Office of Information Technology

UNIVERSITY OF COLORADO **COLORADO SPRINGS**

Construction Standards (Division 27)

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OVERVIEW:

This document shall serve as the UCCS Office of Information Technology (OIT) construction standard. This document has been reviewed by OIT and is a representation of standards that have been put in place for a number of years.

GOALS AND OBJECTIVES:

1. To ensure buildings are constructed according to a set standard so that UCCS can:
    a. Meet technology needs of the students, faculty, staff
    b. Maintain supportable and sustainable infrastructure
    c. Develop best in class architecture that is understood by all parties involved from pre-construction to commissioning and production.
2. To cut down on the ambiguity and heterogeneity of all construction.
3. To ensure technology remains consistent and supportable long term

27 00 00 COMMUNICATIONS

1.01 DEFINITIONS:

IDF: Intermediate Distribution Facility. The IDF is the central termination point for all station wiring. It contains the network equipment necessary to provide connectivity between desktop computers, wireless access points and the University Network. It may contain "hub" connectivity for Video. The IDF will contain "pass thru" patch panels for Voice.

MDF: The Main Distribution Facility. MDF's contain core or intermediate network equipment, connectivity to the University Data, Telephone and Video "networks", as well as Data, Telephone and Video connectivity to the IDF's. The MDF may also contain telephone equipment. An MDF may also act as an IDF.

Rack Unit, "R.U.", "U": The standard measurement on a communications rack, amounting to 1 ¾" (44.45mm). For the purposes of this document, "Rack Unit", "R.U" and "U" are synonymous.

Drop: A single *low/no voltage* line within a Location.

Location: The termination point at which low or no voltage wire is terminated at a "desktop" or "wall".

BCT: Bonding Conductor for Telecommunications: Conductor that bonds the TMGB to the AC Grounding Electrode System.

EF: Entrance Facility: Entrance to a building for both public and private network service cables. May be located in an ER or TR.

ER: Equipment Room: Environmentally controlled centralized space of telecommunications equipment. Sometimes referred to as Main Distribution Frame (MDF), Data Center (DC), or server room.

GE: Grounding Equalizer: Bonding conductor that bonds TGBs on the same floor of a structure.

RMC: Rigid Metal Conduit

SPO: Special Purchase Order

TBB: Telecommunications Bonding Backbone: Bonding conductor that bonds the Telecommunications Main Grounding Busbar to one or more Telecommunications Grounding Busbars.

TE: Telecommunication Enclosure: Floor or tenant serving space (enclosure or cabinet) that provides a connection point between backbone and horizontal infrastructures. Sometimes referred to as an Intermediate Distribution Frame (IDF) or Floor Distributer (FD).

TEBC: Telecommunications Equipment Bonding Conductor: Bonding conductor that bonds all non-current carrying metal telecommunications equipment and materials to the nearest TGB or TMGB.

TGB: Telecommunications Grounding Busbar: Busbar used to connect TEBCs and TBBs in a specific room. TGB is generally connected (bonded) to building structural steel, the nearest low-voltage electrical distribution panel and to the Telecommunications Main Grounding Busbar via the TBB. There is typically one (possibly more) Telecommunications Grounding Busbar per telecommunication room or equipment room.

TMGB: Telecommunications Main Grounding Busbar: Busbar bonded to the electrical service ground (Intersystem Bonding Termination). Origination of the TBB. There is typically one Telecommunications Main Grounding Busbar per building, located in near the communications entrance facility (EF) or in the main telecommunications room (MDF) or Building Distributer (BD).

TR: Telecommunication Room: Floor or tenant serving space that provides a connection point between backbone and horizontal infrastructures. Sometimes referred to as an Intermediate Distribution Frame (IDF) or Floor Distributer (FD).

1.02 INSTALLER CREDENTIALS

STRUCTURED CABLING CONTRACTORS ONLY:

A. Contractor shall be a current Netconnect / ND&I Partner. Provide documentation confirming you are a ND&I Partner.
    1. At least one or more BICSI® RCDD® (Registered Communications Distribution Designer) on staff.
    2. At least 50% of the technician force, a primary designer (an RCDD), the project manager, and the lead installation technician are ND&I ACT I and ACT II certified.
    3. At least one of the primary designers is ACT III certified.
B. Contractor shall provide a 25-year warranty on installation. Provide documentation confirming you can provide warranty.
C. Contractor must have a documented minimum of seven (7) years of successful installation experience with projects utilizing communications structured cabling, media systems, infrastructure, raceway and equipment similar to that required for the project. Provide documentation that you meet this requirement.
D. Contractor must provide two (2) references for the contractor's service department.
E. The company shall have a fully staffed office with technical installations support personnel within 75 miles of UCCS main campus. Provide statement that office is located within 75 miles of UCCS main campus.

DELIVERABLES:

Upon completion of work, the installer will present a full certification report detailing that all cabling falls within accepted industry standards. This report must be submitted in an electronic format. The installer will also submit a jack cut sheet in the format specified in Appendix A of this document. All station-lines run, whether coax or copper, must be documented in the cut sheet. **The cut sheets must also be submitted as an Excel spreadsheet, in an .xls or .xlsx file.**

As-builts must also be provided.

WARRANTY:

Warranties and guarantees must be provided at completion of project. Warranties will be based upon both manufacturer's install and product stated warranty and installation must have an accompanying warranty to be negotiated by Facilities. Warranties will be in effect upon substantial completion of project.

WORKMANSHIP AND QUALITY:

The university expects installations to be performed in a professional, clean, and organized manner. Wiring will be terminated per standards, but will also be dressed-in in a professional and presentable fashion. All cable slack and service loops will be similarly dressed-in and secured. It is expected that all terminations will be completed to industry standards, regardless of a "Pass" in testing. Material used to secure bundled cable and service loops must made out of re-usable material and easily accessible. MDF and IDFs must be cleaned and free of dust and debris before network equipment is to be installed.

27 04 05 SLEEVES, PENETRATIONS, AND FIRESTOPPING

This is an amendment to division 7 requirements.

1.1 SLEEVES

A. Provide sleeves for all locations where cable must pass-through building barriers such as walls, floors or foundations.

B. Sleeves consist of conduit section(s), Cable Pathway Wall Penetration Sleeve Device(s) or Cable Pathway Firestopping Device(s) passing through a penetration/opening in a barrier.

C. Conduit sections used for sleeves shall also be listed under Division 26 electrical standards.

D. Conduit Sleeves shall be:
   1. Cast-in-place: Provide RMC conduit sections unless otherwise shown on the Drawings
   2. Cored: Provide EMT conduit sections unless otherwise shown on the Drawings
   3. Non fire-rated barriers: Provide EMT conduit sections unless otherwise shown on the Drawings

E. Fire-rated Sleeves shall be:
   1. For barriers other than floors: Cable Pathway Firestopping Device Devices shall be pre-manufactured enclosed fire rated pathway devices with a built-in fire sealing system sufficient to maintain the hourly rating of the barrier being penetrated. Sleeves basis of design:
      a. Specified Technologies, Inc.: EZ-Path
      b. Wiremold: FlameStopper
      c. Or approved equal

27 04 06 HANGERS AND SUPPORTS

1.01 HANGERS AND SUPPORTS

A. A complete Hanger/Support System shall be provided to support all components of the raceway/pathway and cabling systems.
   1. All primary distribution of cabling must be in cable tray

B. The Contractor shall provide all materials, labor and incidentals as required for a complete Hanger/Support System.

1.02 CABLE SUPPORTS (J-HOOKS, STRAPS)

A. Cable supports exterior to Communications Equipment Rooms:
   1. J-Hooks are acceptable on secondary distribution areas (between cable tray and rooms).

B. Wire Management within Communications Equipment Rooms:
   1. Cable straps shall be used within communications rooms and spaces and shall be provided for strapping groups of cables to raceway and for controlling/managing patch cables. The use of plastic tie wraps for this purpose is not acceptable. Cable straps shall be self-gripping, reusable, constructed of Velcro, and are hook-and-loop style. Cable straps shall be plenum or non-plenum rated to match that of associated cable. Cable straps shall be manufactured by:
      a. Velcro
      b. Siemens
      c. Panduit

d. Approved Equal

2. Size: Cable strap size shall be:
    a. For Patch Cables: ½ inch wide and minimum 8/maximum 12 inches in length.
    b. For Horizontal Cables: ½ inch wide and minimum 8/maximum 12 inches in length.
    c. For Backbone Cables: ¾ inch wide and minimum 12/maximum 18 inches in length.
3. Color: Cable strap color shall be the same color as the cable color of the bundle to be strapped.

27 05 00 ELECTRICAL TECHNOLOGY

27 05 26 GROUNDING AND BONDING

1.01 GENERAL

A. Manufacturer: Communications grounding and bonding equipment and materials shall be manufactured by a single Manufacturer unless specifically stated otherwise. The manufacturer shall be:
    1. Chatsworth Products, Inc. (CPI)
    2. Erico
    3. Cooper B-Line
    4. Approved equal

B. Part Numbers: Refer to the equipment schedule at the end of this Section or on Drawings for specific part numbers. If no part number is provided, then any part meeting the requirements specified is acceptable.

C. Labels/Identification: Provide labels to identify of all components of the communications grounding and bonding system. Labels shall be permanent (i.e. not subject to fading or erasure) and permanently affixed. Handwritten labels are not acceptable.

D. Equipment and materials in this Section shall be UL Listed and Labeled.

E. Grounding of systems must be provided.

1.02 BCT

Provide insulated green, insulated green with yellow strip, or un-insulated - copper conductor properly sized.

1.03 GE

Provide insulated green, insulated green with yellow strip, or un-insulated - copper conductor. Unless otherwise noted on the Drawings, conductors shall be sized according to conductor length.

1.04 TBB

Provide insulated green, insulated green with yellow strip, or un-insulated - copper conductor. Unless otherwise noted on the Drawings, conductors shall be sized according to conductor length

1.05 TEBC

Provide insulated green or insulated green with yellow strip - 6 AWG copper conductor not to exceed 100 feet in length.

27 05 33 CONDUIT AND BOXES

1.01 CONDUIT

A. Conduit
    1. Flexible (flex) conduit: Flex conduit is not approved and not acceptable.

1.02 JUNCTION BOXES

A. Junction boxes shall be provided to serve as a transition point between pathways/raceways. Junction boxes shall be galvanized stamped steel, deep drawn one piece (without welds or tab connections), with knockouts for conduit entrances.

1.03 DEVICE BOXES

A. General: Unless otherwise shown on the Drawings or specified herein, device boxes shall:
    1. Be galvanized stamped steel, deep drawn one piece (without welds or tab connections), with knockouts for conduit entrances, meeting NEMA OS 1, and equipped with extension rings to suit construction and application.
    2. Have knockouts pre-manufactured to support the conduit size serving the outlet box (i.e. field modifications of the outlet box to support the conduit sizes specified are not acceptable).

1.04 PULL BOXES

A. Coordinate pull box size and location with UCCS Project Manager.

1.05 FLOOR BOXES

A. Floor boxes shall provide the interface for power, communication and/or AV cabling in an above grade floor. Floor boxes shall be flush style, shall exceed UL scrub water exclusion requirements for tile and carpet floors, and shall be complete with covers, brackets and hardware to support installation as shown on Drawings.
    1. Floor boxes may be combined for use by both power and communications where shown on the Drawings. When combined, provided metal dividers separating power from communications and provide separate conduits for power and communications.
    2. Floor boxes shall be complete with brackets, cover plates, and/or other means to support power, communications, and/or AV type connectors shown on the Drawings or called for in the Specifications.
    3. Must be cast aluminum
    4. Poke Through boxes are acceptable provided it is coordinated with the UCCS Project Manager

PART 2 - EXECUTION SPECIFIC

2.01 CONDUIT

A. General:
    1. Run conduit in the most direct route possible, parallel and perpendicular to building lines.
    2. Route conduits as close to structure as possible.
    3. Do not route conduit through areas in which flammable material may be stored, or over or adjacent to boilers, incinerators, hot water lines, or steam lines.
    4. Conceal all conduit unless indicated otherwise, within finished walls, ceilings, and floors.
    5. Keep conduits at least 6-inches away from parallel runs of flues and steam or hot water pipes.

6. Install conduits level and square and at proper elevations.
7. For conduit runs exceeding more than 100 feet in length, provide pull boxes (see *Part 3 – Execution, Pull Boxes* herein) so that no conduit segment between end points/pull boxes exceeds 100 feet.
8. For conduit runs which require more than two 90 degree bends, install pull boxes (see *Part 3 – Execution, Pull Boxes* herein) so that no conduit segment between end points/pull boxes contains more than two 90 degree bends.
9. Ream all conduits to eliminate sharp edges. Conduits shall be reamed after threads are cut.
10. Joints shall be cut square and shall butt solidly into couplings.
11. Terminate all metal conduits with metallic threaded insulated throat bushings, PVC conduit with PVC bushings.
12. Metallic conduits entering communication rooms shall be equipped with grounding lugs.
13. Prevent foreign matter from entering conduits by using temporary closure protection. After cable installation, cap each unused conduit with a mechanical-type seal (tape is not acceptable).
14. Conduits shall be installed in such a manner as to keep exposed threads to an absolute minimum and in no case shall more than three threads be left exposed.
15. Install expansion fittings where conduit crosses an expansion join in the structure or is in an environment where temperature changes combined with conduit run length may produce expansion or contraction stress. Provide a flexible bonding jumper at least three times the nominal width of the joint.
16. Structured cabling and AV cabling are to be in separate conduits, once they leave the cable tray.

B. Minimum Conduit Sizing, where not shown on the Drawings:
    1. Junction Boxes in walls: 1 inch.
    2. Device Boxes: 1 inch.

C. Conduit bends:
    1. A conduit bend shall not exceed 90 degrees and shall not be constructed in such a way as to reduce the effective diameter of the conduit.
    2. Conduit bends shall be sweeping, , and shall be a minimum of no less than 6 times the internal diameter of the conduit for conduits 2-inches or less and a minimum of no less than 10 times the internal diameter of the conduit for conduits greater than 2-inches.

D. Conduit Stubs:
    1. From boxes in partition walls: Conduit stubs shall extend a minimum of 6-inches above top of partition wall and shall be angled 30 degrees toward the nearest raceway/pathway for horizontal cabling.

E. Conduit/duct runs under slab: Coordinate with other trades (electrical, plumbing, etc.) prior to trenching and installation. Communications conduit/duct runs under slab shall not share a trench with conduit/duct runs from other trades.

F. Conduits in slab are acceptable.

G. Bushings: The Contractor is solely responsible for ensuring that bushings (insulated throat for metallic conduit, PVC for PVC conduit) are installed at conduit end(s) prior to cable installation. Where cable is installed prior to the installation of bushings, the Contractor shall remove the cable, install the bushing, and re-install the cable at no additional cost to the Owner.

H. Labels: Label each conduit end in a clear manner by designating, at each end of the conduit, the location of the far end of the conduit (i.e. room name, communications closet name, pull box identifier, cable tray, station identifier, etc.). Indicate conduit length on the label. See label diagram in appendix.

I. Device Box Types
    1. Outlets:
        a. Unless specifically noted otherwise on the Drawings, outlet boxes shall be dedicated to communications, and shall not be shared with power.
        b. The use of dividers to divide a single box into "separate" sections for communications and power (or another function) is not acceptable.
        c. Outlet boxes shall be located within 3 feet of an electrical power receptacle. Where conditions are such that this is not possible, promptly notify the Engineer and await the Engineer's direction prior to rough-in of the box.
    2. Security:
        a. Unless specifically noted otherwise on the Drawings, outlet boxes shall be dedicated to security, and shall not be shared with power.
        b. Refer to drawings and Manufacturer's requirements.
        c. Coordinate with Security contractor prior to rough-in.
    3. Audio/Visual:
        a. Unless specifically noted otherwise on the Drawings, outlet boxes shall be dedicated to audio/visual, and shall not be shared with power.
        b. Refer to drawings and Manufacturer's requirements.
        c. Coordinate with Audio/Visual contractor prior to rough-in.

2.02 PULL BOXES

A. Install pull boxes in an exposed location, readily accessible both at time of construction and after building occupation. Pull boxes shall not be installed in interstitial or otherwise non-accessible building spaces.

B. If mounting a pull box on ceiling structure above ceiling grid, do not mount higher than 4 feet above grid (mount on wall instead).

C. Labels: See appendix.

27 05 36 CABLE TRAYS

1.01 CABLE TRAY SECTIONS AND COMPONENTS

A. General: Except as otherwise indicated, provide metal cable trays, of types, classes and sizes indicated. Cable tray shall be complete with all materials and incidental and miscellaneous hardware required for a complete cable tray system, including but not limited to support hangers, connector assemblies, clamp assemblies, connector plates, splice plates, bolts, nuts and washers for connecting units. Construct units with rounded edges and smooth surfaces; in compliance with applicable standards; and with the following additional construction features.

B. Wire Basket Cable Tray System: Cable tray shall be "wire basket" type and shall be as follows:
    1. Finish: Powder coated carbon steel with electro-plated zinc galvanized finish.
        a. Color: Black
    2. Width: Sized as shown on the drawings. Where not indicated on the Drawings, width shall be sized 1.5x (1.5 times) according to manufacturer's recommendations for the amount of cable to be carried by the tray. This allows for future expansion.
    3. Depth: 4 inch usable loading depth.
    4. Mesh: 2 inch by 4 inch mesh pattern with intersecting wires welded together.
    5. Fittings: Fittings shall be field fabricated through use of manufacturer's hardware and in accordance with manufacturer's instructions.

6. Ceiling Supports: Supports shall be “trapeze” type and provided in quantities as recommended by cable tray manufacturer according to maximum load. Supports shall mount under the tray and shall mount to tray in a “tool-less” fashion. Support hangers shall be 1/4 inch or 3/8 inch diameter rods.
7. Wall Supports: Supports shall be shelf-bracket or L-bracket type and provided in quantities as recommended by cable tray manufacturer according to maximum load. Bracket supports shall be capable of use with trays from 4 inches to 24 inches wide, and have built-in hold down tabs. Where space permits, or unless otherwise noted, shelf-brackets shall be utilized in lieu of L-brackets for wall support applications.
8. Load rating: NEMA (8A) in accordance with NEMA VE 1.
9. Barrier strips: Provide cable tray sections with a single barrier for separation of telecommunications cabling from other low-voltage cables (such as CATV, security, etc.). Barriers shall be of same materials and finish as cable tray.
10. Grounding/bonding: Cable tray shall be complete with manufacturer’s hardware for grounding/bonding.
11. Cable tray and all fittings and supports shall be manufactured by the same manufacturer and shall be:
    a. Cooper B-Line (Flextray)
    b. Legrand (Cablofil)
    c. Cope – Acroba
    d. Chattsworth

27 05 43 UNDERGROUND DUCTS AND RACEWAYS

Under floor ducts systems shall be dedicated space for telecommunication cables and not shared with any other utility. The guideline for planning duct capacity is 1 inch of cross section for each 100ft of useable floor space. Junction boxes shall be placed at a maximum of 60ft to allow access for cable placement. All distribution ducts must be physically linked to a telecommunication room directly or through no more than one feeder duct. Ducts entering the telecommunications room must terminate in either a slot or elbow.

27 10 00 STRUCTURED CABLING

1.01 GENERAL

A. Manufacturer: Structured cabling system components shall be sourced by a single Manufacturer. Products shall not be intermixed between different manufacturers unless the Manufacturer of the chosen communications cabling system has listed (in writing) another manufacturer’s component as an “approved alternative product” (or equivalent wording) and will warrant the “approved alternative product” as part of the Manufacturer’s extended Warranty, or if the product has been specifically called out as a special requirement in the Specifications. Additionally, for a given Manufacturer, all products shall be part of a single product line and the product line shall be specifically engineered “end-to-end” (e.g. the system and all of its components shall have been engineered to function together as a single, continuous transmission path). The structured cabling system shall be:
    1. Commscope / TE - AMP – NetConnect

B. Plenum Rating:
    1. Cable shall be plenum (CMP, OFNP) rated unless otherwise indicated. Cable shall bear plenum markings.

C. Color: All cables of the same type (i.e. Copper Backbone, Copper Horizontal, Fiber Riser, Coaxial CATV Trunk, 62.5µm MM, 50µm MM, SM, etc.) and functionality shall be of the same color. Multiple colors of the same cable use and/or functionality are not acceptable. Cable colors are as follows:
    1. Copper horizontal cable rated Category 5e, 6 or 6a:
        a. Data horizontal cabling shall be blue in color.
        b. Voice (analog) cabling shall be white in color.

    2. Fiber Riser:
        a. Singlemode shall be yellow in color.
        b. Multimode shall be aqua in color.

1.02 PERFORMANCE

A. Protocols/Services:
    1. At a minimum, the communications cabling system shall support data network protocols/services at rates up to 1 Gbps for transmission on copper except for wireless access point lines, and 10 Gbps for transmission on fiber. It shall support Ethernet, ATM and other network protocols. The communications cabling system shall additionally support RS-232 and other dedicated point-to-point protocols. Wireless access point lines shall support NBase-T and 10GBase-T. Outdoor wireless access points not attached to the building shall use Powered Fiber Cable – OM3 – 4 Fibers - Indoor/Outdoor cable.
    2. The communications cabling system shall support PBX telephone services. It shall support analog, digital, and ISDN services, and shall be compatible with direct trunk lines (POTS).

B. Category Rating: Copper components (cable, connectors, etc.) shall meet or exceed the TIA/EIA transmission requirements for the Category for which they are rated.
    1. Horizontal Cable shall be rated Category 6 (400 Mhz).
    2. Horizontal Cable used for wireless access points shall be rated at Category 6A (500 Mhz) and support 10GBase-T.
    3. Voice (analog) Backbone Cable shall be rated Category 3 or higher.

C. Performance Rating: All components (copper and fiber) shall meet or exceed TIA/EIA transmission requirements for their component type.

D. Fiber Performance:
    1. Backbone Cable:
        a. 50/125 µm Multimode: Provide cable with a maximum attenuation of 3.5 dB/km at 850 nm and 1.5 dB/km at 1300 nm. The minimum cable bandwidth shall be 500 MHz-km at 850 nm and 500 MHz-km at 1300 nm.
        b. Singlemode: Provide cable with a maximum attenuation of 1.0 dB/km @ 1310 nm and 1.0 dB/km at 1550 nm.

E. Contractor to provide test reports for installed fiber. Reports must be within manufacturer specifications for warranty.

27 11 00 EQUIPMENT ROOM FITTINGS

1.01 MINIMUM TELECOMMUNICATIONS SPACE REQUIREMENTS

1.02 EQUIPMENT ROOM FITTINGS

A. Manufacturer: Racks, frames, cabinets, enclosures, rack cable distribution hardware, cable runway (ladder rack), and other distribution and incidental components shall be manufactured by a single Manufacturer unless specifically stated otherwise. The manufacturer shall be:
   1. Chatsworth Products, Inc. (CPI)
   2. Cooper/B-Line

B. Color: Unless otherwise indicated, the color of all cable runway, equipment racks, frame, and cabinets, distribution hardware, and other distribution and incidental equipment shall be:
   1. Black in color.

1.03 CABLE RUNWAY (LADDER RACK)

A. Cable runway system shall be complete with all fittings, miscellaneous hardware, and other incidental hardware required for a complete and fully fitted system, including but not limited to splice kits, support hangers, rods, and brackets, center supports, j-bolts, foot kits, vertical wall brackets, wall angles, support hardware, grounding hardware, and protective end caps for exposed cable runway ends.

1.04 EQUIPMENT RACKS, EQUIPMENT FRAMES, SERVER FRAMES AND CABINETS

A. Equipment shall be free standing and shall be complete and fully fitted with all miscellaneous and incidental hardware required, including but not limited to hardware required for assembly, securing to floor, grounding, and seismic bracing (as required by local codes). Height shall be as shown on the Drawings. Provide as shown on the Drawings and as follows:
   1. Equipment Racks: Equipment racks shall be 19 inch wide with a universal alternating hole pattern on both sides of the posts, 3 inch channels, 4 posts, top angles, self-supporting bases, and assembly hardware.

1.05 RACK-MOUNT ACCESSORIES

A. Provide as shown on the Drawings and as follows:
   1. Horizontal Power Strip: Horizontal power strips shall be rack-mountable, 1.75 inches (1U) high by 19 inches wide, shall be rated at 20 amps, and shall have 6 outlets in the front and 6 outlets in the rear, a covered on/off switch, and shall be equipped with a power cord of sufficient length to route to the power receptacle serving the equipment rack/frame.
   2. Storage Drawer: Storage drawers shall be 5.25 inches (3U) high, and shall be capable of mounting flush with the face of the rack.
   3. Single-sided Shelf: Shelf shall be single sided, with side mount brackets 5.25 inches (3U) high, and shall be capable of mounting flush with the face of the rack.

1.06 CABLE MANAGEMENT

A. Provide as shown on the Drawings and as follows:
   1. Horizontal Cable Management Panels: Horizontal cable management panels shall be 19 inches wide, complete with section covers, and shall be provided in heights (rack units) as shown on the Drawings.

2. Vertical Cable Management Sections: Vertical cable management sections shall be complete with double-hinged section covers, “finger” style side cable openings capable of accommodating up to 48 patch cords or horizontal cables, shall be single or double sided as shown on the Drawings, and shall be provided in widths and heights as shown on the Drawings.
    a. MCS-Style front side and VCS-Style back side (ref: Chatsworth CCS Combination Cabling Section Vertical Wire Management)
3. Upper Transition Tray: Provide as shown on Drawings. Unless shown otherwise on Drawings, upper transition trays shall be mounted at the top of equipment racks, frames and enclosures to route patch cables and jumpers. Upper transition trays shall be 19 inches wide.
4. Distribution Rings: Provide for all locations where cable or jumpers will be routed on backboards and similar surfaces. Size shall be appropriate to the quantity of cable to be supported, and shall be a minimum of 2 inches in diameter. Rings shall be manufactured by CPI, or equal. Type of ring shall be as follows:
    a. C-Rings (“open” rings): Provide for those cables or jumpers which will likely be subjected to frequent moves, adds, or changes.
    b. D-Rings (“closed” rings): Provide for those cables or jumpers not likely to be subjected to frequent moves, adds, or changes.

1.07 EQUIPMENT

A. Vertical - Chatsworth Products (CPI): CCS Combination Cabling Section; Double-sided managers that feature an MCS-style front side and a VCS-style back side.
B. Horizontal - Chatsworth Products (CPI): Universal Horizontal Cable Manager, Single-Sided

1.08 BACKBOARDS

A. Provide backboards as shown on the Drawings. Backboards shall be ¾ inch exterior grade Douglas Fir A-C plywood, void free, 2440-mm (8 feet) high unless otherwise noted, capable of supporting attached equipment. Width shall be as required to fully cover walls. Backboards shall be as follows:
    1. Painted to match room color.

1.09 GROUNDING AND BONDING

A. Bonding Conductor for Telecommunications (BCT): Provide #6 AWG insulated solid copper conductor (green) to bond all non-current-carrying metal telecommunications equipment and materials to the nearest TGB.

1.10 POWER TO RACKS

A. At a minimum, a single equipment rack should have three (3) duplex receptacles, each one a separate circuit.

B. One (1) 20amp twist-lock receptacle on its own circuit.

C. For multiple equipment racks coordinate with UCCS OIT for receptacle and circuit quantity and layout.

1.11 FLOORING

A. Sealed concrete topically applied.

1.12 TURNOVER FROM CONTRACTOR

A. Permanent power.

B. Mechanical cooling running, however not commissioned.

C. Security – lockable temporary solution; does not need permanent cores or card access at that time.

D. Cable tray and racks installed.

E. Wall mounted wood backing installed.

F. Room painted.

G. Concrete floor sealed.

H. Room cleaned – no dust present.

I. All A/V and other low voltage data cabling complete that ties into data closet.

27 11 19 TERMINATION EQUIPMENT

1.01 PATCH PANELS

A. Copper: Copper patch panels shall be rack mountable and sized as shown on the Drawings. Patch panel connectors shall be modular type, 8-position/8-conductor, insulation displacement (IDC), non-keyed, and shall accept modular 8-position/8-conductor plugs. Patch panels shall support a universal (T568A and T568B) wiring pattern, shall be equipped with pre-manufactured cable management support bar/strain relief for supporting cables behind the patch panel, and shall be complete with all incidental materials necessary for mounting and installation of the panel and support of the cables which shall be connected to it. Patch panels shall be available in 24-port and 48-port styles.
   1. Horizontal Copper Patch Panels: Provide for terminating copper horizontal cables.
   2. Voice-Grade Copper Backbone Patch Panels: Provide for termination of high pair count voice-grade Category 3 rated copper backbone cables. Patch Panel shall be Category 3 rated or higher.
   3. Data-Grade Copper Backbone Patch Panels: Provide for termination of data-grade 4-pair cable used for connectivity between communications rooms.

B. Fiber: Fiber patch panels shall be dual purpose, capable of both termination/connectorization and splicing (fusion or mechanical) of fiber in the same enclosure, and shall support both regular and high-density connectors. Fiber patch panels shall consist of enclosures pre-assembled with connector panels, blank connector panels (for unused connector slots), strain relief, splice trays (as required) and splice incidentals. Fiber patch panels shall be complete with bulkheads as required to accommodate all fiber strands within the panel, and filler plates as required for all unused bulkhead slots, and with all incidental materials necessary for mounting.
   1. Rack Mount: Fiber Rack mount patch panels shall be 19 inches wide and shall be available in 24/48 (1U), 48/96 (2U), and 72/144 (4U) port sizes.
   2. Rack mount Combination Shelf: Rack mount Combination Shelf is used for a combination of splicing and termination, shall have a sliding shelf, and shall be available in 24 (1U) and 48 (2U) port sizes.

1.02 COPPER TERMINATION BLOCKS

A. 110-Style: Provide IDC connecting clips, designation strips, and labels for each 25 pair strip. Termination blocks shall be provided with or without jumper troughs and with or without legs as required by the

mounting application. Label colors shall be per UCCS Standard. Termination blocks shall be UL listed. Termination blocks shall be provided in the quantities required for complete termination. Provide as shown on the Drawings or as required.

1. Termination Blocks:
    a. For copper backbone cable connectivity: Termination blocks shall be Category 3 rated or higher. Provide 5 pair IDC connection clips as required.
2. Wall Mounting (for termination blocks to be mounted directly on wall):
    a. Provide Termination Blocks and Jumper Troughs with legs.
    b. Provide Jumper Troughs above and below each 300 pair Termination Block. For single 100 pair Termination Blocks, provide one Jumper Trough above.
    c. Termination Block Distribution Ring Backboards: For termination block wall fields with more than one column of termination blocks, provide a row of Termination Block Distribution Ring Backboards above the columns for the routing of jumper cables from one column to another.

27 13 00 COMMUNICATIONS BACKBONE CABLING

1.01 COPPER

A. General:
    1. Cable shall be multi-pair 24 AWG solid copper conductors insulated with color coded PVC, and shall be sized in pair counts as shown on the Drawings.

B. Inside Plant (Interior): Provide indoor rated cable.
    1. Multi-Pair Backbone: Cable shall be unshielded.
    2. Tie: Provide as shown on the Drawings and as required for connecting the back side of termination blocks to entrance protectors, splice enclosures, etc. Tie cables shall be unshielded and shall not be used in plenum environments.
    3. Provide plenum rated cable when applicable

C. Data Backbone: Provide horizontal copper cable

1.02 COAXIAL CATV

A. General: Coaxial cable shall be 75 ohm cable, solid conductor. Cable shall be sized as shown on the Drawings.

B. Inside Plant (Interior): Provide indoor rated cable.
    1. Trunk:
        a. Series 11: Cable shall be Series 11, low loss, quad shield.
    2. Interconnect: Provide for interconnecting Head-End and Trunk cables. Cable shall be Series 6, 18 AWG, low loss, quad shield.

1.03 FIBER

A. General: Provide fiber optic cable in quantities, strand counts, and types (singlemode, multimode, or hybrid) as shown on the Drawings. Fiber cable shall be all-dielectric, shall conform to Bellcore and RUS standards.

B. Inside Plant (Interior): Provide indoor rated cable. Cable shall be tight buffered.

1.04 CONNECTORS

A. General: Connectors shall meet or exceed the TIA/EIA standards and as called for in the Governing Requirements.

B. Horizontal:
   1. Copper: Copper connectors shall be 8-position/8-conductor, insulation displacement connector (IDC), non-keyed, and shall accept modular 8-position/8-conductor plugs. Connectors shall have a universally color-coded wiring pattern for both T568A and T568B. Copper connectors Category rating shall be the same as that specified under
      a. Provide red connectors for data outlets.
      b. Provide blue connectors for voice (analog) outlets.
   2. Coaxial CATV :
      a. Connectors shall be F-type.

C. Backbone:
   1. Coaxial CATV: Connectors shall be F-type.
   2. Fiber: Fiber connectors shall be complete with bulkheads, adapters and adapter plates where required for mounting in fiber patch panels. Connectors shall be ultra polished (UPC), ceramic, epoxy polish, and shall be LC, specific to the fiber core size to be connectorized.
      a. For multimode fiber, provide field installable connectors.
      b. For singlemode fiber, provide manufacturer pre-connectorized pigtail assemblies (tested and certified by the manufacturer prior to installation).

27 13 13 COPPER CABLE TESTING

GENERAL

A. All Category 3 OSP twisted pair cable to be tested with complete wire map and 100 % pass rate for following**:**
   1. DC loop resistance
   2. Wire map
   3. Continuity to remote end
   4. Shorts between two or more conductors
   5. Crossed pairs
   6. Reversed pairs
   7. Split pairs
   8. Any other miss-wiring

B. All Voice and Data Category 6 and 6A twisted pair cables will be tested with a 100% pass rate to the cable categories applicable standard for the following in accordance to Amendment 10 of the TIA/EIA-568-B.2 document:
   1. Insertion Loss (IL)
   2. Near End Crosstalk (NEXT)
   3. Power Sum Near End Crosstalk (PSNEXT)
   4. Attenuation to Crosstalk Ratio (ACR)
   5. Power Sum Attenuation to crosstalk Ratio (PSACR)
   6. Far End Crosstalk (FEXT)
   7. Equal Level Far End Crosstalk (ELFEXT)
   8. Power Sum Equal Level Far End Crosstalk (PSELFEXT

9. Return Loss (RL)
10. Wire Map
11. Propagation Delay
12. Delay Skew
13. Length

27 13 23 COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING

Building to Building connections must be a minimum 96 strand single mode fiber. See Appendix A for detailed specifications.

27 13 23.0 BUILDING OPTICAL FIBER CABLE BACKBONE

GENERAL

Single-mode OS2 and 50 Micron Laser optimized Multi-mode OM4 fiber optic backbone required between the MDF and all IDF locations. All cable to be homerun with no splices and installed in a 1" plenum or riser rated (depending on the application) suitable inner duct. Strand count to be determined by NAU/ITS on a per project basis.

ISP Cable- MIC 2-24 fibers plenum

A. Cable shall be plenum-rated, all-dielectric, with 2 to 24 900 ± 50 µm tight-buffered fibers. TBII® Tight-Buffered Fiber shall be made of a PVC material and shall have a UV-cured acrylate coating (low-friction slip layer) between the acrylate coating of the optical fiber and the PVC buffer. The fiber coating, low-friction slip layer and PVC buffer shall be removable with commercially available stripping tools in a single pass for termination or splicing.
B. The individual fibers shall be color-coded for identification. The optical fiber color coding shall be in accordance with TIA/EIA-598-B, "Optical Fiber Cable Color Coding."
C. Fibers shall be stranded together around jacketed or non-jacketed dielectric strength members via reverse oscillation and surrounded with dielectric strength members and a ripcord. Cables containing 12 to 24 fibers shall have a dual-layer stranded design.
D. The cable jacket color shall be orange for cables containing all multimode fiber, except for cables containing 50/125 µm, 850 nm laser optimized fiber, which shall have an aqua colored outer jacket. The cable jacket color shall be yellow for cables containing all single mode fiber.
E. Cable shall have a storage temperature range of -40° to 70°C on the original shipping reel, installation temperature range of 0° to 60°C, and an operating temperature range of 0° to 70°C.
F. Cable manufacturer shall be ISO 9001 registered.

ISP Cable- UMIC 36-144 fibers plenum

A. Cable shall be all-dielectric and contain 36 to 144 900 ± 50 µm tight-buffered fibers. TBII® Tight-Buffered Fiber shall be made of a PVC material and shall have a UV-cured acrylate coating (low friction slip layer) between the acrylate coating of the optical fiber and the PVC buffer. The fiber coating, low friction slip layer and PVC buffer shall be removable with commercially available stripping tools in a single pass for termination or splicing.
B. The individual fibers shall be color-coded for identification. The optical fiber color coding shall be in accordance with TIA/EIA-598-B, "Optical Fiber Cable Color Coding."
C. Fibers shall be stranded via reverse oscillation with dielectric strength members and a ripcord in either 6-fiber or 12-fiber subunits. Cable with <60 fibers shall contain 6-fiber subunits, otherwise cable shall contain 12-fiber subunits. Subunits shall be stranded together in a planetary configuration around a jacketed or bare glass reinforced plastic (GRP) dielectric central member. Cable shall contain a ripcord

underneath outer cable jacket to facilitate jacket removal. Each subunit jacket shall be made of a PVC material and shall be identified with a unique number at periodic intervals. Subunit color containing multimode fiber shall be orange. Subunit color containing 50/125 µm, 850 nm laser optimized fiber shall be aqua. Subunit color containing single-mode fiber shall be yellow. A dual-layer subunit design shall be used for cables containing 108 to 144 fibers.

D. The cable jacket color shall be orange for cables containing all multimode fiber, except for cables containing 50/125 µm, 850 nm laser optimized fiber, which shall have an aqua colored outer jacket. The cable jacket color shall be yellow for cables containing all single mode fiber. Hybrid cables (containing more than one type of fiber) shall have an outer jacket with the color corresponding to the greatest percentage of total fibers within the cable, except for hybrid cables containing 50/125 µm, 850 nm laser optimized fiber, which shall have an aqua colored outer jacket.
E. Cable shall be listed OFNP/FT-6 and be fully compliant with ICEA S-83-596.
F. Cable outer jacket shall be marked with the manufacturer's name or ETL file number, date of manufacture, fiber count, fiber type, flame rating, listing symbol, and sequential length markings every two feet (e.g., “COMSCOPE CABLE - 01/00 – 72 SM– TB2 - OFNP (ETL) OFN FT6 (CSA) 0001 FEET”). The marking shall be in contrasting color to the cable jacket.
G. Cable shall have a storage temperature range of -40°C to +70°C, installation temperature range of 0°C to +60°C, and an operating temperature range of 0°C to +70°C.
H. Cable manufacturer shall be ISO 9001 registered.

27 13 23 INTER BUILDING OPTICAL FIBER CABLE

A. Fiber Optic cable shall meet following requirements:
    1. Cable shall be all-dielectric, stranded loose-tube design with dry water blocking for outdoor duct and aerial installations in fiber counts from 2 to 288.
    2. Each fiber shall be distinguishable by means of color coding in accordance with TIA/EIA-598-B, "Optical Fiber Cable Color Coding.” The fibers shall be colored with ultraviolet (UV) curable inks.
    3. Buffer tubes shall be made from polypropylene. Each buffer tube shall contain a water-swellable yarn for water blocking protection.
        a. The water-swellable yarn shall be non-nutritive to fungus, electrically non-conductive, and homogeneous. It shall also be free from dirt or foreign matter. This yarn will preclude the need for other water blocking material; the buffer tube shall be gel free.
    4. The optical fibers shall not require cleaning before placement into a splice tray or fan out kit.
    5. The buffer tube shall be manufactured to a standard 3.0 mm in size, regardless of fiber count, to reduce the number of required installation and termination tools. Buffer tubes containing fibers shall be color coded with distinct and recognizable colors in accordance with TIA/EIA-598-B. Buffer tube colored stripes shall be inlaid in the tube by means of co-extrusion when required. The nominal stripe width shall be 1 mm.
    6. Buffer tubes in a hybrid cable (cable containing more than one type of fiber) shall contain only one fiber type. Identification of fiber types in a hybrid cable shall correspond to fiber core diameter (or mode field diameter) from smallest to largest in accordance with TIA/EIA-598-B.
    7. Buffer tubes shall be stranded around the dielectric central member using the reverse oscillation stranding process.
    8. Two polyester yarn binders shall be applied contra-helically with sufficient tension to secure each buffer tube layer to the dielectric central member without crushing the buffer tubes. The binders shall be non-hygroscopic, non-wicking, and dielectric with low shrinkage. Water-swellable yarn(s) shall be applied longitudinally along the central member during stranding.
        a. For dual-layer cables, a second (outer) layer of buffer tubes shall be stranded over the original core to form a two-layer core. A water-swellable tape shall be applied longitudinally over both the inner and outer layer.

b. The water-swellable tape shall be non-nutritive to fungus, electrically non-conductive, and homogenous. It shall also be free from dirt and foreign matter.

9. Cable shall be comprised of water-swellable yarns and/or tapes, dielectric strength members (as required), ripcord(s) and an MDPE jacket containing carbon black to provide ultraviolet light protection while inhibiting the growth of fungus.
10. Cable jacket shall be marked with the manufacturer's name, month and year of manufacture, sequential meter or foot markings, a telecommunication handset symbol as required by Section 350G of the National Electrical Safety Code® (NESC®), fiber count, and fiber type. The actual length of the cable shall be within -0/+1% of the length markings. The print color shall be white, with the exception that cable jackets containing one or more co-extruded white stripes, which shall be printed in light blue. The height of the marking shall be approximately 2.5 mm. Cable shall contain reverse oscillation lay (ROL) markings as needed.
11. Cable shall have a storage temperature range of -40° to 70°C, an installation temperature range of -30°C to 70°C, and an operating temperature range of -40° to 70°C.
12. Cable shall have a short-term tensile rating of 2700 N. No fiber strain shall occur over the service life of the cable when subjected to a maximum, long-term tensile rating of 890 N.
13. Cable shall meet the functional requirements of Rural Utilities Service (RUS) 7 CFR 1755.900 and be fully compliant with ICEA S-87-640.
14. Manufacturer shall be ISO 9001 and TL 9000 registered.

27 13 23 OPTICAL FIBER SPLICING AND TERMINATIONS AND TESTING

GENERAL

Rack mount Housings

A. Housing shall be Centurylink Fiber Optics for OSP(backbone) and/or Comscope for Riser. Housings shall be mountable in an EIA-310 compatible 465- or 592 mm rack. Housings shall be available in 1U, 2U and 4U sizes. The unit shall meet all applicable design requirements listed in ANSI/TIA/EIA-568, ANSI/TIA/EIA-942, and the polymer compounds flammability requirements of UL 94 V-0. Manufacturer shall be ISO 9001 and TL 9000 registered. Housings shall be manufactured using 16-gauge aluminum or equivalent for structural integrity and shall be finished with a black powder coat for durability. All joints shall be welded and finished in a workman-like manner. Installation fasteners shall be included and shall match the housing color. The unit shall include a cable clamping mechanism to provide cable strain-relief.

B. The front and rear doors shall be lockable when used with an optional key lock kit. The Connector Housings shall have a labeling scheme that complies with ANSI/TIA/EIA-606. The housings shall be available with factory-installed connectorized cable stubs in multiple cable and connector types. The housing shall have the ability to accommodate fusion splicing with additional hardware. The housing shall be 16 inches deep for extra cable routing.

C. All Fiber optic cable shall be fusion spliced using pigtails.

Connectors LC SM

A. Connector shall be compliant with industry standard ANSI/TIA/EIA-568-B.3. The connector shall comply with the TIA/EIA Fiber Optic Connector Inter-mate ability Standard (FOCIS) document, TIA/EIA-604-2. The connector installation shall not require the use of epoxies, adhesives or ovens. The connector shall be installable upon 900 µm buffered fiber in one minute or less and upon 2.9 mm jacketed cable in three minutes or less total time. The connector shall be installable upon single-mode optical fiber.

B. Ferrule material shall be ceramic.
C. Connector shall be consistently capable of insertion losses of 0.3 dB (typical) and shall be 0.75 dB (maximum) when installed in accordance with the manufacturer's recommended procedure and tested in accordance with FOTP-171. Connector reflectance shall be measured after manufacture to be less than or equal to -40/-55 dB ultra physical contact (UPC).
D. Manufacturer shall be ISO 9001 and TL 9000 registered. The manufacturer shall have an in-depth knowledge, and more than 10-year history, of manufacturing and supporting connector technology that does not require epoxy or polishing in the field.

Connectors LC MM 50um

A. Connector shall be compliant with industry standard ANSI/TIA/EIA-568-B.3. The connector shall comply with TIA/EIA Fiber Optic Connector Inter-mate ability Standard (FOCIS) document, TIA/EIA-604-2. The connector installation shall not require the use of epoxies, adhesives or ovens. The connector shall be installable upon 900µm buffered fiber in one minute or less and upon 2.9 mm jacketed cable in three minutes or less total time. The connector shall be installable upon 50/125 µm multimode optical fiber.
B. Ferrule material shall be ceramic.
C. The connector crimp on mechanism shall protect the bare fiber from the ingress of air or waterborne contaminants. Connector shall be consistently capable of insertion losses of 0.3 dB (typical) and shall be 0.75 dB (maximum) when installed in accordance with the manufacturer's recommended procedure and tested in accordance with FOTP-171. Connector reflectance shall be less than or equal to -20 dB.
D. Manufacturer shall be ISO 9001 and TL 9000 registered.

Connectors LC MM 50um Laser Optimized OM4

A. Connector shall be compliant with industry standard ANSI/TIA/EIA-568-B.3. The connector shall comply with TIA/EIA Fiber Optic Connector Inter-mate ability Standard (FOCIS) document, TIA/EIA-604-2. The connector installation shall not require the use of epoxies, adhesives or ovens. The connector shall be installable upon 900 µm buffered fiber in one minute or less and upon 2.9 mm jacketed cable in three minutes or less total time. The connector shall be installable upon 850-nm laser-optimized 50 µm multimode optical fiber.
B. Ferrule material shall be ceramic.
C. The connector crimp on mechanism shall protect the bare fiber from the ingress of air or waterborne contaminants. Connector shall be consistently capable of insertion losses of 0.3 dB (typical) and shall be 0.75 dB (maximum) when installed in accordance with the manufacturer's recommended procedure and tested in accordance with FOTP-171. Connector reflectance shall be less than or equal to -20 dB.
D. Manufacturer shall be ISO 9001 and TL 9000 registered.

Splice cases

A. The SCF splice closures shall be available in canister (butt) and in-line styles to fit most applications. All end-caps feature two express ports for uncut feeder cables.

B. Splice case shall be resistant to solvents, stress cracking and creep. The housing materials shall also be compatible with chemicals and other materials to which they might be exposed in normal applications. The optical fiber closure shall be capable of accepting any optical fiber cable commonly used in interoffice, outside plant and building entrance facilities. As an option, the ability to double the cable capacity of an installed canister splice closure by use of a kit shall be available. Such a conversion shall not disturb existing cables or splices.

C. Encapsulation shall not be required to resist water penetration. The splice closure shall be re-enterable. The closure end-cap shall be capable of accepting additional cables without removal of the sheath retention or strength-member clamping hardware on previously installed cables or disturbing existing

splices. The optical fiber splice closure shall provide a clamping mechanism to prevent pistoning of the central member or strength members and to prevent cable sheath slip or pullout. The splice closure shall have appropriate hardware and installation procedures to facilitate the bonding and grounding of metal components in the closure and the armored cable sheath. The cable bonding hardware shall be able to accommodate a copper conductor equal to or larger than 6 AWG.

D. Aerial splice closures shall have available the necessary hardware to attach and secure the closure to an aerial strand. The closure shall accommodate splice trays suitable for single-fiber, single-fiber heat-shrink, mechanical or ribbon heat-shrink splices. The small splice closure shall accommodate up to 72 single-fiber splices or 144 ribbon-fiber splices using 12-fiber ribbons. The medium-sized closure shall accommodate up to 288 single-fiber splices or 432 ribbon-fiber splices. The large closure shall accommodate up to 480 single-fiber splices or 864 ribbon-fiber splices. The installation of the splice closure shall not require specialized tools or equipment, other than those normally carried by installation crews.

E. All fibers (inter and intra building) tested for continuity and tagged at both ends with building number and ID number. All fibers tested for insertion loss, both directions, at 850nm and 1350nm on multi-mode, and at 1310nm and 1550nm on single-mode. All results documented. OTDR signature trace documents on all fibers with pertinent points documented (splice, endpoints, etc.) Only test results with University personnel present will be accepted.

27 15 00 COMMUNICATIONS HORIZONTAL CABLING

GENERAL

A. All wall plates shall be fed by two (2) pair 100 ohm balanced Category 6 plenum rated with blue jacket cable with red color jack. Manufacturer of cable must be accepted by the proposed warranty.
B. No Horizontal cable run shall exceed 90 meters.
C. Cable will be terminated at workstation on Category 6 jack and terminated at the MDF/IDF on Category 6 patch panel. All cables tested and certified to Category 6 standard. All Data jacks should have a Gigabit Ethernet (GbE) capability.
D. Computer labs, classrooms, and all other special applications require the input of IT on number and location of drops.
E. Only Velcro type cable ties shall be used with Category 6 and 6A cabling.
F. All terminations shall be 568-B.
G. All office work stations shall consist of two (2) blue Cat6 cable with red color jacks. Analog voice cables shall be white with blue jack. All cable colors to be bundled separately in the ceiling and all closets. When cables enter the closets they will be packed neatly (i.e.: cigarette packing).
H. All locations outside of offices shall be considered data-only locations unless designated for a wall phone.

27 15 01 WIRELESS DATA COMMUNICATION HORIZONTAL CABLING

WAP locations should be located so that horizontal mounting will be allowed. All WAP locations shall consist of (2) Category 6A gray cables with red color jacks. No permanent link run shall exceed 80 meters (242') including the 10' service loop at the device end. All installations shall be installed in accordance to current TIA TSB-162-A standard. Wireless cables shall be terminated 568-B on Cat6A Patch Panels separate from the station cable Patch Panels. All wireless cabling shall terminate in the MDF unless distance is an issue, then IDF termination is permitted.

Telecommunications contractor is responsible for the mounting of all WAPs on projects.

Any further question/ details shall be referred to OIT Wireless team.

27 16 00 COMMUNICATIONS CONNECTING CORDS, DEVICES, AND ADAPTERS

A. Labeling: For cables: Labels shall be created by a hand-carried label maker or an equivalent computer/software-based label making system.
    1. For horizontal cables: Labels shall 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.
    2. For backbone cables: Labels shall be affixed or engraved on hard plastic markers.

27 16 19 PATCH CORDS

1.01 COPPER PATCH CABLES

A. Contractor shall furnish and install copper and fiber patch cords and cables.

B. Furnish copper patch cables for modular copper cross-connects. Patch cables shall be pre-manufactured (factory-terminated), stranded UTP, with 8-pin modular plugs.
    1. Patch cables shall be 4-pair with snagless modular plugs. Copper patch cables Category rating shall be the same as that specified under Division 27 Specification Section *Communications - General Requirements.* Furnish as follows:
        a. For Work Area Outlets: Furnish 10 foot patch cables for 100% of the outlets shown on drawings.
        b. For Communications Rooms:
            1) Furnish red patch cables for 115% of data outlets. Coordinate lengths with Owner prior to procurement.
            2) Furnish blue patch cables for 115% of voice (analog) outlets. Coordinate lengths with Owner prior to procurement.

1.02 FIBER PATCH CABLES

A. Fiber patch cables shall be pre-manufactured with connectors (factory-terminated) at both ends. Furnish as follows:
    1. For Communications Rooms:
        a. Multimode: Furnish (10) 50/125 µm laser optimized multimode Duplex LC patch cables. Color shall be Aqua. Length should be coordinated with owner.
        b. Singlemode: Furnish (10) singlemode Duplex LC patch cables. Color shall be yellow. Length should be coordinated with owner.

27 21 33 DATA COMMUNICATIONS WIRELESS ACCESS POINTS

1.01 GENERAL

A. This section specifies requirements for the design, layout, and installation of communications data outlets and equipment including IEEE 802.11 wireless access points (WAPs) that help provide Wireless Local Area Network (WLAN) services.

B. It shall be mandatory that these standards and specifications, for communications infrastructure related work on the University campus, are adhered to stringently by all UCCS employees and external contractors.

C. The UCCS OIT Wireless team shall be consulted during the design and construction phases, and must approve all the designs prior to the construction phase. Wireless team (wireless@uccs.edu) is to be consulted as questions arise during the construction phase.

D. The UCCS OIT Wireless team reserves the right to modify these requirements based on the needs of a particular project, however, the requirements outlined in this document shall represent the initial design requirements for any new project unless advised otherwise by Ryerson University.

E. Where the architect, interior designer, corporate real estate or engineer wish to deviate from this standard prior written approval shall be obtained from UCCS OIT Wireless team.

1.02 DESIGN

A. Indoor
    1. Height, reachable by latter, enclosure required, -XXdb signal strength in all areas.
B. Outdoor
    1. Height, reachable by latter, paintable, lighting protection, PoE Extenders, etc..

2.01 PRODUCT

A. Current OIT approved WLAN equipment (as of August 24, 2017) is listed below. All WAPs are standardized on HPE Aruba Network devices. Verify latest models supported by OIT within 3 months of installation.

B. WAPs
    1. Primary Indoor model:
        a. JW801A - Aruba AP-335

    2. Specialized models required OIT approval before using:
        a. JW799A - Aruba AP-334
        b. JY680A - Aruba AP-303H

    3. Primary Outdoor model:
        a. JW178A - Aruba AP-275
        b. JW180A - Aruba AP-277
        c. JX974A - Aruba AP-367

    4. Specialized models required OIT approval before using:
        a. JW176A - Aruba AP-274
        b. JX967A - Aruba AP-365

C. Enclosures
    1. Oberon Wireless Enclosures
    2. ?? need part numbers, had an issue with AP-335 in our normal enclosures

D. Mounts
    1. JW046A - AP-220-MNT-W1 Flat Surface Wall/Ceiling Black
    2. JW047A - AP-220-MNT-W1W Flat Surface Wall/Ceiling White

    3. JW052A - AP-270-MNT-V1 AP-270 Series Outdoor Pole/Wall Long Mount Kit
    4. JW053A - AP-270-MNT-V2 AP-270 Series Outdoor Pole/Wall Short Mount Kit
    5. JW054A - AP-270-MNT-H1 AP-270 Series Outdoor AP Hanging or Tilt Install

E. Mount Kit
    1. JW055A - AP-270-MNT-H2 AP-270 Series Access Flush Wall or Ceiling Mount

F. Antennas
    1. Mfg. Part#: M6060060P23D3620 - TerraWave antenna 11
    2. JW018A - AP-ANT-45 Dual Band 90x90deg 5dBi
    3. JW019A - AP-ANT-48 Dual Band 60x60deg 8dBi

G. Lighting Protector
    1. CAT6A compatible
    2. IEEE 802.3af/at compatible
    3. PoE Endpoint compatible
    4. Example: L-com Item # AL-CAT6AJW

H. PoE+ Extenders
    1. CommScope PowerFiber part numbers??
    2. CommScope Powered Fiber Cable, OM3, 4 Fibers, Indoor/Outdoor, 12AWG Conductor

3.01 EXECUTION

A. WLAN is dependent upon the timely execution of a several infrastructure installation processes before being able to deploy the networking equipment:
    1. Cabling pathways/conduits completed
    2. Data cabling, copper and fiber, rough wiring completed via the established paths/conduits
    3. Submit to UCCS OIT a complete list of ports labels
    4. Data cabling, copper and fiber, termination, labeled and tested
    5. MDF and IDFs cleared of any contractor storage, and no longer used for storage.
    6. MDF and IDFs access is secured via a key system at a minimum.
    7. Total completion of MDF and IDF; Power, Lighting, HVAC, Racks, Cable Trays, Floor, Ceiling, Walls, etc.
    8. Switches racked, powered and connected to the UCCS backbone
    9. All WAPs patched to correct switch ports
    10. Delivery of as-builts to the UCCS OIT Wireless team
    11. UCCS OIT is responsible for the provisions, labeling and installation of all indoor WAPs.
    12. UCCS OIT is responsible for the provisions, labeling and to supervise installation of all outdoor WAPs.

27 31 00 VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT

Voice communications switching and routing equipment will be coordinated with campus OIT.

27 32 00 VOICE COMMUNICATIONS TELEPHONE SETS, FACSIMILES, AND MODEMS

All telephone sets and ancillary equipment furnished by UCCS except Elevator and Emergency Telephones. UCCS utilizes VOIP telephony.

27 32 23 ELEVATOR TELEPHONES

Elevator Telephones will be terminated to the dmarc. However, specification and standards will be provided by Public Safety.

27 32 26 RING-DOWN EMERGENCY TELEPHONES

Ring-Down Emergency Telephones will be terminated to the dmarc. However, specification and standards will be provided by Public Safety.

27 62 00 ACCESS CONTROL SYSTEM

1.01 GENERAL

A. Manufacturer: Unless otherwise indicated, equipment in this Section shall be the standard products of a manufacturer regularly engaged in the manufacture of such products. All components used in the system shall be commercial designs that comply with the Specifications. Each major component of equipment shall identify the manufacturer's name, model and serial number. Items of the same classification shall be identical. This includes equipment, modules, parts, and components. The Engineer retains the right to reject products which reflect, in the Engineer's opinion, sub-standard design practices, manufacturing procedures, support services, or warranty policies.
    1. Unless otherwise indicated, the equipment by the following manufacturers shall not be substituted. The Contractor shall provide the most current model and/or version of product available by listed manufacturer at time of procurement:
        a. Heartland

B. Equipment Schedule(s): The equipment schedule(s) at the end of this Section and/or within the drawings is general in nature and is provided to define system requirements, including but not limited to: functionality, signal compatibility, mounting requirements, space requirements, cooling requirements and overall clarity/intent of operation. The equipment schedule is not all inclusive and is not to be used as a bill of materials. The Contractor shall provide all equipment required for a fully functional and operating system ready for the Owner's use that may or may not be explicitly specified within Construction Documents.
    1. Part Numbers: Refer to the equipment schedule(s) for specific part numbers. Part numbers listed in the equipment schedule(s) define the performance specifications for the parts and shall be per the most recent manufacturer's cut/data specification sheets available at the time of bid. If no part number is provided, then any part meeting the functional and operational requirements specified is acceptable.
    2. Provide materials in quantities as required to provide a fully functional and operational System.
    3. Owner Provided, Contractor Installed: Refer to the equipment schedule at the end of this Section for procurement requirements. Equipment identified with an "OFCI" shall be provided by Owner for the Contractor to install.

1.02 EQUIPMENT SPECIFICATION

A. This equipment shall as a minimum conform to the following specifications:
    1. Access Control Processing Equipment
        a. The access control processing equipment shall provide capacity for current door requirements as referenced in drawings with the ability to expand for future Access Control needs.
        b. The processing equipment shall have a dedicated power supply with battery charger. In the event of power outage, the system shall have a minimum of 7 Amp hours of battery back-up power.
        c. Contractor to verify power requirements of processing equipment prior to installation.

    2. AUXILIARY RELAY

a. The relay shall be of a blade type construction with a double pole, double throw contact configuration.
b. The coil and contact ratings shall exceed the inline current and voltage requirement of the relay controlled devices.

3. Card Reader
    a. The card reader shall be a magnetic swipe type card reader.
    b. The card reader shall have battery back-up power in the event of power outages.
    c. All exterior card readers shall have surge protectors to protect against lightening.

4. Fiber Optic Converter
    a. The Fiber Optic Converters shall be Multi-mode type converters.
    b. The Fiber Optic Converters shall utilize SC type termination.

5. Interface Plate
    a. The Interface plates shall be made of 1/8 inch brushed anodized aluminum with beveled edges, finished in black with 1/8 inch height, white enamel filled lettering.

6. Lock Power Supply
    a. The power supply shall be a dedicated, voltage selectable power supply with battery charger. In the event of power outage, the system shall have a minimum of 7 Amp hours of battery back-up power.
    b. Contractor to verify power requirements of processing equipment prior to installation.

7. Network Manager
    a. The Network Manager shall support a maximum of 50 devices.
    b. Contractor shall provide as many Network Managers as required to provide a fully functional and operating system.
    c. Network Manager Computer shall be a computer system specifically modified by General Meters for Network Manager Applications.

8. Reader Interface
    a. The Reader Interface shall provide inputs for card readers, door positions and request to exit switches.
    b. The Reader Interface shall provide outputs for lock controls and alarm closures.
    c. The Reader Interface shall communicate with the access control processing equipment via a data signal type protocol.

1.03 POWER DISTRIBUTION

A. The Security Contractor shall provide all power distribution equipment required to provide a fully functional and operating system ready for the Owner's use. Power distribution equipment shall include but not be limited to; power conditioners, surge suppressors, power supplies, power strips, power cords and power cabling.
    1. Power distribution equipment may or may not be indicated in drawings and/or specifications.
    2. Power distribution equipment indicated within drawings and/or specifications are shown for specific implementation, isolation from other uses, or general clarification.
    3. Power distribution equipment shown within drawings and/or specifications does not represent the power distribution equipment in its entirety, the Contractor shall provide remaining power equipment as required to provide a fully functional and operating system for the Owner's use.

1.04 WIRE AND CABLE

A. This equipment shall as a minimum conform to the following specifications. Cable gauge and conductor quantity requirements may vary depending on device requirements. Contractor to determine and utilize cable with proper conductor and gauge requirements to provide proper operation.
    1. Card Reader: This cable shall be an Unshielded/Twisted/Pair (Category 5e), eight 24 AWG solid conductors.
    2. Communications System Cable: Refer to Division 27 Specification Section Communication – General Requirements and its sub-specification sections.
    3. Contact Closure: This cable shall be a Shielded Twisted Pair, (2) 20 AWG stranded conductor.
    4. Lock Power: This `cable shall be an Unshielded Twisted Non-Pair, (2) 16 AWG stranded conductors.
    5. Network Patch Cords: Provide patch cords as required by the devices to be served. Patch cable types shall be as specified in Division 27 Specification Section Communication – Patch Cords.
    6. Power Supply: This cable shall be an Unshielded Twisted Non-Pair, (2) 18 AWG stranded conductors.
    7. Reader Interface: This cable shall be an Unshielded/Twisted/Non-Pair, (4) 22 AWG, (2) 18 AWG stranded conductors.
    8. RS-485 data: This cable shall be a shielded twisted pair, (4) 22 AWG stranded conductors.

APPENDIX A – MISC EQUIPMENT SCHEDULES

SINGLE MODE FIBER SPECIFICATIONS FOR BUILDING TO BUILDING CONNECTIONS

A germania-doped silica core surrounded by a concentric silica glass cladding shall comprise each optical fiber. The fiber shall be a matched clad design manufactured by the outside vapor deposition process (OVD). Each optical fiber refractive index profile shall be step index.

Each fiber shall be proof tested by the fiber manufacturer at a minimum of 100 kpsi (0.7 GN/m²). The fiber shall be coated with a dual acrylate protective coating and the coating shall be in physical contact with the cladding surface. The single-mode fiber shall meet EIA/TIA-492CAAB, “Detail Specification for Class lVa Dispersion-Unshifted SingleMode Optical Fibers with Low Water Peak,” and ITU-T G.652.C, “Characteristics of Single-Mode Optical Fiber Cable.” Fiber shall have a mode field diameter of 9.20 ± 0.40 µm at 1310 nm and 10.40 ± 0.50 µm at 1550 nm. Fiber core-clad concentricity shall be = 0.5 µm. Fiber cladding diameter shall be 125.0 ± 0.7 µm. Fiber cladding non-circularity shall be = 0.7%. Fiber coating diameter shall be 245 ± 5 µm.

The attenuation specification shall be a maximum value for each cabled fiber at 23 ± 5°C on the original shipping reel. The cabled fiber attenuation for Loose Tube and Ribbon cable constructions shall be < 0.4 dB/km at 1310 nm and <0.3 dB/km at 1550 nm. For Tight Buffered constructions the cabled fiber attenuation shall be <1.0 dB/km at 1310 nm and <0.75 dB/km at 1550 nm. The attenuation at the water peak (1383 nm) shall not exceed the 1310 nm attenuation value. The cabled fiber shall be capable of operating in the 1360 nm to 1480 nm water peak region.

The attenuation due to 100 turns of fiber around a 50 ± 2 mm diameter mandrel shall not exceed 0.05 dB at 1310 nm and 0.10 dB at 1550 nm. The attenuation due to 100 turns of fiber around a 75 ± 2 mm diameter mandrel shall not exceed 0.10 dB at 1625 nm. There shall be no point discontinuities greater than 0.10 dB at 1310 nm and 1550 nm.

The maximum dispersion shall be = 3.2 ps/(nm•km) from 1285 nm to 1330 nm and shall be =18 ps/(nm•km) at 1550 nm. The cabled fiber shall support Gigabit Ethernet (GbE) operation according to the 1000BASE-LX (1310 nm) specifications up to 5000 m in accordance with the GbE standard. The cabled fiber shall support laser-based 10 Gigabit Ethernet (10GbE) operation according to the 10GBASE-LX4 (1300 nm region), 10GBASE-L (1310 nm) and 10GBASE-E (1550 nm) specifications for distances of 10 km, 10 km and 40 km, respectively.

The cabled optical fiber shall support industry-standard multi-gigabit Fiber Channel physical interface specifications.

Fiber MM 50um Laser Optimized OM4
Each fiber in the cable must be usable and meet required specifications. Each optical fiber shall be sufficiently free of surface imperfections and inclusions to meet the optical, mechanical and environmental requirements of this specification. A germania-doped silica core surrounded by a concentric silica glass cladding shall comprise each optical fiber. The fiber shall be a matched clad design manufactured by the outside vapor deposition process (OVD). Each optical fiber shall be proof tested by the fiber manufacturer at a minimum of 100 kpsi (0.7 GN/m²). The fiber shall be coated with a dual-layer acrylate protective coating. The coating shall be in physical contact with the cladding surface.

The attenuation specification shall be a maximum value for each cabled fiber at 23 ± 5°C on the original shipping reel.

The multimode fiber shall meet TIA-492AAAC, "Detail Specification for 850-nm Laser-Optimized, 50-µm Core Diameter/125-µm Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers."

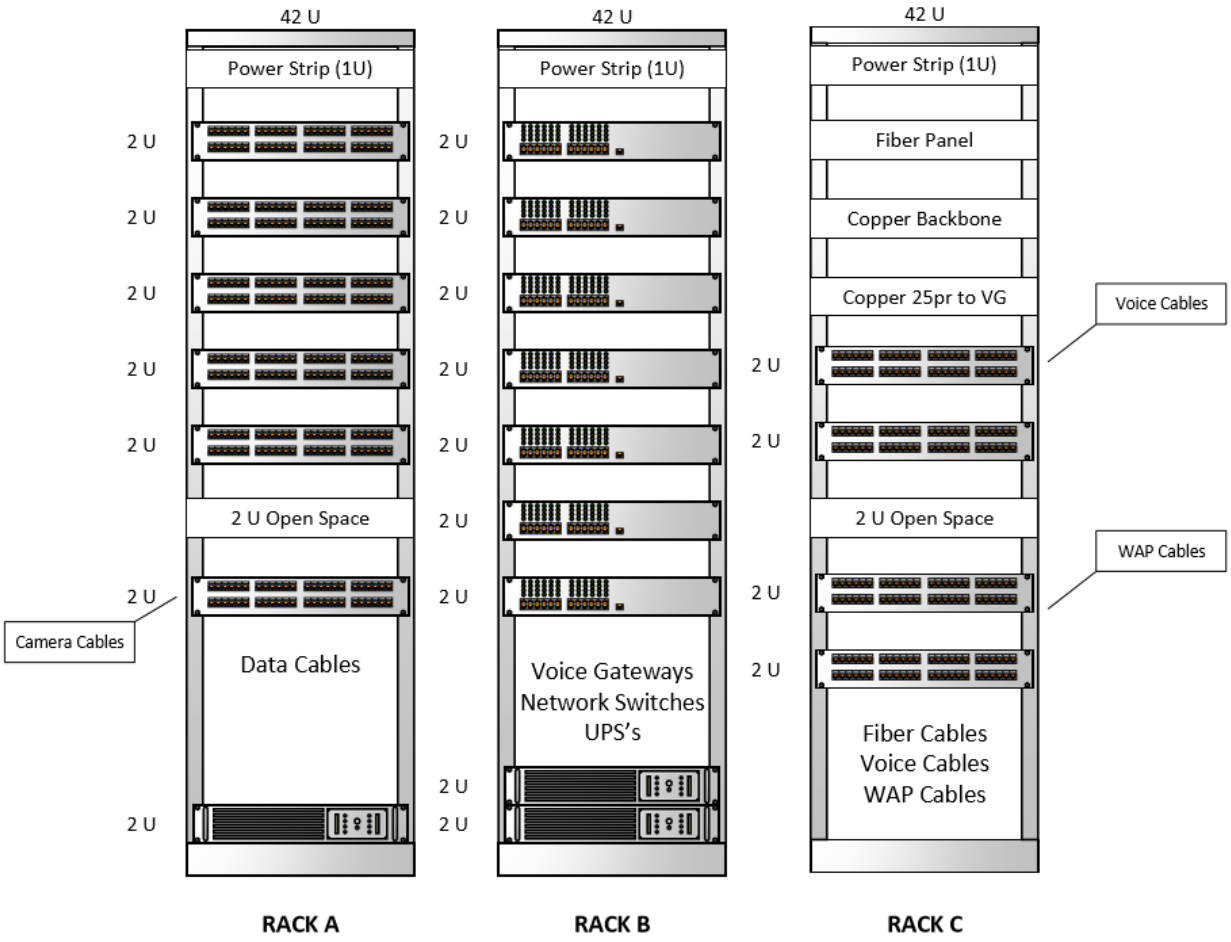
The core diameter shall be 50.0 ± 2.5 µm. The cladding diameter shall be 125.0 ± 2.0 µm. The cladding non-circularity shall be = 1.0%. The core-clad concentricity shall be = 1.5 µm. The coating diameter shall be 245 ± 5 µm. The optical fiber refractive index profile shall be graded. The numerical aperture of the fiber shall be 0.200 ± 0.015.

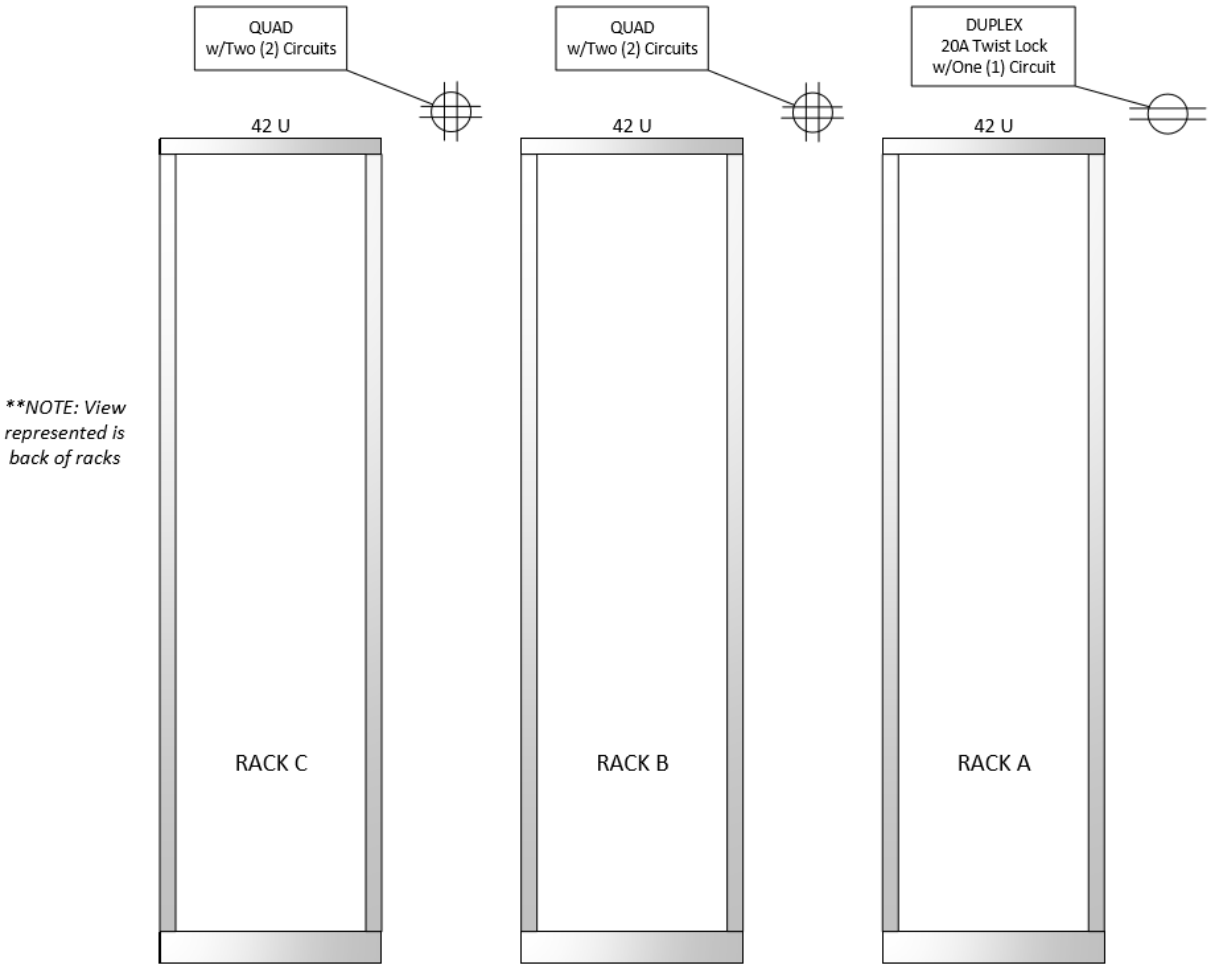
The maximum cabled fiber attenuation shall be 3.0 dB/km at 850 nm and 1.0 dB/km at 1300 nm for all cable types. The cabled optical fiber shall have a minimum effective modal bandwidth (EMB) of 2000 MHz•km at 850 nm in accordance with FOTP-220 for 10 Gigabit Ethernet. The cabled optical fiber shall have a minimum over-filled launch (OFL) bandwidth of 1500/600 MHz•km at 850/1300 nm. The cabled optical fiber shall have a minimum restricted mode launch (RML) bandwidth of 1400 MHz•km at 850 nm in accordance with FOTP-204 for Gigabit Ethernet.

The cabled optical fiber shall support industry-standard IEEE 802.3 10GBASE-S (10 Gigabit Ethernet at 850 nm) physical layer specifications for 300 m. The cabled optical fiber shall support industry-standard IEEE 802.3 1000BASESX (Gigabit Ethernet at 850 nm) physical layer specifications for 1000 m and 1000BASE-LX (Gigabit Ethernet at 1300 nm) for 600 m. The cabled optical fiber shall support industry-standard multi-gigabit Fibre Channel physical interface specifications.

There shall be no point discontinuity greater than 0.2 dB. The attenuation coefficient at 1380 nm shall not exceed the attenuation coefficient at 1300 nm by more than 3.0 dB/km. The attenuation due to 100 turns of fiber around a 75 mm diameter mandrel shall not exceed 0.5 dB at 850 nm and1300 nm.

RACK LAYOUT FOR MDF





***NOTE: View represented is back of racks*

WIRELESS ACCESS POINT DIAGRAMS

OPEN CEILING WITH PAINTED ACCESS POINT COVER THAT MATCHES CEILING COLOR

ACCESS POINT ENCLOSURE FOR CEILING GRID