

## SECTION 27 15 00

INSIDE PLANT STRUCTURED CABLING SYSTEM FOR NON-RESIDENTIAL BUILDINGS

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## PART 1 - GENERAL

## 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to the work of this section.

## 1.02 SUMMARY

- A. Provide all materials and labor for the installation of an inside plant telecommunication system. This section includes Inside Plant Communications cabling, termination, and administration equipment and installation requirements for the specified Structured Cabling System (SCS - See Definition Below).
- B. This document describes the products and execution requirements relating to furnishing and installing Telecommunications Cabling at the new or remodeled residential buildings for Mason. Backbone and horizontal cabling of both copper and fiber, and related support systems are covered under this document.
- C. The Horizontal (station outlet) Cabling System shall consist of a minimum of three, Enhanced Category 6 4-pair Unshielded Twisted Pair (UTP) Copper. Some locations will also have one coaxial cable (Quad Jack) added to the station outlet. The cables shall be installed from the station outlet to the Telecommunications Room (TR) located on the same floor, routed to the appropriate rack serving that area, and terminated as specified in this document.
- D. Wireless Access points shall consist of a minimum of two Enhanced Category 6 4-pair Unshielded Twisted Pair (UTP) Copper Cables.
- E. Wall phones shall consist of one Enhanced Category 6 4-pair Unshielded Twisted Pair (UTP) Copper Cable.
- F. Elevator and Fire alarm panels each shall have one Enhanced Category 6 4-pair Unshielded Twisted Pair (UTP) Copper Cable per phone number required.
- G. Product specifications, general design considerations, and installation guidelines are provided in this document. If the bid documents are in conflict, this specification shall take precedence. The successful vendor shall meet or exceed all requirements for the cable system described in this document.
- H. Related sections include but are not necessarily limited to the following:
  - 1. Division 07 Section — "Firestopping"
  - 2. Division 01 Section — "Cutting and Patching"
  - 3. Division 26 Section — "Basic Electrical Materials and Methods"

4. Division 27 Section — "Conduit and Backboxes for Communications Systems"
5. Division 27 Section — "Grounding for Communications Systems"
6. Division 27 Section — "Underground Ducts and Raceways for Communications Systems"

I. Products furnished (but not installed) under this section:

1. Clarity Modular Category 6 Patch Cords
  - a. The following lengths shall be furnished in yellow.
    - 1) 3, 5, 7 and 9 feet lengths.
  - b. The following shall be furnished in blue.
    - 1) 3, 5, 7 and 9 feet lengths
  - c. The following shall be furnished in orange.
    - 1) 3, 5, 7 and 9 feet lengths

1.03 REFERENCES

A. General:

1. National Electrical Code (NEC)
2. National Electrical Safety Code (NESC)
3. Occupational Safety and Health Act (OSHA)

B. Communications:

1. ANSI/TIA/EIA - 455: Fiber Optic Test Standards
2. ANSI/TIA/EIA - 526: Optical Fiber Systems Test Procedures
3. ANSI/TIA/EIA - 568-B: Commercial Building Telecommunications Cabling Standard
4. ANSI/TIA/EIA - 569: Commercial Building Standard for Telecommunication Pathways and Spaces
5. ANSI/TIA/EIA - 606: The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
6. ANSI/TIA/EIA - 607: Commercial Building Grounding and Bonding Requirements for Telecommunications
7. ANSI/TIA/EIA -TSB67: Transmission Performance Specifications for Field Testing of Unshielded Twisted Pair Cabling Systems
8. ANSI/TIA/EIA -TSB75: Additional Horizontal Cabling Practices for Open Offices
9. NECA/FOA 301-1997: Standard for Installing and Testing Fiber Optic Cables
10. NECA/BICSI 568-2001: Standard for Installing Commercial Building Telecommunications Systems
11. IEEE 802.3 (series): Local Area Network Ethernet Standard, including the IEEE 802.3z Gigabit Ethernet Standard
12. ISO/IEC IS 11801: Generic Cabling for Customer Premises
13. BICSI: BICSI Telecommunications Cabling Installation Manual
14. BICSI: BICSI Telecommunications Distribution Methods Manual (TDMM)

- C. If this document and any of the documents listed above are in conflict, then the more stringent requirement shall apply. All documents listed are believed to be the most current releases of the documents. The Contractor has the responsibility to determine and adhere to the most recent release when developing the proposal for installation

## 1.04 DEFINITIONS

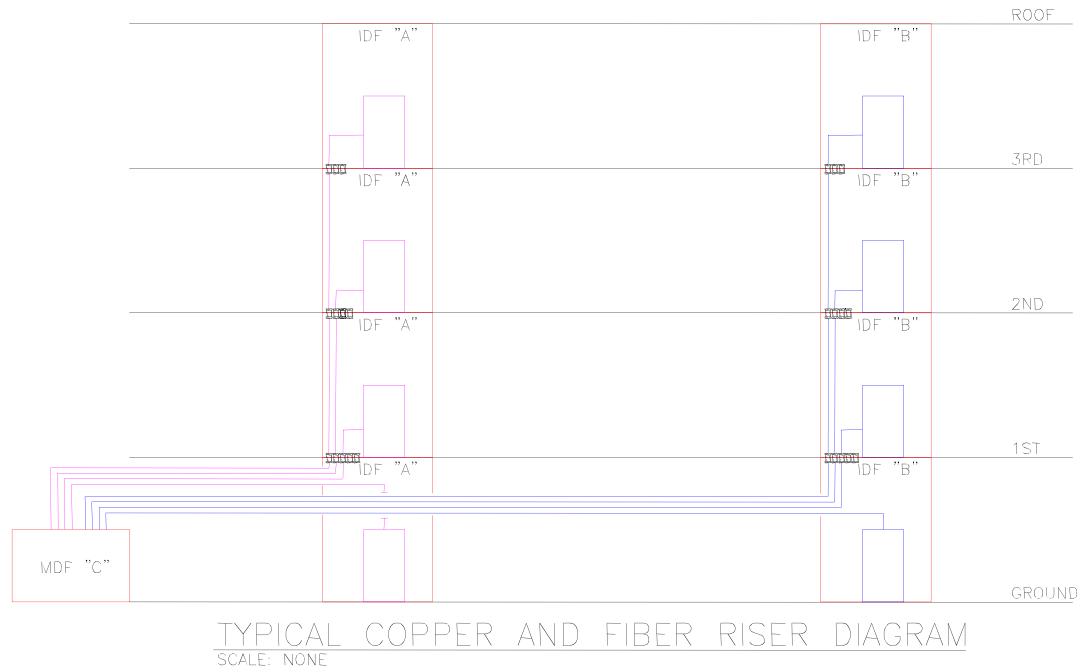
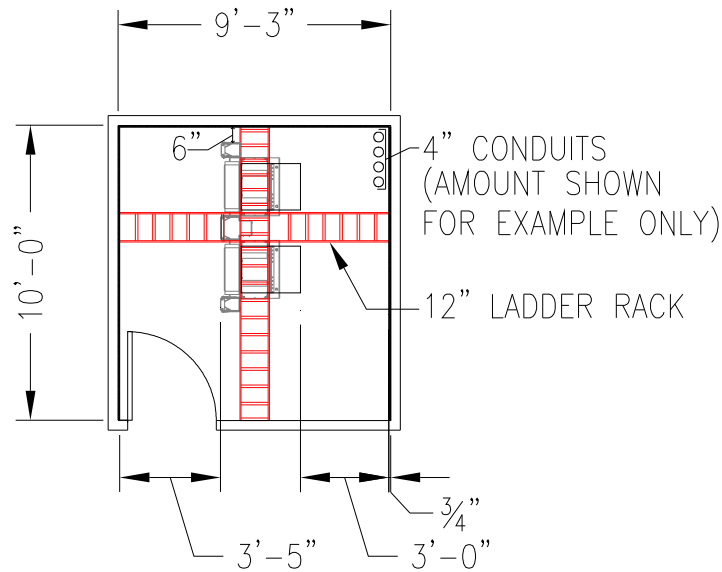
- A. "SCS" shall mean *Structured Cabling System*. The SCS is defined as all required equipment and materials including (but not limited to) ANSI/TIA/EIA 568-B and ISO/IEC 11801 compliant copper station cable (Category 3, Category 5E, Category 6, etc.) and fiber optic cable (multimode and singlemode), patch cables, stations and station connectors, termination blocks, patch panels, racks/enclosures (such as EIA standard equipment racks, enclosures, and vertical and horizontal cable management hardware), pathway/raceway materials (such as conduit, sleeves, D-rings, surface raceway, ladder rack, cable tray, etc.), and other incidental and miscellaneous equipment and materials as required for a fully operational, tested, certified, and warranted system, compliant with all applicable codes and standards.
- B. "TMGB" shall mean *Telecommunications Main Grounding Busbar*. There is typically one TMGB per building, located in the main telecommunications room. This busbar is directly bonded to the electrical service ground.
- C. "TGB" shall mean *Telecommunications Grounding Busbar*. There is typically one TGB per telecommunications room. The TGB is connected both to the TMGB and to building structural steel or other permanent metallic systems.
- D. "TBB" shall mean *Telecommunications Bonding Backbone*. The TBB is a conductor used to connect TMGBs to TGBs.
- E. "UTP" shall mean *Unshielded Twisted Pair* cable.
- F. "MTS" or "MDF" shall mean the Main Distribution Frame (Room). The MDF is the entrance facility where the Outside Plant connects to the Riser cables from the IDFs (TRs).
- G. "TR" or "IDF" shall mean Intermediate Distribution Frame. The IDFs are the floor level rooms where horizontal cable terminates.

## 1.05 SYSTEM DESCRIPTION

- A. Furnish, install, test and place into satisfactory and successful operation all equipment, materials, devices, and necessary appurtenances to provide a complete ANSI/TIA/EIA, NECA/NEIS and ISO/IEC compliant communications Structured Cabling System (SCS) as hereinafter specified and/or shown on the Contract Documents. The system is intended to be capable of integrating voice, data, and video signals
- B. The work shall include all materials, equipment and apparatus not specifically mentioned herein or noted on the plans but which are necessary to make a complete working ANSI/TIA/EIA and ISO/IEC compliant SCS.
- C. Telecommunication Rooms (IDFs)
  - 1. Telecommunication Rooms (IDFs) shall be stacked on adjacent floors on all levels. See diagram below.
  - 2. Buildings with more than 6 IDF's should have a separate MDF room.
    - a. The MDF will act as a transition point between OSP (outside plant) and interior cabling.

- b. The MDF should be located on the same floor that the OSP ductbank enters the building.
  - c. The MDF must be within 50 feet of where the OSP ductbank enters the building.
  - d. All remaining items in this section also apply to the MDF with the exception of 3 (size) and 6 (power).
  - e. Power for the MDF shall be (2) L6-30R outlets.
  - f. The MDF room size should be at least 10 feet by 10 feet.
3. Size requirements for IDF's are based on distributing telecommunications service to one individual work area per 100 sq. ft. of occupied floor space. Minimum telecommunications room sizes are shown in the table below:
- | IF THE SERVING AREA IS:                 | THEN THE ROOMS MUST BE AT LEAST |
|---|---------------------------------|
| Less than 5,000 sq. ft.                 | 10 ft. x 7 ft.                  |
| Between 5,000 sq. ft. and 8,000 sq. ft. | 10 ft. x 9 ft.                  |
| Larger than 8,000 sq. ft.               | 10 ft. x 11 ft.                 |
- Minimum adequate space provides 3 feet from the farthest extending equipment, shelf or organizer to the wall on the front, back, and one side of the racks.
- a. Multiple IDFs may be required to ensure that no horizontal cable length exceeds 90 meters (295 ft.).
- 4. All walls of each Telecommunications Room to be lined with ¾ inch fire retardant plywood.
  - 5. All Telecommunications Rooms, at a minimum, will have the following electrical outlets: two duplex electrical outlets on the walls and 2 network equipment outlets as specified in 1.5 C 5, the exact locations to be determined at a later date. All electrical outlets in Telecommunications Rooms should be on an emergency building generator if available. In addition, the rooms must provide at least an air flow of one complete air exchange per hour. The temperature must be kept between 64 and 75 degrees Fahrenheit, at all times. The Telecommunications Rooms shall also maintain positive pressure, and humidity levels between 30-40%.
  - 6. As initial design guidelines, Telecommunication Rooms that terminate less than 100 outlet locations will have (2) L5-30R outlets and a heat load of 3500 BTU/HR. Telecommunications Rooms that terminate more than 100 outlet locations will have (2) L6-30R outlets and a heat load of 10000 BTU/HR. Coordinate with NET/ITU at time of 85% drawings for final determination of exact power and heat load.
  - 7. There shall be no exposed pipes in the Telecommunications Rooms, and they shall not be shared with unrelated utilities (i.e. Security, Building Automation, etc...).
  - 8. Floors shall be VCT tile or sealed concrete, carpet is prohibited. The rated distribution floor loading should be greater than 250 psf. The rated concentrated floor loading should be greater than 1000 lbs.
  - 9. Telecommunications Rooms will not have a suspended ceiling. The recommended minimum ceiling height is 8' 6".
  - 10. Lighting requirements shall be a minimum of 50 lumens at 3' AFF. The location of lighting should coordinate closely with rack placement and should be powered by a panel not in the Telecommunications Room. Emergency lighting is recommended.

11. Telecommunications rooms shall not have door sills or center posts. The door shall be 7'H x 3'W. The locks on the doors shall be "store room function".
12. Typical Copper and Fiber Riser diagram is shown below.



1.06 SUBMITTAL INFORMATION

- A. Product Data Submittals: Provide submittal information for review before materials are delivered to the job site. Combine product submittals for all products and submit together as a single submittal.
  1. Submit a cover letter stating that the materials will be provided as specified, and specifically listing any items that will not be provided as specified. State in the letter that the Contractor has reviewed the specified items and agrees that they are applicable to this project in all respects.

2. Provide standard manufacturer's cut sheets and the operating and maintenance (O&M) instructions at the time of submittal review for each device in the system, regardless of whether it is submitted as specified or as an approved equal. These instructions shall detail how to install and service the equipment and shall include information necessary for rough-in and preparation of the building facilities to receive the materials.
  - a. For those items noted as allowing "or equal," and which are not being provided as specifically named, submit a written description detailing the reason for the substitution, along with standard manufacturer's cut sheets or other descriptive information.
- B. The telecommunications contractor shall receive approval from an authorized Mason ITU/NET member on all substitutions of material. No substituted materials shall be installed except by written approval from Mason ITU/ NET.
- C. Substitutions
  1. Any items proposed as substitutions for the above equipment must meet the following four (4) point test for equivalence:
    - a. The item must meet or exceed all electrical specifications for the specified item,
    - b. The item must be 'replaceable component compatible' with the specified item,
    - c. The item must be similar in shape, size, color and detail as to be indistinguishable to the casual observer, when replacing the specified item.
    - d. The item must provide equivalent or superior warranty to the specified item as installed.
  2. Any item that appears to pass all four (4) of the above tests can then be submitted for final determination of 'equivalence'.
  3. GMU NET holds final determination of compliance with the above points.
- D. Work shall not proceed without the Owner's approval of the submitted items.
- E. Quality Control Submittals: Provide submittal information for review as follows:
  1. Prior to bidding, in accordance with the QUALITY ASSURANCE requirements below, submit the following contractor-qualifications documentation:
    - a. Documentation from the SCS manufacturers demonstrating that the Contractor is trained and certified by the Manufacturers to install, test, and maintain the SCS and is certified by the SCS Manufacturers to provide the SCS a 25 year Manufacturer's Warranty (see PART 1 - WARRANTY).
      - 1) NetClear Warranty in accordance with the Certified Ortronics and Berk-Tek OASIS program.(for copper and fiber).
    - b. Documentation indicating that the Contractor will have only manufacturer-trained and manufacturer-certified employees perform installation, testing, and firestopping work, as detailed below.
      - 1) A list of the personnel who will be assigned to the project, the type of work they will be performing, and copies of the manufacturers' training certifications for each. If personnel changes are made during the project, submit the above information for any new personnel prior to their commencement of work on the project.
    - c. Documentation demonstrating that the Contractor employs a minimum of one Registered Communications Distribution Designer (RCDD) certified

- by and in current good standing with BICSI. The document shall declare that the RCDD is a direct full time employee of the Contractor also that the Contractor will continue to employ a minimum of one RCDD throughout the duration of the project. RCDD shall remain assigned to project from start to finish and be available to provide guidance to the installation team.
- d. List of references for no less than five similar projects (in terms of size and construction cost) performed by the Contractor under the Contractor's current business name within the past three years. Detail the following for each project:
    - 1) Project name and location
    - 2) Construction cost
    - 3) A brief description of the project, the components involved, and the SCS manufacturer used on the project.
    - 4) Number of station drops
    - 5) Customer contact names, phone numbers, and addresses
2. Submit a cable routing and grouping plan as follows:
    - a. Where the cable routing and grouping is to be provided as shown on the Contract Documents, do not provide a cable routing and grouping plan. Submit written documentation stating that the cable routing and grouping will be provided as shown on the Contract Documents, that the Contractor has reviewed the routing and grouping on the Contract Documents with applicable Subcontractors and suppliers and agrees that it does not create conflicts with other building utility infrastructure, and that the routing and grouping meets applicable codes, regulations and standards.
    - b. Where changes in cable routing and grouping are proposed, submit complete floor plan(s) and/or detail drawing(s) showing the proposed routing, raceway sizes and locations, and cabling in a manner equal to that of the Contract Documents. Ensure that any cabling changes are coordinated with comparable accommodating changes to the raceway routing and grouping. Specifically note each location where the proposed routing and grouping is different from the Contract Documents. Submit written documentation detailing the reason for each change request. Each change request must be approved in writing by the Designer prior to proceeding with the change.
  3. Submit wall field termination block and wire management elevations as follows:
    - a. Where wall field termination blocks and wire management are to be provided as shown on the Contract Documents, do not submit elevations. Submit written documentation stating that the wall field termination blocks and wire management will be provided as shown on the Contract Documents, that the Contractor has reviewed the elevations on the Contract Documents with applicable Subcontractors and suppliers and agrees that it does not create conflicts between trades, and that the elevations meet applicable codes, regulations and standards.
    - b. Where changes to the wall field termination blocks and wire management are proposed, submit wall field termination block and wire management elevations along with written documentation detailing the reason for the change. The change request must be approved in writing by Mason ITU/NET personnel prior to proceeding with the change.
  4. Submit a list of proposed test equipment for use in verifying the installation of the SCS. Proposed test equipment shall meet the criteria as stated in PART 3 – TESTING.

- a. Submit for each testing device:
    - 1) Manufacturer and product number
    - 2) Documentation from the manufacturer showing date and outcome of last re-calibration. Testing device shall have been re-calibrated within the manufacturer's recommended calibration period, encompassing the period of time when the testing device will be used on this project.
    - 3) Documentation from the manufacturer showing software revision. Software revision shall be most current revision available for the device and shall be based upon the most current ANSI/TIA/EIA testing guidelines.
  - b. Submit proposed copper and fiber cable test forms (see PART 3 – TESTING for more detail).
- F. Closeout Submittals: Provide submittal information for review as follows:
1. O&M Manual for Communications - At the completion of the project, submit O&M information from product data submittals (above), updated to reflect any changes during the course of construction, to Mason ITU/NET in the telecommunications-specific O&M Manual for Communications binder labeled with the project name and description. Provide three bound copies of the O&M Manual for Communications.
  2. Records - Maintain at the job site a minimum of one set of Record Drawings, Specification, and Addenda. Record Drawings shall consist of redline markups of changes to Contract Documents such as drawings, specifications and spreadsheets, including maintenance hole/handhole butterfly drawings.
    - a. Document changes to the system from that originally shown on the Contract Documents and clearly identify system component labels and identifiers on Record Drawings.
    - b. Keep Record Drawings at the job site and make available to the Owner and Designer at any time.
    - c. Keep Record Drawings current throughout the course of construction. ("Current" is defined as not more than one week behind actual construction).
    - d. Show identifiers for major infrastructure components on Record Drawings.
    - e. Three set of preliminary "as-builts" shall be submitted to Mason ITU/NET 60 days prior to the Mason scheduled move-in date.
    - f. Four sets of the final "as-builts" must be given to Mason ITU/NET within 2 weeks of building closeout.

#### 1.07 QUALITY ASSURANCE

- A. Contractor Qualifications:
1. Contractor shall be trained and certified by the Manufacturers to install, test, and maintain the SCS and be certified by the SCS Manufacturers to provide the SCS Manufacturers' Warranties (see PART 1 - WARRANTY).
  2. Contractor's employees directly involved with the supervision, installation, testing, and certification of the SCS shall be trained and certified by the selected SCS' manufacturers. Training and certifications by employee type are required as shown below:
    - a. Supervisors/Project Foremen: All (100%) shall be trained/certified for installation and testing.



- b. Test Technicians: All (100%) shall be trained/certified for installation and testing.
  - c. Installation Technicians: Prior to bidding, half (50%) shall be trained/certified for installation. Upon award of the project, the remaining untrained installation technicians shall be trained and certified by the manufacturer at no cost to the Owner.
  - d. Other personnel: Personnel not directly responsible for installation supervision, installation, testing or certifying the SCS (i.e. project managers, cleanup crew, etc.) are not required to be manufacturer trained and certified. Otherwise, personnel not manufacturer-trained and certified shall not be allowed on the job site.
3. Contractor's employees whose duties include the application of firestopping material shall be trained and certified by the specified firestopping manufacturer. Training and certifications by employee type are required as shown below:
    - a. Supervisors/Project Foremen: All (100%) shall be trained/certified for installation.
    - b. Firestopping Technician: All (100%) shall be trained/certified for installation.
  4. Contractor shall employ a minimum of one Registered Communications Distribution Designer (RCDD) certified by and in current good standing with BICSI. The RCDD shall be a direct full time employee of the Contractor (i.e. an RCDD consultant/sub-contractor to the Contractor is not acceptable). Contractor shall continue to employ a minimum of one RCDD throughout the duration of the project.
  5. Contractor shall have successfully completed no less than five similar projects (in terms of size and construction cost) under the Contractor's current business name within the past three years.

#### 1.08 SEQUENCING

- A. Provide coordination with the cabling manufacturers to ensure that manufacturers' inspectors are available to schedule site visits, inspections, and certification of the system. Provide and coordinate any manufacturer-required modifications and have manufacturer re-inspect and certify the system prior to the scheduled use of the system by the Owner.
- B. The Contractor is solely responsible for all costs associated with scheduling the manufacturer inspection, the inspection itself and any manufacturer-required re-inspections, and for any modifications to the installation as required by the manufacturers.

#### 1.09 WARRANTY

- A. Contractor Warranty:
  1. Provide a Contractor-endorsed two-year service warranty against defects in materials and workmanship.
    - a. Provide all labor attributable to the fulfillment of this warranty at no additional cost to the Owner.
      - 1) The Contractor Warranty period shall commence upon Owner acceptance of the work.
- B. SCS Manufacturer Warranties:

1. Provide SCS Manufacturer extended product, performance, application, and labor warranties that shall warrant all passive components used in the SCS. Additionally, these warranties shall cover components not manufactured by the SCS Manufacturers, but approved by the SCS Manufacturers for use in the SCS (i.e. "Approved Alternative Products"). The SCS Manufacturer warranties shall warrant:
  - a. That the products will be free from manufacturing defects in materials and workmanship.
  - b. That the cabling products of the installed system shall exceed the specification of ANSI/TIA/EIA 568-B and exceed ISO/IEC 11801 standards.
  - c. That the installation shall exceed the specification of ANSI/TIA/EIA 568-B and exceed ISO/IEC 11801 standards.
  - d. That the system shall be application independent and shall support both current and future applications that use the ANSI/TIA/EIA 568-B and ISO/IEC 11801 component and link/channel specifications for cabling.
2. Provide materials and labor attributable to the fulfillment of this warranty at no cost to the Owner.
3. The SCS Manufacturer Warranties shall be provided by the selected SCS Manufacturers and shall be:
  - a. NetClear 25-year System Warranty.
    - 1) Provide a copy of the warranty registration document to the Owner at the time of submittal to the SCS manufacturer..
4. The SCS Manufacturer Warranty period shall commence upon a Warranty Certificate being issued by the manufacturer. The Warranty Certificates shall be issued no later than three months after Owner acceptance of the work.

## PART 2 - PART 2 – PRODUCTS

### 2.01 GENERAL

- A. Mason has standardized on products that support the 25 year NetClear Warranty for all SCS in Mason Facilities
- B. Unless specifically stated as "Or equal", equivalent items are not acceptable. Provide items as specified.
- C. Physically verify existing site conditions prior to purchase and delivery of the materials, including but not limited to lengths of conduit and/or pathway to be used for routing backbone cabling. Pre-cut materials of insufficient length are the sole responsibility of the Contractor.
- D. SCS components shall be manufactured by the manufacturers listed below. Components shall not be intermixed between different manufacturers unless the manufacturer of the SCS has listed (in writing) another manufacturer's component as an "Approved Alternative Product" and will warrant the "Approved Alternative Product" as part of the SCS Manufacturer Warranty (see PART 1 - WARRANTY).
  1. Bid only the following SCS Manufacturers and only bid manufacturers for which the Contractor is certified. The SCS Manufacturers shall be the following. Substitution is not acceptable:

- a. Ortronics and Berk-tek for copper and fiber-related products
- E. All copper and fiber related components shall be part of the same SCS product line – Components shall not be intermixed between manufacturers’ SCS product lines. The SCS product lines shall be engineered “end-to-end” – the system and all of its components shall be engineered to function together as a single, continuous transmission path.
  1. The SCS Product Line shall be the following, per manufacturer. Substitution is not acceptable:
    - a. For Enhanced Category 6 Copper Distribution: Berk-Tek LANmark-2000.
    - b. For Fiber Distribution: Berk-Tek Premise Distribution w/Armor-Tek.
- F. Racks, rack cable distribution hardware, ladder rack, and other rack and distribution components shall be manufactured by a single manufacturer unless stated otherwise in this Specification or in the Contract Documents. Do not intermix equipment and components between different manufacturers.
  1. Rack/Distribution Equipment: Ortronics Mighty Mo 6.
  2. Wall-mount Racks and Cabinets:
    - a. Ortronics
- G. Provide all incidental and/or miscellaneous hardware not explicitly specified or shown on the Contract Documents that is required for a fully operational, tested, certified and warranted system.

## 2.02 PATHWAYS AND CABLE SUPPORTS

- A. Installation and materials for the raceway and boxes for the SCS shall be as specified under Division 16 Section — “Raceways and Boxes for Communications Circuits” except where noted below.
- B. Surface Raceway: UL listed under Section 5 with fittings including (but not limited to) mounting clips and straps, couplings, internal and external elbows, cover clips, bushings, end fittings, outlet boxes and other incidental and miscellaneous hardware required for a complete Surface Raceway system.
  1. Surface Plastic Raceway (SPR):
    - a. Wiremold 2800/2900/5400 w/Category 6 fittings
  2. Surface Metal Raceway (SMR): Wiremold w/Category 6 fittings
  3. Sleeves: EMT conduit, with insulated throat bushings for each end.
  4. Backboards: ¾ inch A-C non-fire-retardant plywood backboards, void free, 2440-mm (8-ft) high unless otherwise noted.
  5. D-Rings:
    - a. Metallic: CPI 10941, 10942, 10943
- C. Cable Supports (J-Hooks, Straps): Complete with incidental materials and assemblies required for mounting.
  1. CADDY CableCat Wide Base Cable Supports (J-Hooks):
    - a. CAT12 (up to 16 4-pair/2-strand UTP/fiber cables)
    - b. CAT21 (up to 50 4-pair/2-strand UTP/fiber cables)
    - c. CAT32 (up to 80 4-pair/2-strand UTP/fiber cables)
  2. CADDY CableCat Adjustable Cable Supports (Straps):
    - a. CAT425 (up to 425 4-pair/2-strand UTP/fiber cables)

- D. Ladder Rack: Complete with fittings including (but not limited to) splice kits, cable radius drop, radius bends, protective end caps, retaining posts, support brackets, foot kits, vertical wall brackets, wall angles, grounding hardware and other incidental and miscellaneous hardware required for a complete ladder rack system. Ladder rack components shall be manufactured by the selected Rack/Distribution Equipment manufacturer.
1. Unless otherwise indicated, all ladder rack and incidental equipment color shall be:
    - a. Black
  2. Ladder rack:
    - a. For CPI: Universal Cable Runway 10250-xxx
  3. Horizontal radius bends:
    - a. For CPI: Cable Runway E-Bend 10822-xxx
  4. Cable Retaining Posts:
    - a. For CPI: 10596-108
  5. Radius Drops:
    - a. For CPI: 1210x-xxx
  6. Ladder rack/cable runway Grounding kits:
    - a. For CPI: 12061-001
- E. Innerduct: 1 ¼" Outside Diameter, bright orange in color.
- F. Pull Strings: Plastic or nylon with a minimum test rating of 200 lb.

### 2.03 FIRESTOPPING

- A. Firestopping material: Conform to both Flame (F) and Temperature (T) ratings as required by local building codes and as tested by nationally accepted test agencies per ASTM E814 or UL 1479 fire test in a configuration that is representative of the actual field conditions. Manufactured by:
1. Specified Tech. Inc. (or approved equal).

### 2.04 EQUIPMENT RACKS/ENCLOSURES

- A. Unless otherwise indicated, equipment racks/enclosures and incidental equipment color shall be:
1. Black
- B. Unless otherwise indicated, equipment rack/enclosure/wall-mounted brackets and incidental materials and equipment shall be provided by the selected Rack/Distribution Equipment manufacturer. Do not intermix products from different manufacturers.
- C. Free Standing Equipment Racks: EIA-standard 7-foot high x 19-inch wide racks with universal alternating-hole pattern, complete with top angles, self-supporting bases, and mounting holes on both sides of the rails.
- D. Free standing Equipment Rack shall:
1. Provide the necessary strain relief, bend radius and cable routing for proper installation of high performance cross connect products, meeting all ANSI/TIA/EIA-568-B standards.
  2. Have top cable trough with waterfall and built in patch/horizontal cable distribution separator.

3. Have EIA hole pattern on front and rear.
  4. Be available with a 6.5", 10.5" and 16.25" channel depth and four post server racks.
  5. Be available with hook and loop straps for securing bulk cables inside the vertical U-channels.
  6. Assemble as 19" (483 mm) with no additional hardware.
  7. Be available with three styles of vertical patch cord management: interbay with latches, cable management rings, or fingerduct with covers.
  8. Provide floor and ceiling access for cable management and distribution.
  9. Provide pre-drilled base for floor attachment of rack.
  10. Be available in standard color of black.
  11. Be manufactured by an ISO 9001 registered company.
- E. The equipment rack shall provide vertical cable management and support for the patch cords at the front of the rack and wire management, support, and protection for the horizontal cables inside the legs of the rack. Waterfall cable management shall be provided at the top of the rack for patch cords and for horizontal cables entering the rack channels for protection and to maintain proper bend radius and cable support. Wire management shall also be mounted above each patch panel and/or piece of equipment on the rack. The rack shall include mounting brackets for cable tray ladder rack to mount to the top of the rack. Velcro cable ties shall be provided inside the rack channels to support the horizontal cable. Rack shall be black in color to match the patch panels and cable management.
1. Racks: Floor mounted racks shall be Mighty Mo 6 cable management racks, 10.5" Channel depth, 7 feet tall, 45 rack units, Ortronics P/N OR-MM6710
  2. Vertical Cable Management
    - a. Vertical Cable management between every 2 racks shall be Mighty Mo 6 cage with hinged doors, include four spools and 12 bend limiting clips, 10" x 13" x 7' Ortronics P/N OR-MM6VMD710.
    - b. Vertical Cable management for every end rack shall be Mighty Mo 6 cage with hinged doors, include four spools and 12 bend limiting clips, 6" x 8" x 7', Ortronics P/N OR-MM6VMD706.

## 2.05 GROUNDING AND BONDING

- A. As specified under Division 16 Section – "Grounding and Bonding for Telecommunications."
- B. Refer to ANSI/TIA/EIA-607
- C. Refer to NEC

## 2.06 VIDEO DISTRIBUTION EQUIPMENT

- A. All video distribution components shall be capable of functioning in a 750mhz sub-split system.
  1. All amplifiers shall be C-Cor Flexmax 900 series. All amplifiers shall be powered "in-line".

## 2.07 PATCH PANELS

- A. Fiber Patch Panels: Pre-assembled enclosures with connector panels, blank connector panels (for unused connector panel slots), and strain relief, complete with fiber connectors and fiber optic receptacle adapters and with incidental materials necessary for mounting. Fiber patch panels shall be manufactured by the selected SCS Manufacturer:
1. For Fiber:
    - a. IDF Fiber Patch Cabinet: Holds six adapter panels, Front locking door, Holds 36 SC fibers, 3.5" H, 2 rack units P/N Ortronics OR-FC02U-P.
    - b. MDF Fiber Patch Cabinet: Holds 12 adapter panels, Front locking door, Holds 72 SC fibers, 5.25" H, 3 RU, Ortronics P/N OR-FC04U-P.
    - c. Adapter Panel: 3-SC duplex (6 fibers) single-mode, blue adapters, ceramic alignment sleeves Ortronics P/N OR-OFP-SCD12AC.
    - d. Adapter Panel: 3-SC duplex (6 fibers) Multimode, aqua adapter, ceramic alignment sleeves, Ortronics P/N OR-OFP-SCD12LC.
  2. For Copper
    - a. The Modular Patch Panels shall
      - 1) meet category 6 component compliance and be verified by a third-party nationally recognized independent testing laboratory
      - 2) use low emission IDC contacts
      - 3) use dual reactance technology to enhance the signal-to-noise ratio
      - 4) require standard termination practices using a 110 impact tool
      - 5) use a single piece IDC housing designed to accept larger Category 6 conductors
      - 6) support both T568B and T568A wiring
      - 7) include easy to follow wiring labels
      - 8) include label fields
      - 9) allow for the use of icons
      - 10) include full length metal rear cable management
      - 11) be available in standard or high density
      - 12) be backward compatible to category 3, and 5
      - 13) be center tuned to category 6 test specifications
      - 14) the modular patch panel shall be compliant with the SCS warranty

## 2.08 CONNECTORS

- A. Fiber Connectors:
1. SC OptiMo Field-Installable Pre-Polished Connectors
    - a. SC 50/125, 900 Micron Buffer, Pre Polished Connector, Ortronics P/N OR-205KAS9FA-50T.
    - b. SC Single-mode, 900 Micron Buffer, Pre Polished Connector Ortronics P/N OR-205KAS9FA-09.
    - c. Substitution of Corning connectors may be made with approval from Ortronics/Berk-Tek.

## 2.09 RISER COPPER TERMINATION BLOCKS

- A. Krone
1. Series II, 10 Pair blocks, type 105 can

## 2.10 STATIONS

- A. Station cables shall each be terminated at their designated location in the connector types described in the subsections below. Included are modular telecommunication jacks. These connector assemblies shall snap into a faceplate.
- B. The station Outlet Assembly shall accommodate:
1. A minimum of three (3) modular jacks
  2. Additional accommodations for specific locations as noted in the plans for coaxial and/or additional copper cables as necessary
  3. A blank filler will be installed when extra ports are not used.
  4. The same orientation and positioning of jacks and connectors shall be utilized throughout the installation.
  5. Prior to installation, the telecommunications contractor shall submit the proposed configuration for each outlet assembly for review by the Owner.
  6. The modular jack shall incorporate printed label strip for identifying the outlet. Printed labels shall be permanent and compliant with ANSI/TIA/EIA-606-A standard specifications. Labels shall be printed using Ortronics label program (LabelMo) or using a printer such as a Brady hand held printer. Hand printed labels shall not be accepted.
- C. Faceplates: The faceplates shall:
1. be Series II style as appropriate to fit the modular jack used
  2. be UL listed and CSA certified.
  3. be constructed of high impact, ABS plastic UL 94V-0 construction (except where noted otherwise).
  4. be fog white.
  5. be compliant with the above requirements along with the following when incorporating optical fiber:
    - a. be a low profile assembly,
    - b. incorporate a mechanism for storage of cable and fiber slack needed for termination,
    - c. position the fiber optic couplings to face downward or at a downward angle to prevent contamination and,
    - d. incorporate a shroud that protects the optical couplings from impact damage.
      - 1) be available as single-gang or dual-gang.
      - 2) provide easy access for adds, moves, and changes by front removal of jack modules.
      - 3) possess recessed designation windows to facilitate labeling and identification.
      - 4) include a clear plastic cover to protect labels in the designation window.
      - 5) have mounting screws located under recessed designation windows.
      - 6) comply with ANSI/TIA/EIA-606-A work area labeling standard.
      - 7) allow for the UTP modules to be inverted in place for termination purposes.
      - 8) be manufactured by an ISO 9001 registered company.
- D. Jack Modules

1. Jacks shall be Series II, 8-position modular jacks and shall be Category 6 performance as defined by the references in this document. All pair combinations must be considered, with the worst-case measurement being the basis for compliance. Modular jack performance shall be third-party verified by a nationally recognized independent testing laboratory.
  2. The modular jack shall use dual reactance modular contact array.
  3. The modular jack shall have low emission IDC contacts.
  4. The modular jack shall use standard termination practice using 110 impact tool
  5. The modular jack shall be backwards compatible to Category 3, and 5.
  6. The modular jack shall be center tuned to category 6 test specifications.
  7. The modular jack shall be designed for the SCS.
- E. Stations to be used for wall-mount telephones: Brushed stainless steel with stainless steel mounting lugs suitable for supporting wall-mount telephones:
1. SUTTLE SE-630AD4, or approved equal.
- F. Surface Device Boxes: Surface mount device boxes shall be:
1. Wiremold
- 2.11 CABLE
- A. General: Cables shall be manufactured by the selected SCS Manufacturer.
- B. Copper Cable:
1. For Horizontal Distribution:
    - a. Plenum Enhanced Category 6, 24 AWG, bare copper wire insulated with FEP. Two insulated conductors twisted together to form a pair and four such pairs cabled to form the basic unit jacketed with flame-retardant PVC. Tested at 600 mhz.
    - b. Riser Enhanced Category 6, 24 AWG, bare copper wire insulated with polyethylene. Two insulated conductors twisted together to form a pair and four such pairs cabled to form the basic unit jacketed with flame-retardant PVC. Tested at 600 mhz.
      - 1) 4-pair, UTP, 24 AWG, with solid copper conductors
  2. For Backbone Distribution:
    - a. Copper backbone cable shall be non-shielded 24-AWG solid copper conductors insulated with color coded PVC, shall be UL Verified to TIA/EIA 568-B for Category 3 performance. Cable shall be manufactured the selected SCS Manufacturer:
- C. Coaxial Cable
1. For station outlets
    - a. All runs shall use Quad Shield RG-6 Coaxial cable.
  2. For Intra-Building Distribution
    - a. All Riser and Horizontal distribution shall use Commscope QR 540 JCA Coaxial cable
  3. For Inter-Building Backbone
    - a. All Outside Plant Coaxial Backbone shall use Commscope QR 860 JCASS Coaxial cable.
- D. Fiber Cable:
1. For Backbone Distribution:



- a. Each Multimode Fiber shall be/have:
  - 1) Graded-index optical fiber wave-guide with nominal 50/125 $\mu$ m-core/cladding diameter.
  - 2) Comply with the latest revision of ANSI/EIA/TIA-4920000.
  - 3) Attenuation measured in accordance with ANSI/EIA/TIA-455-46, 53 or 61.
  - 4) Information transmission capacity measured in accordance with ANSI/EIA/TIA-455—204 for overfilled launch.
  - 5) The measurements performed at 23 degrees C +/- 5 degrees.
  - 6) Maximum attenuation dB/Km @ 850/1300 nm: 3.5/1.5
  - 7) Bandwidth: > 1500 MHz-km @ 850nm for overfilled launch,
  - 8) Bandwidth 500 MHz-km @ 1300nm.
  - 9) Bandwidth 2000 MHz-km characterized using FOTP 220
  - 10) Optical Fiber laser optimized and guaranteed for 10 Gigabit Ethernet distances of 300m/300m for 850nm and 1300nm respectively
  - 11) Optical Fiber laser optimized and guarantee Gigabit Ethernet distances of 1000m/600m for 850nm and 1300nm respectively
- b. Physical Characteristics:
  - 1) Shall be rated for environment being distributed.
  - 2) Shall have 900 $\mu$ m tight-buffered construction
  - 3) Shall be available with a fiber stand count range from 6 to 144.
  - 4) Shall have an UL-OFNR/FT4 Flame Rating.
  - 5) Strength members shall be aramid yarn.
  - 6) Tight buffered fibers shall be color coded in accordance with EIA/TIA 598 with an overall orange jacket.
  - 7) Suitable for operation between -20° to 75° C.
  - 8) Shall comply with ICEA S-83-596
  - 9) Cables containing Laser Optimized 50/125  $\mu$ m fibers (Effective Modal Bandwidth equal or greater than 2000 MHz•km at 850 nm) shall have an AQUA jacket
- c. Each Single-mode Fiber shall be:
  - 1) Class IVa dispersion - unshifted single mode optical fibers with Low Water Peak complying with ANSI/EIA/TIA-492BAAA492CAAB-2000.
  - 2) The zero dispersion wavelength shall be between 1300 nm and 1320 nm. The ANSI/EIA/TIA-455-168 maximum value of the dispersion slope shall be no greater than 0.090 ps/km-nm<sup>2</sup>. Dispersion measurements shall be made in accordance with ANSI/EIA/TIA-455-169 or ANSI/EIA/TIA-455-175-B.
  - 3) The nominal mode field diameter shall be 9.1  $\mu$ m with a tolerance of  $\pm$ 0.4  $\mu$ m at 1310 nm when measured in accordance with ANSI/EIA/TIA-455-191-B.
  - 4) Transmission Characteristics:
  - 5) Maximum cabled attenuation dB/km @ 1310/1550 nm: 1.0/1.0
  - 6) The cabled cutoff wavelength shall be  $\leq$ 1260 nm when measured in accordance with ANSI/EIA/TIA-455-80-C
  - 7) Distance vs. bandwidth using a Laser transmitter operating at a 1310 nm wavelength

- d. Physical Characteristics:
  - 1) Shall be rated for environment being distributed.
  - 2) Shall be available with a fiber strand count range from 6 to 144.
  - 3) Bundled cable constructions shall have a sub-unit core size of 5.2mm for 12 fibers and 4.5mm for 6 fibers.
  - 4) Shall have and be marked with an UL-OFNR and OFN FT4 Flame Rating.
  - 5) Shall comply with Telcordia GR-409.
  - 6) Shall comply with the requirements of ICEA S-83-596.
  - 7) Strength members shall be dielectric and may be either FGE/aramid/yarn.
  - 8) Buffered fibers shall be color coded in accordance with EIA/TIA-598 with an overall yellow jacket.
  - 9) Shall have a ripcord for overall jacket.
  - 10) Suitable for operation between -20°C to +75°C
  - 11) Shall be of an all dielectric design
  - 12) Cables containing Single-mode shall have a YELLOW jacket
  - 13) Single-mode shall be tight buffered and manufactured by the selected SCS Manufacturer

#### 2.12 CABLE ASSEMBLIES (PATCH CORDS) AND CROSS-CONNECTS

- A. Hook and Loop Cable Managers: Reusable hook and loop (similar to Velcro) style, adjustable tension, roll or spool dispensed
- B. The contractor shall provide factory terminated and tested UTP and optical fiber patch cords and equipment cords for the complete cabling system. The UTP patch cables shall meet the requirements of ANSI/TIA/EIA-568-B for patch cord testing.
  - 1. Copper (UTP) patch cords shall:
    - a. be a Category 6 Clarity patch cord.
    - b. use 8 position connector with impedance matched contacts and designed using dual reactance.
    - c. be constructed of 100 ohm, 4 pair, 24 AWG, stranded conductor, unshielded twisted pair copper per the requirements of the ANSI/TIA/EIA-568-B.2 and standard.
    - d. meet TIA Category 6 component specifications in ANSI/TIA/EIA-568-B
      - 1) 100% factory tested to meet Category 6 performance and
      - 2) ETL or any other nationally recognized 3<sup>rd</sup> party verification
    - e. be center tuned to Category 6 performance specifications by using paired bi-level contact array
    - f. be capable of universal T568A or T568B wiring schemes.
    - g. Modular connector shall maintain the paired construction of the cable to facilitate minimum untwisting of the wires.
    - h. have a performance marking indelibly labeled on the jacket (by the manufacturer).
    - i. have the ability to accept color-coded labels and icons to comply with ANSI/TIA/EIA-606-A labeling specifications.
    - j. have “snagless” protection for the locking tab to prevent snagging and to protect locking tab in tight locations and provide bend relief
    - k. be available in three standard colors
    - l. be available in 3 foot, 5 foot, 7 foot, 9 foot, and 15 foot standard lengths

- m. be backwards compatible to Category 3, 5 and 5E
- n. be manufactured by an ISO 9001 registered company.
- o. shall be manufactured by the selected SCS Manufacturer
- 2. Optical Fiber patch cords shall:
  - a. contain two (2) multi-mode optical fibers.
  - b. use multi-mode, graded-index fibers with a 850 nm Laser Optimized 50.0micron core.
  - c. be capable of transmission at both 850 nm and 1300 nm wavelengths.
  - d. include listing of actual loss of patchcord when packaged
  - e. be manufactured in standard lengths of 1 m (3.27 ft), 2 m (6.56 ft ), 3 m (9.84 ft), 4 m ( 13.11 ft), 7 m (22.95 ft), and 10 m (32.79 ft), and special ordered in any other lengths.
  - f. be manufactured by an ISO 9001 registered company.
  - g. be manufactured by the selected SCS Manufacturer

C. Copper Jumper Wire: Category 5 (for cross connects):

### 2.13 LABELING AND ADMINISTRATION

A. Labels:

- 1. As recommended in ANSI/TIA/EIA 606. Permanent (i.e. not subject to fading or erasure), permanently affixed, and created by a hand-carried label maker or a computer/software-based label making system. Handwritten labels are not acceptable.
  - a. For Station Cable:
    - 1) 1) Brady: Bradymaker Wire Marking Labels WML-511-292 (or approved equal)
  - b. For Backbone Cable:
    - 1) 1) Panduit Marker Tie (or approved equal)

B. Hand-carried label maker:

- 1. Brady: ID Pro Plus (or approved equal).

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. The Contractor is solely responsible for the safety of the public and workers in accordance with all applicable rules, regulations, building codes and ordinances.
- B. All work shall comply with applicable safety rules and regulations including OSHA . All work shall comply with the requirements of the National Electrical Safety Code (NEC) and the NEC except where local codes and/or regulations are more stringent, in which case the local codes and/or regulations shall govern.
- C. All work shall comply with the standards, references and codes listed in PART 1 -- REFERENCES above. Where questions arise regarding which standards, references, or codes apply, the more stringent shall prevail.

- D. All work shall comply with the requirements and recommendations of the product manufacturers. Where questions arise regarding which requirements and recommendations apply, the more stringent shall prevail.
- E. Replace and/or repair to original (or better) condition any existing structures, materials, equipment, etc. inadvertently demolished or damaged by the Contractor during the course of construction at no additional cost to the Owner.
- F. Remove surplus material and debris from the job site and dispose of legally.
- G. Cleaning: Clean Telecommunication Rooms after installation activities are complete and prior to releasing them to the Owner for the Owner's use. This includes all debris, extra material, packaging, and boxes. Wipe down network racks, cabinets, horizontal and vertical managers to remove dust, dirt, etc.

### 3.02 RACEWAY

- A. Surface Raceway: Provide for all surface mounted stations as shown in the Contract Documents.
  - 1. Size surface raceway according to the quantity of cable to be routed through it according to ANSI/TIA/EIA 569 cable capacity standards, plus an additional 100% for future expansion. Size fittings/bends to accommodate Category 5/6 and fiber optic bend radii as specified in ANSI/TIA/EIA 569.
  - 2. Match surface raceway finish as close as possible to the finish of the wall it is to be mounted on but do not paint surface raceway. Surface raceway shall be:
    - a. Installed per Article 352 of the NEC. Surface raceway shall be installed as mechanically and electrically continuous and bonded in accordance with NEC and ANSI/TIA/EIA 607 codes and standards.
    - b. Installed according to ANSI/TIA/EIA standards for fiber optic and Category 5/6 bend radii. Bend points shall have a minimum two inch radius control.
    - c. Securely supported using screws or other anchor-type devices (tape or glue is not an acceptable support medium) at intervals not exceeding 5 feet and with no less than two supports per straight raceway section. Surface raceway shall be supported in accordance with the manufacturer's installation requirements.
    - d. Completely installed including insulating bushings and inserts where required by manufacturer's installation requirements.
    - e. Installed parallel and perpendicular to surfaces or exposed structural members, and following surface contours where possible.
    - f. Close any unused raceway openings.
- B. Backboards: Provide backboards as shown on Contract Documents. Backboards shall be capable of supporting attached equipment, and painted with a minimum of two coats (over primer) of fire retardant, non-conductive paint, and one coat of white colored semi gloss top coat paint. Mount A-C plywood backboards with the "A" side exposed.
- C. Sleeves: Provide sleeves where required for cable pass-thru through building structures and/or fire rated barriers. Provide roto-hammering or core drilling where required for sleeve installation. Seal (and if a fire rated barrier, firestop) between sleeve and building structure and/or barrier. Size sleeves:
  - 1. As noted in the Contract Documents.

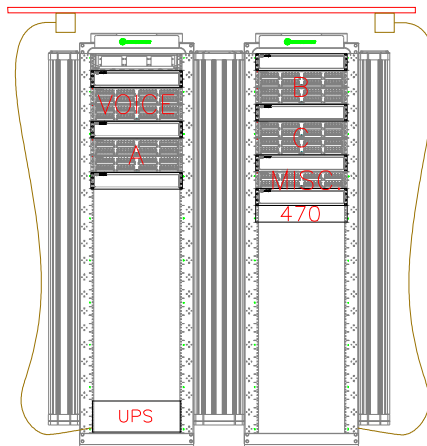
2. Where not noted, size sleeves a minimum of 2 inches in diameter or by the type and quantity of cable to be routed through the sleeve per ANSI/TIA/EIA 569 cable capacity standards plus an additional 100% for future expansion - whichever is greater.
- D. D-Rings: Provide D-Rings as necessary to route exposed cables in telecommunications rooms and on backboards and for raceway for routing cable in non-exposed open access environments, and as shown in the Contract Documents. D-Rings may be affixed to wall/ceiling structures or other supports, but not attached to a ceiling support system. In telecommunications rooms, mount D-Rings at 12 inch intervals and as shown in the Contract Documents. Mount D-rings used for raceway in open access environments at 4 foot intervals unless otherwise specified in the Contract Documents.
1. Size D-Rings as noted in the Contract Documents.
  2. Where not noted, size D-Rings according to the type and quantity of cable to be routed through the ring per TIA/EIA 569 cable capacity standards, plus an additional 100% for future expansion, but not less than a minimum of 2 inches in diameter.
- E. Cable Supports (J-Hooks, Straps): Provide cable supports for routing cable in non-exposed open access environments as shown in the Contract Documents. Cable supports may be affixed to wall/ceiling structures or other supports, but not attached to a ceiling support system. Mount cable supports at 4 foot intervals unless otherwise specified in the Contract Documents. Do not use cable supports for more cables than they were designed to support. Provide multiple cable supports where the total cable count exceeds the maximum cable count for which the support was designed. Size according to the type and quantity of cable to be routed through the ring per ANSI/TIA/EIA 569 cable capacity standards, plus an additional 50% for future expansion.
- F. Ladder Rack: Install ladder rack per manufacturer's instructions with flat (rung) side up. Provide ladder rack to affix tops of racks to walls, to route cable from walls to racks within telecommunications rooms, and in locations shown in the Contract Documents. Size and install as shown in the Contract Documents. Cut ends of ladder rack square. Ream cut ends to remove burrs and sharp edges. Cap cut ends with manufacturer's recommended caps. Mount retaining posts as required. Provide Cable Radius Drops wherever cable is to drop from one section of ladder rack to another lower section of ladder rack or onto racks or cabinets. Provide 90-degree horizontal radius bends for each 90-degree change in direction of ladder rack angle. Provide Cable Retaining Posts for all sides of ladder rack within a telecommunications room not directly adjacent to a wall. Affix posts at 2 foot centers and at corners and/or junctions. Provide Cable Runway Grounding kits across ladder rack splices and where ladder racks end at or are connected to racks/cabinets.
- G. Innerduct: Provide bright orange innerduct as pathway for backbone fiber optic cables (backbone only – not station cables), from backbone fiber patch panels to conduit or plenum entrances, and as shown in the Contract Documents. Innerduct installed in plenum rated environments shall be plenum rated.
- H. Pull Strings: Provide a pull string in existing conduits that are to remain vacant after existing cable is demolished and in existing and new conduits that have new cable installed under this project.

## 3.03 FIRESTOPPING

- A. Only employees trained/certified by the firestopping manufacturer shall apply firestopping materials.
- B. Maintain fire rating of penetrated fire barriers. Fire stop and seal penetrations made during construction.
  - 1. Provide firestopping material for through and membrane penetrations of fire-rated barriers.
  - 2. Install firestops in strict accordance with manufacturer's detailed installation procedures.
  - 3. Install firestops in accordance with fire test reports, fire resistance requirements, acceptable sample installations, manufacturer's recommendations, local fire and building authorities, and applicable codes and standards referenced in PART 1 – REFERENCES. Apply of sealing material in a manner acceptable to the local fire and building authorities.
  - 4. For demolition work, apply firestopping to open penetrations in fire rated barriers where cable is removed. Apply firestopping regardless of whether or not the penetrations are used for new cable or left empty after construction is complete.
  - 5. Firestopping material used to seal open penetrations through which cable passes shall be re-usable/re-enterable.

## 3.04 EQUIPMENT RACKS/ENCLOSURES

- A. Provide EIA racks/cabinets and all associated hardware according to locations, elevations, and plan views as shown in the Contract Documents. A typical two rack elevation is shown below.



- B. For Floor Mount Racks/Cabinets:
  - 1. Using ladder rack, horizontally affix the top of a given rack/cabinet to the wall as shown on the Contract Documents. Bolt horizontal ladder rack to rack/cabinet and to walls. Bolt rack/cabinet to floor.
- C. Free Standing Equipment Racks:
  - 1. Coordinate with Owner to identify desired location for shelf. Provide shelf, installed per Owner's direction.

2. Coordinate with Owner to identify desired location for lockable storage drawer. Provide drawer, installed per Owner's direction.

### 3.05 GROUNDING AND BONDING

- A. Grounding and bonding work shall comply with the Uniform Building Code, Uniform Fire Code, WAC, National Electrical Code, and UL 467, ANSI/TIA/EIA standards and the references listed in PART 1 – REFERENCES above, as well as local codes which may specify additional grounding and/or bonding requirements.
  1. Provide a minimum of one wall-mountable telecommunications ground bus bar per telecommunications room and as shown on the Contract Documents.
  2. Grounding conductor shall be installed to bond all non-current carrying metal telecommunications equipment and materials to the nearest TMGB or TGB (as provided under Division 16 Section — “Grounding for Communications Circuits and Raceway”).
    - a. Ensure that bonding breaks through paint to bare metallic surface of all painted metallic hardware.
    - b. Provide ladder rack grounding kits to bond each section of ladder rack and bond ladder rack to racks/cabinets where ladder racks are connected.
  3. In multi-story buildings, if there is more than (1) IDF per floor, the TGBs must be bonded together at top floor and at every third floor interval per ANSI/TIA/EIA-607.

### 3.06 VIDEO DISTRIBUTION

- A. The Video Distribution for the project shall be designed to connect to the existing 750mhz sub-split video plant.
  1. Outside Plant Backbone Cable will be Commscope QR 860 JCASS extending from the exist plant to the project. The exact location for the interconnection to the existing plant will be coordinated with Mason ITU/NET upon review of project cable plant design.
  2. Riser cable will be Commscope QR 540 JCA from the MDF to the IDFs. Amplifiers will be installed as required to provide adequate signal levels.
  3. Commscope QR 540 JCA will be used for horizontal distribution from the IDFs to a location within 150 feet of the station outlet. Tap locations will be designed and installed to provide an appropriate signal level for either 75 or 150 foot station outlet cables.
  4. Station outlet cables will be Quad Shield RG-6 coaxial cable of either 75 or 150 foot length and attached to an appropriate tap to provide 0db +-4db at the station outlet. Tilt between channel 3 and channel 105 will be no greater than 4db.

### 3.07 PATCH PANELS

- A. Provide patch panels and horizontal wire management according to locations, elevations, and plan views as shown on the Contract Documents.
  1. Fiber: Size and install rack-mountable patch panels as shown on the Contract Documents. Use fiber patch panels to terminate multimode and/or singlemode fiber backbone cables.
  2. Horizontal Wire Management: Provide horizontal wire management as shown on the Drawings.

## 3.08 CONNECTORS

- A. Copper Connectors (modular jacks):
  - 1. 1. For Horizontal Distribution:
    - a. Terminate Category 6 cable using the T568B wiring pattern.

## 3.09 COPPER TERMINATION BLOCKS

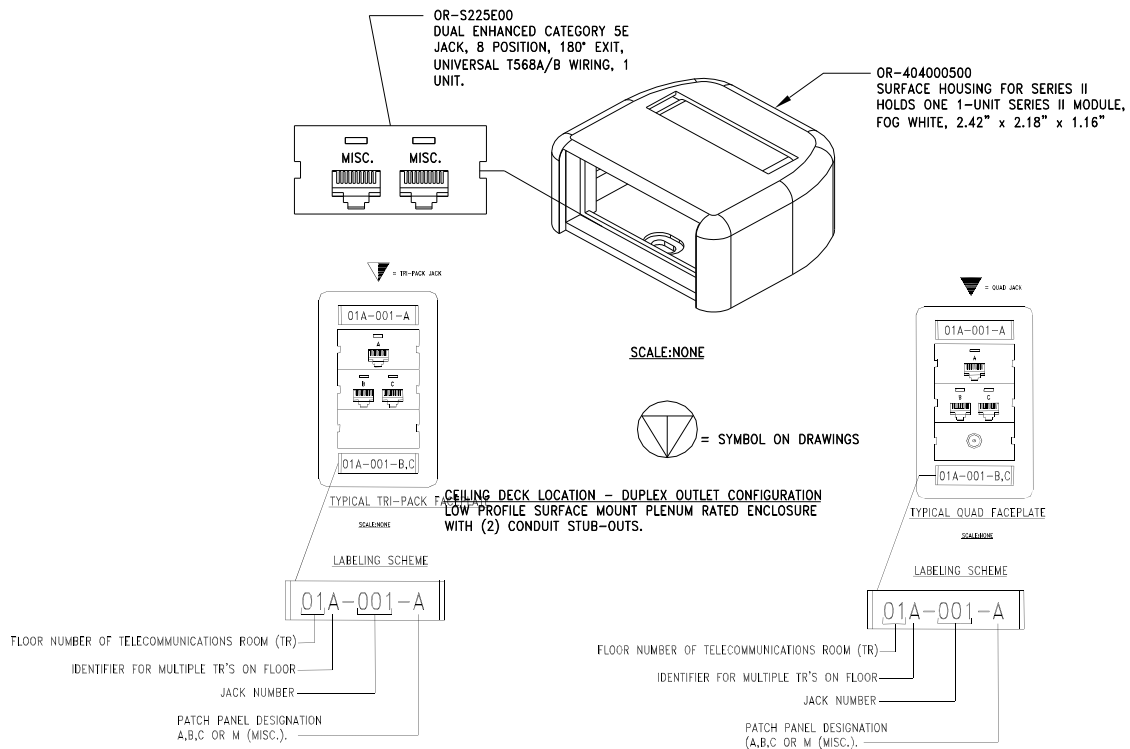
- A. Provide vertical and horizontal cable management for jumper/patch cables between termination blocks. Provide termination blocks and (jumper troughs) with or without legs based on the following mounting conditions:
  - 1. 1. Mounting on Backboards: Provide termination blocks, jumper troughs, and distribution rings with legs and as shown on the Contract Documents. Use jumper troughs above and below each termination block in a column. Use a distribution ring backboard in place of jumper troughs in the vertical middle of each column of 600 pair or more.
  - 2. 2. Mounting on Racks: Provide termination blocks and jumper troughs without legs. Use rack mount brackets to mount termination blocks on EIA standard 19" floor and wall-mount racks.
- B. Provide one horizontal cable termination block with connecting blocks, designation strips, and labels, to Owner for spare.
- C. Provide one backbone cable termination block with connecting blocks, designation strips, and labels, to Owner for spare.
- D. Route cable horizontally along base of backboard until it reaches the termination block column on which it is to terminate and then route vertically to the termination block.
- E. Install termination block wall field according to the elevations shown in the Drawings.
- F. Install termination block punch downs for riser cable as follows:
  - 1. Terminate the cable consecutively on the Krone, Series 2, 10 pair blocks.
  - 2. On the connections from the Krone blocks to the racks, terminate the cables consecutively on the Voice riser patch panel (DO NOT DROP THE 25<sup>TH</sup> PAIR IN EACH BINDER). Example: If the voice riser is 50 pair, the patch panel will be pairs 1-48, not terminating the last 2 pair of the 50 pair cable.
- G. Punch down cable using only the selected SCS Manufacturer approved impact tool.

## 3.10 STATION OUTLETS

- A. Faceplates: Provide faceplates for stations in the locations and gang counts shown on the Contract Documents. Faceplates shall completely conceal outlet boxes, reducer plates, etc. Faceplates shall provide a snug and sure fit for connectors – loose connectors are not acceptable.
- B. Faceplates shall be level and plumb.
- C. Faceplate Mounting Brackets: Provide faceplate mounting brackets as required and as shown for flush mounted communications outlets.



- D. Surface Device Boxes: Provide surface mount device boxes as required and as shown for surface mounted communications outlets.
- E. Dual Port RJ45 outlet will be installed and concealed above the common area ceiling for wireless access points (WAP). The outlet must be installed in an appropriate enclosure for the location. The number and locations will need to be sufficient to provide adequate coverage for all bedrooms and common areas. See drawing below.
- F. Station Outlets: Provide appropriate amount of Enhanced Category 6 cable and coax (if applicable) to the outlet. All outlets shall be wired with the T568B standard. All outlets containing three Enhanced Category 6 cables shall be wired in an (A, B, C) configuration. Each outlet shall have a single RJ45 jack insert in the top position, and a dual RJ45 insert in the middle and a single F connector in the bottom position. Each outlet shall be wired with the top single RJ45 port labeled “A”. The middle left RJ45 port labeled “B” to the horizontal patch panel labeled “B”. The middle right RJ45 port labeled “C” to the horizontal patch panel labeled “C”. All outlets with one or two Enhanced Category 6 cables shall terminate on a separate appropriately sized patch panel, marked “miscellaneous”, in the Telecommunications Room. No horizontal cable can exceed a length of 90 meters (295 ft.) from patch panel to station jack. **See drawing below.**



### 3.11 CABLE

- A. General (applicable to all cable types): Provide non-plenum (CM/CMR, OFNR) rated cable for locations where cable is to be installed in conduit. For cable not installed in conduit, provide plenum (CMP, OFNP) rated cable if cable is installed in a plenum air

space environment, non-plenum rated otherwise. Cabling shall bear plenum or non-plenum markings for the environment in which it is installed.

1. For Horizontal Distribution: Provide station cable in types, sizes, and quantities as defined by the Symbol Schedule and as shown on the Contract Documents. Install cable between the station and its associated telecommunications room. Provide one cable per each connector at each station.
2. Install cable in compliance with ANSI/TIA/EIA and ISO/IEC 11801 requirements and BICSI TCIM practices.
3. Penetrations through floor and fire-rated walls shall utilize metallic sleeves and shall be fire-stopped after installation and testing, utilizing a firestopping system approved for that application.
4. Adhere to the bending radius and pull strength requirements as detailed in the ANSI/TIA/EIA standards and the manufacturer's installation recommendations during cable handling and installation.
  - a. Pull all cables simultaneously where more than one cable is being installed in the same raceway.
  - b. Use pulling compound or lubricant where necessary. Use compounds that will not damage conductor or insulation (Polywater, or approved equal).
  - c. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage media or raceway. Repair or replace conduit bushings that become damaged during cabling installation.
5. Install cable in a continuous (non-spliced) manner unless otherwise indicated.
6. Install exposed cable parallel to and perpendicular to surfaces on exposed structural members and follow surface contours where possible.
7. Tie or clamp cabling. Attaching cables to pipes, electrical conduit, mechanical items, existing cables, or the ceiling support system (grids, hanger wires, etc.) is not acceptable. Install tie-wraps in conformance with the SCS manufacturer's installation recommendations. Do not over-tighten tie wraps or cause cross-sectional deformation of cabling.
8. Cable at the backboards:
  - a. Lay and dress cables to allow other cables to enter raceway (conduit or otherwise) without difficulty at a later time by maintaining a working distance from these openings.
  - b. Route cable as close as possible to the ceiling, floor, sides, or corners to insure that adequate wall or backboard space is available for current and future equipment and for cable terminations.
  - c. Lay cables via the shortest route directly to the nearest edge of the backboard from mounted equipment or blocks. Support cables so as not to create a load on the equipment upon which the cables are terminated. Tie-wrap similarly routed and similar cables together and attach to D-rings vertically and/or horizontally, then route over a path that will offer minimum obstruction to future installations of equipment, backboards or other cables.
  - d. See COPPER TERMINATION BLOCKS above for details on routing copper cabling to termination blocks.
9. Cable in the telecommunications rooms:
  - a. For telecommunications rooms with ladder rack, lay cable neatly in ladder rack in even bundles and loosely secure cabling to the ladder rack at regular intervals with tie-wraps or hook-and-loop straps.
10. Cable terminating on patch panels located on racks:

- a. Route cables in telecommunications rooms to patch panels on racks by routing across ladder rack across top of rack and then down vertical ladder rack to patch panel.
- B. Copper Cable: Terminate all pairs within a cable. Un-terminated cable pairs are not acceptable.
  1. For horizontal distribution: Provide station cable in the locations shown on the Contract Documents. Provide service loops with a minimum length of 12 inches in outlet boxes and no less than 10 feet in the ER/TR's.
    - a. For workstation outlets with both Category 6 and coaxial cable for TV Distribution, terminate Category 6 cabling after coaxial cable has been installed and terminated.
    - b. Route station cable that is exposed (not in conduit) to comply with ANSI/TIA/EIA-569 requirements for avoiding potential EMI sources and as follows:
      - 1) 48 inches from motors or transformers
      - 2) 12 inches from conduit and cables used for electrical power distribution
      - 3) 5 inches from fluorescent lighting
- C. Fiber Cable: Terminate all fiber strands within a fiber cable. The installation of "dark fiber" is acceptable upon approval by Mason ITU/NET.

### 3.12 CABLE ASSEMBLIES (PATCH CORDS) AND CROSS-CONNECTS

- A. Furnish copper patch cables for modular copper cross-connects. Use a quantity of 1.25, 9ft patch cables for every station outlet for budgeting purposes. Exact quantities and colors to be coordinated with Mason ITU/NET at the time that the preliminary as-builts, as specified in Section 1.6 F, are delivered. Cables to be delivered to Mason ITU/NET within 6 weeks of the quantities being provided.
- B. Furnish fiber patch cables for fiber cross connects. Deliver patch cables to Owner in the lengths and quantities below:
  1. For Multimode:
    - a. Length (e.g. 3m) - (Qty. 20), Type: (Duplex SC-to-SC)
    - b. Length (e.g. 1m) - (Qty. 20), Type: (Duplex SC-to-SC)
- C. Furnish one (1) spool of Category 5 jumper wire for each telecommunications room for cross connects and deliver unopened to Owner.
- D. Furnish hook-and-loop cable managers for managing patch cords in the telecommunications rooms. Provide in colors, sizes and quantities as indicated below. Cable managers shall be the same color as the patch cable type that they manage.
  1. Furnish four (4) cable managers each 6 inches in length for each telecommunications room with fiber connectivity
  2. Furnish one roll of 50 cable managers each 6 inches in length for use in Main Equipment Room.

### 3.13 LABELING AND ADMINISTRATION

- A. General: Labeling and administration shall comply with ANSI/TIA/EIA 606 and standard industry practices.

- B. Telecommunications Rooms: Affix a permanent label to the door of each telecommunications room. Where telecommunications room names are required in other labels, use the telecommunication room name shown on the Contract Documents.
- C. Racks: Label racks as shown on the Contract Documents. Affix label centered across top cross-member of rack.
- D. Grounding/Bonding Conductors: Label bonding conductors; “WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!”
- E. Cables:
  - 1. Label Location: Affix at each end of the cable.
  - 2. Station Cables: Label station cables with the same label as the station connector (see STATION CONNECTORS (PORTS) below) that terminates the cable at the station location. Include a clear vinyl adhesive wrapping applied over the label in order to permanently affix the label to the cable. Using transparent tape to affix labels to cables is not acceptable.
  - 3. Provide labels at each end of each cable within 24” of telecommunications room entrance and again within 24” of termination point.
- F. Termination Blocks:
  - 1. General:
    - a. Label termination block ports/pairs sequentially beginning on the first row of each termination block column. Begin with “001” for the first port/pair.
    - b. Label termination strip pairs sequentially (left to right).
  - 2. For Horizontal Distribution:
    - a. Label station outlets in accordance with EIA/TIA-606 using typed or computer printed labels that fit the jack insert and are consistent with the patch panel labeling in the Telecommunications Room. (I.E. The top label on the faceplate of the first outlet from the First Floor A Telecommunications Room will be 1A-001-A and the bottom label on the same outlet will be 1A-001-B, C. Label jacks with three UTP cables as follows:
      - 1) First character – The floor designator, 1.
      - 2) Second character – Telecommunications Room Designator, A.
      - 3) Third, fourth, and fifth character – a three-digit number identifying each outlet, numbered sequentially.
      - 4) Sixth character - A, B, or C based on the position of the port in the outlet.
    - b. Label cables and patch panels with designations that are the same as the outlet.
    - c. Outlets shall be numbered on the patch panels sequentially starting with 001. DO NOT skip outlet numbers on the patch panels. If a pre-numbered outlet has been deleted, leave that position blank on the patch panel.
- G. Conduits: Label each conduit end (existing or new) in a clear manner by designating the location of the other end of the conduit (i.e. room name, telecommunications room identifier, pull box identifier, outlet identifier (use the label of the first port of the outlet as the outlet identifier), etc.). Indicate conduit length on the label.

- H. Pull Strings: Label each pull string in a clear manner by designating the location of the other end of the pull string (i.e. room name, telecommunications room name, pull box identifier, outlet identifier (use the label of the first port of the outlet as the outlet identifier), etc.).

### 3.14 TESTING

- A. Provide test records on a form approved by the Owner and Designer. Include the test results for each cable in the system. Submit the test results for each cable tested with identification as discussed under LABELING AND ADMINISTRATION above. Include the cable identifier, outcome of test, indication of errors found, cable length, retest results, and name and signature of technician completing the tests. Provide test results to the Owner and Designer for review and acceptance within two weeks of Substantial Completion.
  - 1. Print test records for each cable within the system directly from the tester and submit in paper form (in a binder) and in electronic form (on diskette or CDROM) to the Owner and Designer for review. Handwritten test results will not be accepted.
- B. Test the SCS after installation for compliance to all applicable standards as follows:
  - 1. Copper:
    - a. For Horizontal Distribution: Test all pairs of each copper station cable, for conformance to ANSI/TIA/EIA 568-B Category 6, and ANSI/TIA/EIA 568-B standards. To the extent possible, perform tests with building electrical systems fully powered on (i.e. Lights, HVAC, etc.).
      - 1) Test each end-to-end link (the entire channel from the connector at the station to the connector or termination in the telecommunications room) utilizing sweep tests, for continuity, shorts, polarity, near-end cross talk (NEXT), far-end cross talk (FEXT), attenuation, installed length, transposition (wire map), mutual capacitance, characteristic impedance, resistance, ACR, and presence of AC voltage. Use the Power Sum method to test NEXT and FEXT. Test each cable in both directions.
        - a) Testing Device: Fluke DSP-4000 with latest software and hardware releases.
  - 2. Fiber: Test fiber optic cable on the reel upon delivery to the job site prior to installation, and again after installation.
    - a. Prior to testing, calculate the cable loss budget for each fiber optic cable and clearly show the result on the test documentation. Calculate maximum loss using the following formula, assuming no splices:
      - 1) For Horizontal Distribution:
        - b)  $\text{Max Loss} = 2.0\text{db (per ANSI/TIA/EIA 568-B)}$
      - 2) For Backbone Distribution:
        - c)  $\text{Max Loss} = [(\text{allowable loss/km}) * (\text{km of fiber})] + [(.3\text{db}) * (\text{\# of connectors})]$
        - d) A mated connector to connector interface is defined as a single connector for the purposes of the above formula.

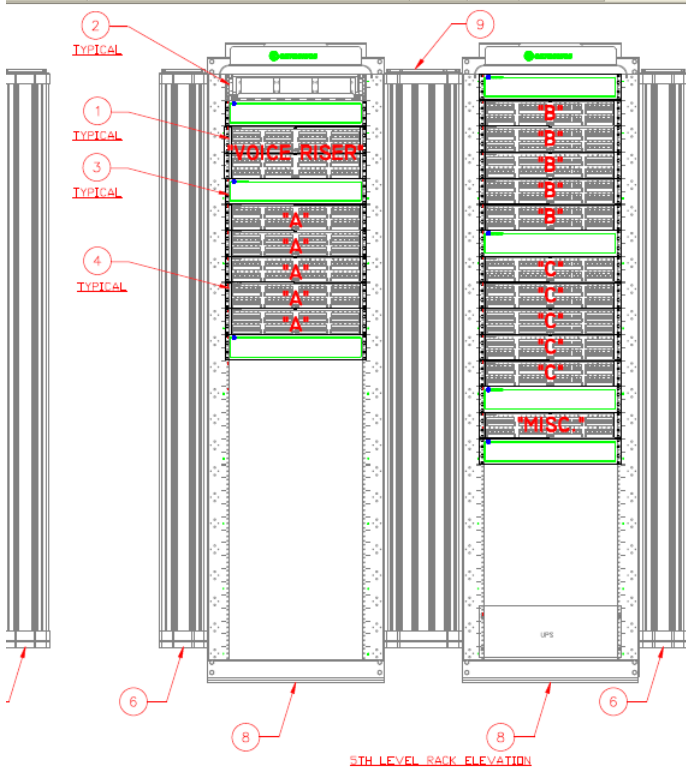
- e) A given fiber strand shall not exceed its calculated maximum loss (per the above formula).
- b. Test all strands using a bi-directional end-to-end optical transmission loss test instrument (such as an OTDR) trace performed per ANSI/TIA/EIA 455-61 or a bi-directional end-to-end power meter test performed per ANSI/TIA/EIA 455-53A, and ANSI/TIA/EIA 568-B.
  - 1) Calculate loss numbers by taking the sum of the two bi-directional measurements and dividing that sum by two.
  - 2) Provide test measurements as follows:
    - f) For Multimode Cable: Test at both 850 and 1300nm.
- c. For Singlemode Cable: Test at both 1310 and 1550nm.
- d. Test results shall conform to:
  - 1) The criteria specified in ANSI/TIA/EIA-568B
  - 2) The Contractor's calculated loss budget above
  - 3) The criteria specified in IEEE 802.3z (1000Base-X Gigabit Ethernet)
    - g) In addition to the above, perform tests both recommended and mandated by manufacturer. Tests shall confirm/guarantee compliance to manufacturer's performance standards and also IEEE 802.3z for a maximum end-to-end dB loss of 2.5 dB.
  - 4) The criteria specified in IEEE 802.3z (1000Base-X Gigabit Ethernet)
- C. Identify cables and equipment that do not pass to the Owner and Designer. Determine the source of the non-compliance and replace or correct the cable or the connection materials, and retest the cable or connection materials at no additional expense to the Owner. Provide new test results to the Owner and Designer in the same manner as above.
  - 1. In addition to the above, if it is determined that the cable is at fault, remove the damaged cable and replace it with a new cable. Cable "repairs" are not acceptable. The procedure for removing the cable shall be as follows:
    - a. Prior to removal of damaged cable and installation of new cable:
      - 1) Inform the Owner and Designer of the schedule for the removal and installation.
      - 2) Test the new cable on the reel per paragraph B, above.
      - 3) Test cables that occupy the same innerduct or conduit (if not in innerduct) as the damaged cable per paragraph B, above, regardless of whether or not they are new cables installed as part of this project or existing cables installed prior to this project.
      - 4) Provide test results to the Owner and Designer for approval by the Owner and Designer.
    - b. Remove the damaged cable and provide new cable.
    - c. After the removal of the damaged cable and installation of the new cable:
      - 1) Test the new cable per the paragraph titled TESTING.
      - 2) Test cables that occupy the same innerduct or conduit (if not in innerduct) as the damaged cable per paragraph B, above, regardless

of whether they are new cables installed as part of this project or existing cables installed prior to this project.

- h) If any of the cables requiring testing are in use, coordinate with the Owner to schedule an outage opportunity during which the testing can be performed.
- 3) Provide test results to the Owner and Designer for approval by the Owner and Designer.
- d. If a cable which occupies the same innerduct or conduit (if not in innerduct) as a damaged cable is damaged by the extraction and installation process, replace the cable at no additional expense to the Owner.
  - 1) Damaged cables which are replaced shall be subject to the testing procedures of the paragraph titled TESTING.

3.15 FOLLOW UP

- A. For the first four weeks that the system is in full operation, provide technical assistance for trouble shooting, training, and problem solving by phone and (within 24 hours of notice) on site. Provide up to 40 hours of assistance (in addition to any warranty-related work), including phone, travel, and on site time during this period.



KEYED NOTES:

- ① OR-401004789  
BLANK FILLER PANEL, 2 RU.
- ② CORNING CCH-02U  
2 RU. FIBER HOUSING WITH PANEL
- ③ (2) TWO OR-PHA66U48  
ANGLED "CLARITY" CATEGORY 6, MODULAR TO 110  
PATCH PANEL, W/6 PORT MODULES,  
96 PORTS, HIGH DENSITY, T568 A/B, 4 RU.
- ④ OR-PHA66U48  
ANGLED "CLARITY" CATEGORY 6, MODULAR TO 110  
PATCH PANEL, W/6 PORT MODULES,  
48 PORTS, HIGH DENSITY, T568 A/B, 2 RU.
- ⑤ OR-MM6VMD806  
MIGHTY MO 6 VERTICAL CABLE MANAGEMENT CAGE WITH HINGED DOORS,  
INCLUDES FOUR SPOOLS AND 12 BEND LIMITING CLIPS, 6" x 8" x 8"  
51 RACK UNITS
- ⑥ OR-MM6VMD706  
MIGHTY MO 6 VERTICAL CABLE MANAGEMENT CAGE WITH HINGED DOORS,  
INCLUDES FOUR SPOOLS AND 12 BEND LIMITING CLIPS, 6" x 8" x 7"  
45 RACK UNITS
- ⑦ OR-MM6810  
MIGHTY MO 6 CABLE MANAGEMENT RACK, 10.5" CHANNEL DEPTH, x 7" TALL,  
51 RACK UNITS
- ⑧ OR-MM6710  
MIGHTY MO 6 CABLE MANAGEMENT RACK, 10.5" CHANNEL DEPTH, x 7" TALL,  
45 RACK UNITS
- ⑨ OR-MM6VMD710  
MIGHTY MO 6 VERTICAL CABLE MANAGEMENT CAGE WITH HINGED DOORS,  
INCLUDES FOUR SPOOLS AND 12 BEND LIMITING CLIPS, 10" x 13" x 7"
- ⑩ OR-401004788  
BLANK FILLER PANEL, 1 RU.