example: **5730**
5. Blo-Lite Tubes:
- a. Label each end of Blo-Lite tube.
  - b. Label Locations: 12 inches from each end at each splice location.
  - c. Label Information: Origination and designation information.
  - d. Method: Use appropriately sized cable labels.
6. Outside Plant Cables:
- a. Label Location: On the jack or sheath of the cable at the ends and at every splice, case, and manhole. Place near the hardware on which the cable is terminated.
  - b. Locate label in a visible and readable location.
  - c. Label Information: The cable identifier is the cable number followed by the cable pair count (numeric characters), both the beginning and ending count. The cable identifier is unique to the campus. Refer to the schematic drawings.
  - d. Provide polyethylene non-conductive cable tags with cable numbers as shown on the plans. Provide "Mini-Tags" model number SH as manufactured by Almetek Industries, Inc.
  - e. Install tags at splices (on each cable that enters the splice case), terminations, cable tray to conduit transitions, in manholes (at least once on each cable as it passes through the manhole), and at other locations as directed by the Owner.
  - f. Example: A03 001-0100 A03 0101-0200
7. Inside Plant Cables:
- a. Label Location: Within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
  - b. Label Information: Cable number. Follow detail drawings or EIA/TIA standards.
8. Equipment Racks:
- a. Rack Label Location: On the cross bar at the top of the rack on both sides of the rack.
  - b. Rack Label Information: See detail drawings.
  - c. Example: **R001**
9. Building Fiber Terminations Within the Fiber Termination Enclosure Frames:
- a. Label Location: On the inside front panel of the enclosure in the location identified by the manufacturer for the label. In most cases, the manufacturer's label will be used and relabeled. The

connector layout within each closure may vary. In general, the columns of fiber connectors are grouped in units of six connectors. Columns count from left to right. Termination positions within a column count from top to bottom. Refer fiber termination numbering conflicts to the Owner for a decision.

## **1.6 270610 - SCHEDULES FOR STRUCTURED CABLING AND ENCLOSURES**

- A. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project, in software and format selected by Owner. Keep track of any moves, adds, or changes.

## **1.7 270800 – COMMISSIONING OF COMMUNICATIONS**

- A. A telecommunications designer, who is a BICSI certified RCDD, shall approve and stamp architectural engineered prints relating to the telecommunications infrastructure, including TRs, riser diagrams identifying cable counts and sizes, WAO locations, and logical designs. Current certifications shall be provided to DoIT in conjunction with print and/or design submittals.
- B. The cabling vendor shall provide documentation supporting their active status as a qualified certified installer prior to award of the bid and/or installation of cabling components. Copies of the certificates shall be provided to DoIT prior to installation. The Contractor, once work is completed, shall provide as-built drawings entailing final wiring configurations showing jack locations and labeling.
- C. The Ortronics CI/CIP or Berk-Tek OASIS telecommunications Contractor shall be a company specializing in communications cabling installation. At least 30% of the installation and termination crew must be certified from BICSI or Ortronics with a technician's level of training. The Contractor must be certified from Blo-Lite (General Cable) in regards to installation and certification testing of Blo-Lite tubing and fiber products when the project requires installation of air-blown fiber.
- D. CATV video systems shall be designed and engineered by an SCTE Broadband Communications Engineer. CATV video systems shall be installed and tested by SCTE broadband communications technician(s).
- E. Trades working on the installation of the telecommunications infrastructure, voice, LAN, CATV video, CCTV video, and access control systems shall provide licenses and /or certifications as required for manufacturer's warranties.
- F. Structured Cabling Testing

1. Submittals:
  - a. Field quality-control test reports.
2. Quality Assurance:
  - a. Comply with ANSI/TIA/EIA-568-B.1 Commercial Building Telecommunications Cabling Standard – Part 1 General Requirements.
  - b. Comply with ANSI/TIA/EIA-568-B.2 Commercial Building Telecommunications Cabling Standard – Part 2 Balanced Twisted-Pair Cabling Components.
  - c. Comply with ANSI/TIA/EIA-568-B.3 Optical Fiber Cabling Components Standard.
  - d. Comply with ANSI/TIA/EIA-526-14A-Method B Optical Power Loss Measured of Installed Multimode Fiber Cable plant.
  - e. Comply with BICSI Telecommunications Distribution Methods Manual, current edition.
3. Approved Test Equipment Manufacturers:
  - a. Horizontal Copper Test Equipment:
    - 1) Agilent Technologies.
    - 2) Fluke.
    - 3) Ideal Industries.
    - 4) Microtest.
  - b. Fiber Optic Test Equipment:
    - 1) Agilent Technologies.
    - 2) Alcoa Fujikura.
    - 3) Corning Cable Systems.
    - 4) Fluke.
    - 5) Ideal Industries.
    - 6) Microtest.
4. General Testing Requirements:
  - a. Install and terminate cables prior to testing.
  - b. Reterminate and retest cables which fail.
  - c. Replace cables which fail the second test.
  - d. Utilize cable testing equipment capable of generating a report for each cable tested. Provide a hard copy report per TIA/EIA-568-B.
  - e. Provide certification reports printed on 8-1/2 inch x 11 inch sheets. Provide one or more three-ring binders as required to contain reports. Provide a separate tab for each group of cables served from a common communication room. Provide an additional tab for backbone cables. Present cable testing results in a matrix format.
  - f. Perform Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of pairs installed. Remove temporary connections when tests have been satisfactorily completed.
  - g. Inspect for physical damage and test each conductor signal path for continuity and shorts. Test for faulty connectors, splices, and terminations.

5. Copper Horizontal Cable Testing:
  - a. Test horizontal cables from the punch-down blocks, patch panels, or other termination equipment, to the jacks unless otherwise noted.
  - b. Test horizontal cables from punch-down block to punch-down block.
  - c. Field Test Requirements for a Category 6 Balanced Twisted-Pair Cabling System:
    - 1) Test every cabling link in the installation in accordance with the Telecommunications Industry Association (TIA) Standard ANSI/TIA/EIA-568B, 100-Ohm Twisted-Pair Transmission Performance and Field Test Requirements.
    - 2) The test equipment (tester) must comply with or exceed the accuracy requirements for the Level III field testers as defined in the TIA Cat 6 Document. The tester including the appropriate interface adapter must meet the specified accuracy requirements.
    - 3) Test horizontal copper station cables for Category 6 according to the parameters set for in the TIA/EIA-568-B Standard. The test of each Category 6 link must contain the following parameters as detailed below. In order to pass the link test, measurements at each frequency in the range from 1 MHz through 250 MHz must meet or exceed the limit value determined in the above-mentioned Category 6 standard.
    - 4) Perform the following tests as defined in TIA/EIA-568-B: Wire map, length, insertion loss (attenuation), NEXT loss, pair-to-pair PSNEXT loss, ELFEXT loss, pair-to-pair PSELFEXT loss, return loss, ACR, PSACR, propagation delay and delay skew.
    - 5) Test Result Documentation: Record the test results information for each link in the memory of the field tester upon completion of the test. Transfer the test results records saved by the tester into a Windows™-based database utility that allows for the maintenance, inspection and archiving of these test records.
6. Copper Outside Plant Cable Testing and Reports:
  - a. Test OSP copper cable for short circuits and open or reversed pair conductors.
  - b. Report pair, problem type, and resolution activity.
  - c. Test reports not utilizing the proper cable number and pair identification numbers will be rejected.
7. Optical Fiber Testing:
  - a. General Requirements: Test every fiber optic cabling link in the installation in accordance with the field test specifications defined by the Telecommunications Industry Association (TIA standard

ANSI/TIA/EIA-568-B (or by the appropriate network application standard(s)) whichever is more demanding. See paragraph “Performance Test Parameters” in this Section.

## 1.8 271100 – COMMUNICATIONS EQUIPMENT ROOM FITTINGS

- A. These rooms have specific requirements due to the nature, size, and complexity of the equipment. Only approved (listed) Contractors distributing wiring or support equipment shall transgress pathways put in place to house voice, data, fiber, and coaxial installations. Refer to Appendix for more specific telecommunications room requirements.
- B. General Information:
1. Design considerations include, but are not limited to, location, size, lighting, ceiling, flooring, HVAC, grounding, power, doors, relay racks, clearances, and pathways required to complete the voice, LAN, CATV video, CCTV video, and access control systems. Modifications may be necessary due to University and/or building-specific needs, which typically require a minimum of 100 square feet of useable floor space. TRs shall be vertically stacked directly over one another with a minimum of two (2) common vertical walls to provide easy vertical pathway in multi-story facilities.
  2. Each MDF and IDF/TR shall be stand-alone wiring closets located such that no single UTP horizontal cable run shall exceed 200 feet. Wiring closets shall not be co-located in custodial, mechanical, electrical, or other shared space where damage to critical electronics may occur. Each room shall be sized according to use and meet the criteria listed below.
  3. Detailed layouts for relay racks, cable management, backboards, termination fields, power outlets, and appropriate clearances shall be shown on the T-drawings. One (1) wall shall be designated for the CATV layout, one (1) wall for fiber terminations, and one (1) wall for access control system layout. .
  4. Creighton University’s LAN system requires a minimum of two (2) floor-mounted relay racks per TR. Planned rack usage shall not exceed 288 connections or 30 rack-mount units. Additional racks shall be required to avoid exceeding these limits. The specifications may require room sizes to be larger than those specified by BICSI and industry standards, which bases TR size on square footage of service area.  
*Note: The use of one (1) rack may be appropriate in installations where LAN counts are minimal and future growth is limited. However, any deviation from Creighton University’s standard requirements is subject to approval by DoIT.*
  5. TRs shall have a minimum of 12-inch wide black basket tray, installed around the perimeter and over the equipment racks to provide a cable pathway. The pathway shall be strong and well secured to support the weight of the cables and any possible splice enclosures.

6. A minimum of four (4) 20-amp dedicated quad power outlets (one [1] for each area of voice, LAN, CATV video, and access control system terminations.) One (1) quad power outlet box should be placed in close proximity to the voice termination field, one (1) for the CATV video field, and one (1) for the access control system. One (1) quad power outlet box should be mounted on the wall near the location of the racks or, if the racks are located in the center of the room, the outlet box should be mounted on the back of the active electronics relay rack, 18" from the floor, outside the vertical channel of the rack.
  - a. The room shall be permanently located and not subject to change due to building alterations or rearrangement of interior partitions.
  - b. The room shall house only equipment directly related to the telecommunications system and its environmental support systems.
  - c. The room shall be directly accessible from public corridors and spaces for unrestricted access by authorized personnel.
  - d. Rooms should be free of safety hazards and should have no suspended ceilings. They should not be placed adjacent to electrical rooms or equipment. The walls must be continuous from floor to underside of the floor above. The space allotted shall be dry and free from the danger of flooding. No exposed water, gas, or steam pipes shall enter in or run through these rooms. No drains, duct, or clean-outs shall be permitted. If necessary, sump pumps should be incorporated in the environmental design.
  - e. The rooms shall be located away from sources of electromagnetic interference. Special attention shall be given to electrical power supply transformers, motors, and generators, X-ray equipment, radio or radar transmitters, and induction devices.
7. TRs shall have card access and be locked and keyed per Creighton University specifications. Refer to the Creighton University Security Standards for additional requirements.

C. Telecommunications room Physical Requirements:

1. Size: Design of the TR is dependant on the following items:
  - a. Size of building.
  - b. Floor space served.
  - c. Occupant needs.
  - d. Telecommunications services provided (PBX, etc.).
  - e. Length of horizontal run (not exceeding the 200 feet limit).
2. Every building is served by at least one (1) TR or equipment room, with a minimum of one (1) TR per floor. There is no maximum number of TRs that may be provided within a building.

<u>Floor area served:</u>	<u>Room must be at least:</u>
5,000 sq. ft. or less	10 feet x 10 feet
5,000-8,000 sq. ft.	10 feet x 12 feet
>8,000 sq. ft.	12 feet x 14 feet minimum without PBX

14 feet x 16 feet minimum with PBX

3. Design Requirements:
  - a. Floor Surface: Floors shall be VCT tile or sealed concrete. Carpet is prohibited.
  - b. Floor Loading: 50lb/ft<sup>2</sup> minimum or as required by applicable codes.
  - c. Ceiling Heights: Minimum of 8 feet 6 inches. Preferred ceiling height is 9 feet 6 inches permitting cable tray mounting at 7 feet 6 inches with adequate tray top access. To permit maximum flexibility and accessibility of cabling pathways, false ceilings are NOT permitted in TRs.
  - d. Door Size: Doorways to TRs shall be designed with minimum measurements of 3 feet x 6 feet 8 inches and shall open outward into the corridor. Door should have door sweep for dust control. The Office of Fire and Accident Prevention may approve limited exceptions. TR doors are to be keyed alike. Locksets shall be self-locking storeroom function wired for access control.
  - e. Security: Unique telecommunications key based on Creighton University master key policy and use of card swipe module to control access in and out of communication spaces.
  - f. Walls: Backboard should be provided on walls consisting of AC-grade  $\frac{3}{4}$  inches x 4 feet x 8 feet sheet plywood mechanically fastened vertically to walls of each TR. There should be no voids and should be coated with two (2) coats of fire retardant paint in an off-white or beige color design. The fire-treated plywood shall begin at 4 inches AFF and end at 8 feet 4 inches AFF with the smooth ("A") side out. The room walls shall be finished with drywall (completely taped, sanded, and painted) or concrete block (painted) prior to mounting the plywood.
4. Cable Management:
  - a. 4-inch deep cable tray shall loop the entire perimeter inside TR at no less than 7 feet 6 inches AFF. Maintain a 4-inch clearance from each wall. Support with wall-mount brackets. See sections later in this document regarding additional cable tray requirements.
  - b. 12-inch cable tray shall be installed above the top of the communications racks, spanning the width of the room. Additional sections may be added to the voice backbone wall field. Radius drop-outs shall be installed on cable trays where cables exit the tray to a lower elevation.
  - c. Extend vertical conduit sleeves a maximum of 12 inches from the floor or ceiling. Provide vertically mounted cable tray from the end of the conduit to provide vertical support for cables.
5. Drainage:
  - a. When possible, TRs shall not have floor drains in order to avoid the threat of back-flooding. Telecommunication rooms shall not be located in any area which may be threatened by flooding.

Rooms cannot be located in basements susceptible to flooding. DoIT Design and Engineering must approve any exceptions.

6. Electrical Requirements:
  - a. A minimum lighting level of 50 foot candles maintained 3' off the floor must be provided.
  - b. Power: Provide three (3) dedicated non-switched, double-duplex 120-VAC 20-amp receptacles. Multiple double duplex receptacle must be provided to power telephone key systems, computer interfaces, and other telecommunications equipment. A minimum of one (1) double duplex receptacle per wall is required. Each double-duplex receptacle outlet shall be connected to a dedicated 20-amp 120-volt circuit breaker. One (1) double-duplex receptacle shall be installed at a height of 7 feet AFF. DoIT Engineering shall determine the location. Some UPS equipment shall require a 30-amp dedicated outlet with one (1) NEMA L5-30A plug type. DoIT Design and Engineering shall determine the need and the placement of this outlet. Circuits must be tied to an emergency generator when available. Outlets must be flush when cut through plywood. TR circuits are to be labeled and identified in breaker boxes to avoid being turned off in error. General purpose 120-volt 20-amp grounded duplex receptacles should be provided every 10 linear feet.
  - c. Two (2) 120-VAC 20-amp surge protected outlets on two (2) dedicated circuits must be provided.
  - d. Grounding and Bonding: Install a contiguous intra-building grounding and bonding system in compliance with NEC Article 250 and TIA/EIA-607 using a minimum conductor size of #6 AWG to be located on each plywood backboard with ground bus bar as directed. Cable trays within the TR shall be grounded to the telecommunications grounding system with a wire not smaller than #12 AWG copper. Ground wire and clamps shall be installed on the exterior of the cable tray. For cable tray that has power coat paint, use ground clamps with paint piercing teeth to make connection to the cable tray.
7. Environmental Control:
  - a. TRs shall be environmentally controlled to maintain a room temperature range of 65° to 75° F with a maximum relative humidity level of 50%.
  - b. TRs shall be conditioned with a fresh air exchange of a minimum of one (1) air change per hour. Room cooling ability must be provided to remove a minimum of 3500 BTU per hour 24 hours a day, seven days a week, 365 days a year.
  - c. No plumbing, HVAC, or electrical conduit shall pass through or be directly above the TR. In renovation projects where new TRs are established, overhead utilities shall be relocated out of the room. Equipment rooms must be environmentally controlled 24 hours a

day, seven days a week, 365 days per year. If the building system cannot assure continuous operation, a stand-alone unit shall be provided for the equipment room. If a standby power source is available in the building, consideration should be given to connecting the HVAC system serving the telecommunications equipment room to standby supply.

- d. HVAC shall be included in the design of the room to maintain a temperature between 65° and 75° F with a minimum of one (1) air change per hour.
  - e. A positive pressure differential with respect to surrounding areas should be provided.
  - f. The humidity must be maintained between 30% and 55%.
  - g. The filters in the HVAC system should have an ASHRAE dust spot rating of 85% or better.
8. Fire Protection:
- a. As required by applicable codes. There shall be no automatic fire sprinklers except as required by building code. If sprinklers are required within the equipment area, the heads shall be provided with wire cages to prevent accidental operation. Drainage troughs shall be placed under the sprinkler pipes to prevent leakage onto the equipment within the room. For some applications, consideration should be given to the installation of alternate fire-suppression systems.

D. Equipment Racks: Freestanding and wall-mounting, aluminum units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.

- 1. Finish: Baked-polyester powder coat.
- 2. Freestanding Racks:
  - a. Configuration: Standard EIA 19”.
  - b. Height: 84 inches.
  - c. Manufacturer: Ortronics Mighty Mo 6.
- 3. Hinged Wall Bracket:
  - a. Configuration: Standard EIA 19”.
  - b. Height: 49 inches.

E. Vertical Cable Management:

- 1. Include components that aid in routing, managing, and organizing cable to and from equipment, protect network equipment by controlling cable bend radius and providing cable strain relief, and a universal design mounted to EIA 19-inch racks.
- 2. Use 6.5 inch wide Mighty Mo cable management when room has two racks and 10.5 inch Mighty Mo cable management when room has three or more racks.

F. Horizontal Cable Management:

1. Include components that aid in routing, managing, and organizing cable to and from equipment, protect network equipment by controlling cable bend radius and providing cable strain relief, and a universal design mounted to EIA 19-inch racks.
2. Install the horizontal cable management panel in between each patch panel.

G. Distribution Rings:

1. Use for supporting ground conductors in telecom room.
2. Wall Mounted 6-Inch D-Rings:
  - a. Metal: Senior Industries No. 4754 or equivalent.
3. Wall Mounted 4-Inch D-Rings:
  - a. Metal: Senior Industries No. 4753 or equivalent.

H. Cable Bundling Hardware:

1. Reusable Velcro cable ties.

I. Ladder Rack:

1. Use ladder rack to vertically support cables within telecommunications room.

J. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.

1. Number of Jacks per Field: One for each four-pair UTP cable.
2. Mounting: EIA/TIA 19-inch rack mounting.
3. TIA/EIA Category 6.
4. Front Connections: Modular jacks.
5. Rear Connections: 110.
6. Wiring Scheme: T568B.
7. Ports: 24.
8. Manufacturer: Ortronics TracJack Panel.

K. Splice Closures:

1. Designed for the number of cables, size of cables, quantity of conductors, and environment of the splice location.
2. Able to be positioned either horizontally or vertically as indicated on the drawings.
3. Closures effect a complete splice closure system and include the manufacturer's recommended hardware and parts for the splice type and environment including, but not limited to, end caps or covers, splice wrappers,

flange seals, bond connectors and clamps, ground braids, alignment bars, lubricants, cover clips, external bond braids or ribbons, and cleaning kits.

L. Splice Connecting Hardware:

1. 25-pair modular connectors specifically designed for straight splicing or half-tapping applications as required.
2. Designed to accommodate splicing of 22-26 AWG solid copper conductors having Polyvinyl Chloride (PVC) or Polyethylene Insulation (PIC).
3. Solder plated contacts and filled (encapsulated) in moisture- or corrosion-prone environments.
4. Type: MS-4000 or 710 series hardware.

M. Entrance Copper Lightning Protectors:

1. Termination Type:
  - a. In: 110 connector.
  - b. Out: 110 connector.
2. Number of Pairs: 100 pairs.
3. Fuse Type: 5-pin solid state.

N. Fiber-Optic Connectors and Termination Equipment:

1. Cable Connectors: SC connectors with self-centering, axial alignment mechanisms. Insertion loss not more than 0.7 dB.
2. Patch Panel: Modular panels housing multiple-numbered cable connectors.
  - a. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to satisfy specified expansion criteria.
  - b. Mounting: Rack.
3. Patch Cords: Dual fiber cables in 36-inch lengths.
4. Fiber Optic Splice Case:
  - a. Designed for the number of cables, size of cables, quantity of strands, and environment of the splice location.
  - b. Able to be positioned either horizontally or vertically, other than aerial.
  - c. Closures affect a complete splice closure system and include the manufacturer's recommended hardware and parts for the splice type and environment including, but not limited to, end caps or covers, splice wrappers, flange seals, bond connectors and clamps, ground braids, alignment bars, lubricants, cover clips, external bond braids or ribbons, and cleaning kits.
5. Fiber Optic Splice:
  - a. Type: Fusion.
  - b. Provide physical protection for splices.

O. Cable Bundling Products:

1. Reusable, adjustable, cable straps, capable of withstanding fastening to wall with screws or equipped with snap-and-button fasteners. Black in color. With or without cinch ring as applicable.

P. Assorted Support Products:

1. Fire Retardant Paint: A premium quality intumescent fire-retardant paint; white in color.
2. Manufacturers:
  - a. Benjamin Moore & Co.; Iron Clad Retardo Latex Fire Regardant Paint 220.
  - b. Pittsburgh Paints; Speedhide Interior Fire Retardant Flat Latex.

Q. Patch Cords:

1. Provide one closet patch cord for each station cable terminated at a patch panel.
2. The same manufacturer of the patch panel.

R. Equipment Racks and Cabinets:

1. Provide equipment racks as indicated on drawings.
2. Bolt freestanding equipment racks to the floor. Securely fasten hinged wall brackets to the wall on which they are mounted.
3. Provide horizontal cable management above and below each patch panel.
4. Provide vertical cable management on each side of each equipment rack.

S. General Optical Fiber Termination:

1. Directly terminate fiber optic cable with SC crimp connectors.
2. Use manufacturer-furnished nylon cable wrap to bundle pigtails.
3. Terminate, install, protect cable and fiber according to the connector manufacturer's recommended practices. Use the manufacturer's kits, processes, cleaners, solvents, fasteners, and other mechanisms necessary for a complete termination unless otherwise indicated herein.
4. Unless otherwise indicated, route, manage, prepare, protect, install, and store cable according to the hardware manufacturer's recommended practices. Use the manufacturer's kits, processes, cable and fiber management hardware, fasteners, and other mechanisms necessary for a complete installation.
5. Use manufacturer-recommended breakout kit to prepare outside plant cable for termination.
6. Incorporate industry standard color coding and positioning within the enclosures.

- A. Submittals:
  - 1. Product Data: Include data on features, ratings, and performance for each component specified.
- B. Twisted Pair Cables, Connectors, and Terminal Equipment:
  - 1. Cables: Listed as complying with Category 6 of TIA/EIA-568-B.
  - 2. Conductors: Solid copper.
  - 3. UTP Plenum Cable: Listed for use in air-handling spaces. Features are as specified for cables, conductors, and UTP cable, except materials are modified as required for listing.
- C. Backbone Cables:
  - 1. Category 3:
    - a. Type: UL Listed, Category 3.
    - b. Conductors: 24 AWG, copper.
    - c. Quantity of Pairs: as indicated on drawings.
    - d. Shielding: overall grounding shield.
- D. Fiber-Optic Cables:
  - 1. Cables: Factory fabricated, tight buffered, jacketed, low loss, glass type, fiber-optic cables, 125 micron cladding diameter.
  - 2. Backbone, Strands per Cable: 12 singlemode, unless otherwise indicated. See detail drawings.
  - 3. Plenum (OFNP) Rated: UL Listed for use in plenums.
  - 4. Operating Temperature Range: Minus 20 to plus 70 deg C.
  - 5. Cable Types:
    - a. Single Mode Fiber:
      - 1) Maximum Attenuation: Minus 0.70 dB/km at 850 nm. minus 0.70 dB/km at 1300 nm.
      - 2) Minimum Modal Bandwidth: Not applicable.
- E. Fiber-Optic Connectors:
  - 1. SC connectors with self-centering, axial alignment mechanisms. Insertion loss not more than 0.7 dB.
- F. Fiber-Optic Splice Cases and Splices:
  - 1. Designed for the number of cables, size of cables, quantity of fiber strands, and environment of the splice location.
  - 2. Able to be positioned either horizontally or vertically as indicated on the drawings.
  - 3. Closures affect a complete splice closure system and include the manufacturer's recommended hardware and parts for the splice type and environ-

ment including, but not limited to, end caps or covers, splice wrappers, flange seals, bond connectors and clamps, ground braids, alignment bars, lubricants, cover clips, external bond braids or ribbons, and cleaning kits.

4. Fiber-Optic Splice Type: Fusion.

G. Application of Media:

1. Backbone Cable for Data Service: Use fiber-optic cable for runs between equipment rooms and telecommunications rooms and for runs between telecommunications rooms.
2. Backbone Cable for Voice Service: Use UTP Category 3 cable for runs between equipment rooms and telecommunications rooms and for runs between telecommunications rooms.

H. Backbone Cables:

1. Provide cables for voice backbone to interconnect telecommunications rooms as indicated on drawings. Where more than 100 pairs are required for a single closet, provide multiple 100 pair cables.
2. Provide OFNP rated singlemode and fiber-optic cable in between the entrance facility and telecommunications rooms as indicated on drawings. Refer to drawings for specific strand counts.
3. Provide supports as required for vertical cable runs. Provide three supports per floor and a service loop or offset every three floors to allow for proper strain relief.
4. Where riser cables serving multiple telecommunications rooms pass through the same conduit sleeve or are mounted on the same backboard, separately bundle the cables serving each closet using commercially available wire ties.
5. Backbone cables shall be installed separately from horizontal distribution cables. Where cables are housed in conduits, the backbone and horizontal cables shall be installed in separate conduits. Where backbone cables are installed in an air return plenum, riser rated cable shall be installed in metallic conduit. Where backbone cables and distribution cables are installed in a cable tray or wire way, backbone cables shall be installed first and bundled separately from the horizontal distribution cables. Backbone cables shall be securely fastened to the side wall of the TR on each floor. Backbone cables spanning more than three (3) floors shall be securely attached at the top of the cable run with a wire mesh grip and on alternating floors or as required by local codes. Vertical runs of cable shall be supported to messenger strand, cable ladder, basket tray, or other method to provide proper support for the weight of the cable. Large bundles of cables and/or heavy cables shall be attached using metal clamps and/or metal banding to support the cables.

I. Copper Backbone Cable Installation and Termination:

1. Provide riser cables as shown on drawings.
2. Terminate riser cables on 100 pair 110 blocks.
3. Support cable with vertically installed cable ladder tray when installed in a vertical pathway.
4. Do not splice riser cables.

J. Optical Fiber Backbone Cable Installation:

1. Install fiber-optic backbone cables in innerduct. Install optical fiber cable after installation of the innerduct.
2. Provide continuous optical fiber cable from the telecom service room to the telecommunications room being served and between telecommunications rooms. Do not splice cables.
3. Install cable in accordance with the manufacturer's specifications for installation and loading. Do not violate the short and long term cable loading.
4. Do not violate the manufacturer's minimum bending radius for both loaded and unloaded conditions. Avoid cable wrinkling.
5. Replace damaged optical fiber cable with new material.
6. Provide a service loop of 20 feet at each end of each cable. Place the location of the service loop such that the cable can be extended without interference of other systems such as mechanical systems, electrical piping, plumbing, racking, etc. Wind the loop such that the cable enters the rack and distribution hardware with minimal bends. Store the loop out-of-way and fasten to the wall or ceiling to prevent possible damage. See detail drawings.

K. Outside Plant Cabling:

1. Twisted-Pair Cables, Connectors, and Terminal Equipment:
2. Outside Copper Plant Cables:
  - a. Type: RUS/REA design, PE 89 or PE 39.
  - b. Conductors: 24 AWG solid copper.
3. Splice Closures:
  - a. Designed for the number of cables, size of cables, quantity of conductors, and environment of the splice location.
  - b. Able to be positioned either horizontally or vertically as indicated on the drawings.
  - c. Closures effect a complete splice closure system and include the manufacturer's recommended hardware and parts for the splice type and environment including, but not limited to, end caps or covers, splice wrappers, flange seals, bond connectors and clamps, ground braids, alignment bars, lubricants, cover clips, external bond braids or ribbons, and cleaning kits.
4. Splice Connecting Hardware:
  - a. 25-pair modular connectors specifically designed for straight splicing or half-tapping applications as required.

- b. Designed to accommodate splicing of 22-26 AWG solid copper conductors having Polyvinyl Chloride (PVC) or Polyethylene Insulation (PIC).
- c. Solder plated contacts and filled (encapsulated) in moisture- or corrosion-prone environments.
- d. Type: MS-4000 or 710 Series.

L. Fiber-Optic Cables, Connectors, and Terminal Equipment:

- 1. Cables: Factory fabricated, loose tube, jacketed, low loss, glass type, fiber optic cables, 125 micron cladding diameter.
- 2. Strands per Cable: 24 single mode, unless otherwise indicated. See drawings in Appendix.
- 3. Outside plant rated. Rated for use in conduit.
- 4. Operating Temperature Range: Minus 20 to plus 70 deg C.
- 5. Shielding: None.
- 6. Cable Types:
  - a. Single Mode Fiber:
    - 1) Maximum Attenuation: Minus 0.35 dB/km at 850 nm; minus 0.24 dB/km at 1300 nm.
    - 2) Minimum Modal Bandwidth: Not applicable.

M. Fiber-Optic Splice Cases and Splices:

- 1. Splice Closures:
  - a. Designed for the number of cables, size of cables, quantity of strands, and environment of the splice location.
  - b. Able to be positioned either horizontally or vertically as indicated on the drawings.
  - c. Closures affect a complete splice closure system and include the manufacturer's recommended hardware and parts for the splice type and environment including, but not limited to, end caps or covers, splice wrappers, flange seals, bond connectors and clamps, ground braids, alignment bars, lubricants, cover clips, external bond braids or ribbons, and cleaning kits.
- 2. Fiber Optic Splices:
  - a. Type: Fusion.
  - b. Provide physical protection for splices.

N. Innerduct:

- 1. UL Listed, corrugated, specifically designed for optical fiber cable pathways.
- 2. Outdoor rated.
- 3. Nominal Size: 1 inch (inside diameter), minimum; 1-1/4-inch (outside diameter), maximum.
- 4. Pulling Strength: Minimum of 600 pounds.

5. Color: Orange or white.
6. Fittings and Innerduct Bodies: Utilize manufacturer's recommended fittings including couplings, adapters, end caps, end bells, expansion couplings, plugs, sleeves, a full compliment of connective devices, and other components to make a complete innerduct system suitable for its intended purpose.

O. Conduit:

1. Size: Minimum 4 inches.
2. Color: Orange.

P. Application of Media:

1. Campus Voice Backbone Cable: Use underground copper cable for runs between buildings.
2. Campus Data Backbone Cable: Use underground fiber optic cable for runs between buildings.

Q. Installation:

1. Wiring Method: Provide wiring and optical fiber in conduit, raceway and cable tray. Conceal raceway and wiring except in unfinished spaces.

R. Abandoned Cables:

1. Whenever possible, abandoned cable shall be removed from tunnels, manholes, and conduit. If it is not feasible to remove abandoned cable, it shall be clearly tagged at both ends as abandoned with appropriate labeling and shall be reported to DoIT and the Facility's Manager of Utilities.

S. Innerduct Installation:

1. Provide innerduct for each fiber optic cable.
2. Install innerduct prior to installation of the optical fiber cable. Coordinate innerduct routing path through the pathway system and receive Owner approval before innerduct is installed.
3. Provide innerduct for the entire length of the cable from termination enclosure to termination enclosure. Provide a mechanically continuous system connected to boxes, device mounting brackets, and cabinets.

T. Outside Plant Copper Installation:

1. Make splices in outside plant copper cables using mechanical tools and modules/connectors of the same manufacturer which are specifically designed for the type and size of cable being spliced. Perform splices in a splice closure. Bond metallic shields of telecommunications cables within

the closure of splices. Secure cables entering a splice case to a supporting structure so the splice case is accessible for re-entry.

2. Provide specified lightning protection on both ends of cable entering the building. Protect pairs. Properly ground entrance protector.
3. Terminate outside plant cable within 50 feet of entering building unless enclosed in metallic conduit.
4. Test and guarantee underground copper cable systems for shorts, opens, tip/ring crossovers and split pairs.

U. Outside Plant Optical Fiber Cable Installation:

1. Provide innerduct for each fiber optic cable.
2. Install optical fiber cable after installation of the innerduct.
3. Provide continuous optical fiber cable between buildings. Do not splice cables.
4. Install cable in accordance with the manufacturer's specifications for installation and loading. Do not violate the short and long term cable loading.
5. Do not violate the manufacturer's minimum bending radius for both loaded and unloaded conditions. Cable wrinkling shall be avoided.
6. Replace damaged optical fiber cable with new material.
7. Provide a service loop of 20 feet at each end of the cable and 50 feet at each manhole. Place the location of the service loop such that the cable can be extended without interference of other systems such as mechanical systems, electrical piping, plumbing, racking, etc. Wind the loop such that the cable enters the rack and distribution hardware with minimal bends. Store the loop out-of-way and fasten to the wall or ceiling to prevent possible damage.

**1.10 271333 - COMMUNICATIONS COAXIAL BACKBONE CABLING**

A. Submittals:

1. The following submittals are required:
  - a. Cables (coax, etc.).

B. Hard Line Coaxial Cable:

1. Specify Parameter III .500 hard-line coaxial CATV-R distribution cable to be installed between TRs. No kinks or damage to the outer sheath are allowable. Connectors shall be terminated with OEM specified tools. At least 10 feet of slack shall be left neatly routed around the perimeter of the termination area in each TR that it is located within. Minimum bend radius restrictions shall be observed for coaxial backbone cable.

C. Installation:

1. Installation Practices. Equipment shall be installed in a neat and workmanlike manner and to the satisfaction of an authorized representative.
2. Cable shall be adequately supported and connectors specifically designed for the type cable in use shall be installed.
3. Wiring. Bends shall be kept to a minimum with bending radius not to be less than allowed by cable manufacturer. Install cable per manufacturer's recommendations. Cables shall be installed in raceways except in accessible ceiling spaces. Corridor cable runs shall be neatly laid in cable trays above suspended ceilings.

## **1.11 271500 - COMMUNICATIONS HORIZONTAL CABLING**

### **A. Submittals:**

1. Product Data: Include data on features, ratings, and performance for each component specified.

### **B. Coordinate with pathway installer to ensure that EIA/TIA distance limits and installation tolerances are maintained. Outlets that are beyond EIA/TIA distance shall be brought to the Owner/Engineer's attention as soon as possible. Owner/Engineer shall not be responsible for outlets beyond distance limits as a result of incorrectly routed pathways.**

### **C. Twisted-Pair Cables, Connectors, and Terminal Equipment:**

1. Cables: Listed as complying with Category 6 of TIA/EIA-568-B.
2. Copper Horizontal Cables (Station Cables):
  - a. Category 6 Voice:
    - 1) Type: UTP, EIA/TIA Category 6.
    - 2) Conductors: 24 AWG, copper.
    - 3) Quantity of Pairs: 4.
    - 4) Jacket: plenum rated.
    - 5) Jacket Color: white.
    - 6) Manufacturer: Berk Tek LanMark 1000.
  - b. Category 6 Data:
    - 1) Type: UTP, EIA/TIA Category 6.
    - 2) Conductors: 24 AWG, copper.
    - 3) Quantity of Pairs: 4.
    - 4) Jacket: plenum rated.
    - 5) Jacket Color: blue.
    - 6) Manufacturer: Berk Tek LanMark 1000.
3. Jacks and Jack Assemblies for UTP Cable:
  - a. Modular Faceplate:
    - 1) Size: Single Gang.
    - 2) Outlet Positions: 4 or 6 port.
    - 3) Fillers: As required for unused jack openings.
    - 4) Color: Ivory.

- 5) Manufacturer: Ortronics.
- b. Surface Mount Boxes:
  - 1) Panduit JB ID.
- c. Voice Jack:
  - 1) Mounting: in modular faceplate.
  - 2) TIA/EIA Category: 6.
  - 3) Pins: 8.
  - 4) Connection: T568B.
  - 5) Color: electric ivory
  - 6) Manufacturer: Ortronics TracJack.
- d. Voice Jack (Wall Phone):
  - 1) Mounting: Wall plate with studs to support phone.
  - 2) TIA/EIA Category 6.
  - 3) Plate: Stainless steel.
  - 4) Pins: 8.
  - 5) Connection: T568B.
  - 6) Manufacturer: Ortronics TracJack.
- e. Data Jack:
  - 1) Mounting: In modular faceplate.
  - 2) TIA/EIA Category: 6.
  - 3) Pins: 8.
  - 4) Connection: T568B.
  - 5) Color: Blue.
  - 6) Manufacturer: Ortronics TracJack.
- 4. UTP Patch Cords:
  - a. Four-pair cables terminated with RJ-45 plug at each end.
  - b. Category 6.
  - c. Color:
    - 1) Blue for data.
    - 2) White for voice.
  - d. The same manufacturer as the connectivity.
  - e. Lengths:
    - 1) Workstation: 10 feet.
    - 2) Closet: 12 inches x 18 inches

D. Application of Media:

- 1. Horizontal Cable for Data Service: Use UTP Category 6 cable for runs between telecommunications rooms and workstation outlets.
- 2. Horizontal Cable for Voice Service: Use UTP Category 6 cable for runs between telecommunications rooms and workstation outlets.

E. Installation:

- 1. Terminate horizontal voice and data station cable and voice cable on modular patch panels in their respective TR or equipment room as specified on the drawings. Cabling shall be rack-mounted. Jacks shall be the

Ortronics Clarity6 TracJacks. Data cabling jacks shall be dark blue in color and voice jacks shall be electric ivory in color. The same type Category 6 cabling shall be used for voice, as well as for data locations. Voice wiring shall be white in color and data wiring shall be blue in color. ONLY plenum wiring shall be used for installations. Voice connectivity shall consume one (1) rack with distribution cables and data connectivity shall consume the second rack with the switching hardware. DoIT shall set forth the configuration of the data and voice rack configurations and layout. Refer to Appendix for typical rack layouts.

2. Install cables continuous from the jack on the telecommunication outlet faceplate to the termination frame serving the area. Do not splice horizontal cables.
3. Terminate cables in accordance with EIA/TIA-568-B Commercial Building Telecommunications Wiring Standard, observing the industry standards for terminating the various types of color coded cables within a building.
4. Adequately support cables from building structure in such a manner that the cable will not be damaged by normal building use. Provide strain relief for the cables above suspended ceilings, and where any continuous cable support system is interrupted, using mechanical fasteners such as Category 5 rated J-hooks and other necessary devices to support cables from the structure or ceiling support. Do not use suspended ceiling support wires or ceiling grid to support telecommunications cabling.
5. Route cables in a direct path between the termination points. Neatly arrange cables in cable trays and in communication closets.
6. Plan cable installation and cable routes such that the capacity of the conduit and cable tray is used most efficiently. Fill conduits and sleeves to maximize capacity and to minimize cross-over of future cable installations.
7. Horizontal Cables:
  - a. Route cables from outlets to communication closets so that the maximum cable length is 295 feet. Install cables parallel to the building structure.
  - b. Allow adequate slack for cable termination.
    - 1) Wall outlets: 12 inches.
    - 2) Systems furniture: as necessary to reach the farthest point on each desktop using the furniture raceways plus 12 inches at the jack location.
    - 3) Communication Rooms: as necessary to reach the most distant patch panel or punch-down block plus a length equal to 2 times the room height.
  - c. Provide 36" slack loop above ceiling on the outside of room where cable is terminated.
  - d. For areas and locations that are close to EIA/TIA distance limits, run a length test on proposed routing to said area or location. Inform Owner and Engineer of any jacks beyond EIA/TIA distance

limits. Owner and Engineer shall not be responsible for out-of-distance outlets that are not tested prior to installation.

8. Horizontal Cable Pathways:
  - a. In renovation projects, telecommunications cable pathways cannot always be accurately predicted and may need to be adjusted during construction. Direct pathways are needed to maintain cable length as required by this specification. The Engineer and Contractor shall work together in a creative and diligent manner to find short pathways for telecommunications cables.
  - b. If, in the course of installation, the Contractor finds a location that appears to exceed the distance limitation, it shall be the responsibility of the Contractor to field verify the actual distance prior to installing the horizontal cable. Upon discovery of an over-length cable, the Contractor shall cease installation of the cable and immediately notify the Owner and Engineer. The Contractor shall follow this notification with a formal Request for Information (RFI). The Contractor shall consult with the Engineer and Owner to resolve the problem. There shall be no additional payment to the Contractor for rerouting of over-length cables which are discovered after installation.
9. Patch Cords:
  - a. Provide one voice and one data closet and one station patch cord for each outlet assembly.
10. Telecommunications Outlet Assembly or Work Area Outlet (WOA):
  - a. A minimum of one (1) modular jack.
  - b. Additional accommodations for specific locations as noted in the plans for additional copper cables as necessary and may include fiber microduct or coaxial connection. The microduct does not require any mounting to the faceplate. If installed, the microduct shall only be left vacant in mounting box of the plate.
  - c. A blank filler shall be installed when extra ports are not used.
  - d. A dust cap shall be provided on modular jacks with the circuit number on the identifier strip.
  - e. The same orientation and positioning of jacks and connectors shall be utilized throughout the installation. Prior to installation, the Telecommunications Contractor shall submit the proposed configuration for each outlet assembly for review by the Owner.
11. The following are minimum WAO requirements for common locations:
  - a. Smart Classroom and Classroom: Four (4) data jacks, one (1) voice jack, one (1) CATV coaxial jack, one (1) Blo-lite tube (unpopulated), and one (1) wall-mount voice only outlet located near the podium.
  - b. Office: Two (2) data jacks, one voice jack.
  - c. Wireless Access Point: One (1) data jack.

- d. Residence Hall Rooms shall house at a bare minimum, one (1) voice, two (2) data, one (1) coaxial per work area, unless otherwise approved by DoIT.

## **1.12 271533 - COMMUNICATIONS COAXIAL HORIZONTAL CABLING**

### **A. Flexible Coaxial Cable:**

1. Station Coaxial feeds under 200' in length shall be RG-6, 75 Ohm Berk-Tek 10073067 or CommScope 2276V and plenum in construction. The following requirements are a minimum in construction:
  - a. Center Conductors: 18 AWG copper/steel.
  - b. Dielectric: Foam FRP – diameter over dielectric 0.170-inch nom.
  - c. Shield: Foil/aluminum/polyester tape 90% coverage at 34 AWG.
  - d. Jacket: Plenum PVC.
2. For coaxial feeds over 200 feet, consult with CATV service provider prior to installation of cable run.
3. Manufacturer: Ideal compression type or equal.

### **B. Coaxial Cable Connectors:**

1. Coaxial cable connectors shall be used to connect to equipment as required. Connectors shall be solderless, 75-ohm impedance and be designed for the specific type of cable used. Splices in any coaxial cable line are not acceptable. Units shall meet FCC specifications on radiation leakage.
2. Connectors for cable shall be of radiation-proof design and shall be equipped with integral compression sleeve for long-term radiation shielding.
3. Manufacturer: Ideal compression type or equal.

### **C. Installation:**

1. Installation Practices. Equipment shall be installed in a neat and workmanlike manner and to the satisfaction of an authorized representative.
2. Cable shall be adequately supported and connectors specifically designed for the type cable in use shall be installed.
3. Wiring. Bends shall be kept to a minimum with bending radius not to be less than allowed by cable manufacturer. Install cable per manufacturer's recommendations. Cables shall be installed in raceways except in accessible ceiling spaces. Corridor cable runs shall be neatly laid in cable trays above suspended ceilings.
4. Outlets shall be radially fed. Run a separate cable from each TV outlet to the nearest telecommunications room.