

EXHIBIT A

Colorado Mountain College Infrastructure Standards

1. Overview

a. GENERAL

The purpose of the telecommunications cabling standards is to insure the highest level of performance, while allowing for the easy migration of emerging technologies within the Colorado Mountain College (CMC) infrastructure labeling.

b. CONTRACTOR/SUB CONTRACTOR

- i. All necessary permits and schedule of inspections will be the responsibility of the contractor. A copy of the permit will be provided to the College before work begins and a copy of the final sign off by the inspector will be provided to College Staff.
- ii. Various small jobs may be allowed using the College Electrical permit process. Information Services/Network Services will determine this before work starts.
- iii. Contractors will coordinate all work with College staff as not to interfere with College activities. All OSHA and other College safety requirements will be observed.
- iv. Contractors must be licensed and bonded and must have a minimum of five years experience, under the present firm name, in the installation and maintenance of the system equipment specified, including supporting materials and equipment.
- v. The Contractor/installer shall insure that telecommunications cable is installed with care, using techniques which prevent kinking, sharp bends, scraping, over tightening of tie wraps, cutting, or deforming the jacket, or other damage. During inspection by the Engineer or College, evidence of such damage will result in the material being declared unacceptable. The Contractor shall replace unacceptable cable at no additional expense to the College.

c. WARRANTY

- i. CMC requires a minimum of a 15-year manufacturer's warranty covering telecommunications passive infrastructure products for all new installations. The warranty will include labor and materials for the installation, as well as, an applications assurance clause.

2. Infrastructure Standards

a. INTER-BUILDING CONNECTIVITY

- i. Inter-Building connectivity will be supplied by means of fiber optic cable. This should be single-mode (preferred) or OM3 multi-mode (for short runs only) Transmission capacity shall not be less than 500 MHz on any installed fiber.
- ii. All Inter-Building Fiber shall be installed in a minimum of 1 inch innerduct between Telecommunication IDF/MDF Rooms.
- iii. Each inter-building fiber optic cable shall be fitted with a fan-out assembly prior to termination. The contractor shall use a fan-out assembly recommended by the cable manufacturer. All fiber optic strands shall be terminated with LC type connectors in accordance with accepted best practices. All strands shall be terminated.

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- iv. Line of sight wireless may be used as a last resort, if cable cannot be run (example: the city would have to dig across a main road). This will be evaluated by the Network Service team before installation
 - v. Inter-Building backbone copper cables shall be a minimum of 10-12 multipairs, category 6a cable from the campus MDF to the building IDF. The cable shall consist of an ASP sheath with 24 AWG solid-copper conductors encapsulated with Flexgel filling compound for moisture protection
- b. INTRA-BUILDING CONNECTIVITY
- i. All intra-building cabling shall be pulled only from an MDF location, to an IDF. IDF to IDF trunks will not be permitted and will be considered against design and infrastructure guidelines.
 - ii. If intra-building fiber cabling is to be used, it shall be 50 micron OM3 multimode with a minimum of 12 strands. A minimum of six strands shall be terminated for each fiber cable.
 - iii. If intra-building copper cabling is to be used, it shall be a minimum of Category 6, and it shall meet minimum plenum and shield ratings for the installed environment. This will be evaluated by the network services team before installation
 - iv. All intra-building cable shall be installed in a minimum of 1 inch innerduct between Telecommunication IDF/MDF Rooms. Shielded interlocking fiber cable may be used without innerduct. Conduit shall be evaluated for adequate size and expansion capabilities before cable is pulled to ensure longevity and expansion.
- c. INTERMEDIATE DISTRIBUTION
- i. Edge port distribution shall be a minimum of Category 6 from the distribution frame to the communications outlet
 - ii. A minimum of Category 6 cable shall be plenum rated and shielded where needed. This will be evaluated by the Network Service team prior to installation
 - iii. All communications outlet shall be rated for minimum Category 6 specifications
 - iv. All cables, other than those in the Telecommunication IDF/MDF Rooms at the terminal backboard shall utilize conduit or cable tray/ladder when being routed through the building (required for all new construction.)
 - v. In cases where conduit or cable is not available the contractor shall provide an approved cable support method. CMC network services team must approve the proposed support method prior to installation.
 - vi. All horizontal support outside of a cable tray shall route parallel and perpendicular to building walls, and will follow hallways or corridors wherever possible. Diagonal routing of horizontal cable shall not be permitted without prior approval from CMC network services team.
 - vii. All bend radius and pulling tensions must comply with EIA/TIA-568-B.
 - viii. Cable bundles shall contain no more than 50 cables at any support point; plenum tie wraps utilized to secure cables shall not damage the cable jacket.
 - ix. Horizontal cable shall be installed from the Telecommunications IDF/MDF Room to each work area outlet.
 - x. The length of each cable shall not exceed 90 meters.
 - xi. Horizontal wiring shall be star-wired from the telecommunications to each work area outlet, with no intermediate connections.
 - xii. Cables shall not be spliced or taped.

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- xiii. There shall be adequate slack wire between the Category 6 jack and the wall surface of the outlet box to allow for future repeat termination.
- xiv. The contractor shall leave a minimum 6-foot service loop in each horizontal cable neatly coiled in the ceiling area.
- xv. Cable bend radii shall be observed for any work area service coils.
- xvi. The contractor shall terminate the 4-pair cable according to the manufactures recommended practices.
- xvii. The cable jacket shall be maintained as close as practicable to the point of termination and pair twists shall be maintained to within ½” of the pair termination.

3. TERMINATION BLOCKS

- a. The 110 block termination systems are considered part of the horizontal cabling system. These components shall be of the same manufacturer, system, and warranty and performance level installed for the horizontal cabling system.
- b. The 110-cabling system is the standard for the termination of backbone cabling.
- c. The 110-termination block system shall include wiring block, standoff legs, and vertical/horizontal wire management on all sides of the termination blocks.
- d. The 110 system shall also include (6) C-4's for 4 pair cable installations, and (5) C-5's for 25 pair wiring strip and labels.
- e. Connect telco patch panel with a 25 pair cables terminating on 110 blocks.
- f. Install horizontal wire management components on the top and bottom of each block. All wire management components shall be of the same manufacturer and system type of the termination block.
- g. The connections between terminal blocks shall be made using with 24-gauge cross-connect wire. All connections will be made by the owners unless otherwise specified and approved by CMC network services team.
- h. Telecommunication IDF/MDF Rooms shall contain wiring blocks as required to terminate all incoming pairs and all outgoing pairs to all TRs.
- i. Labeling for riser cables shall designate the corresponding destination wiring block
- j. The installation of block splices to extend distribution cable is not permitted.

4. FIBER OPTIC PATCH PANELS

- a. All terminated fiber strands shall be housed in a fiber optic patch panel. The fiber panels shall be sized based upon the number of strands being terminated plus 25% for growth.
- b. The fiber panels shall be capable of being rack mounted in a standard 19” equipment frame.
- c. Each fiber optic panel installed shall be loaded with duplex LC coupling modules.
- d. Each connection shall be labeled per the label standards later in this document

5. WORK AREA OUTLETS

- a. Prior to the start of work, a Network Services representative shall define the quantity and location of the work area outlets.
- b. For each flush mount outlet, a minimum 3/4” conduit is required with a single gang wall box or larger wall box as dictated by the number of ports.
- c. All wall boxes shall have a minimum depth of 2 ½”.
- d. The data outlets shall be mounted at 18” above the finish floor and all wall phone outlets shall be mounted at 48” above finish floor.
- e. The faceplates at each work area shall be either a single gang or double gang plate depending on the outlet type.
 - i. Each data insert shall be a single 8-position category 6 minimum jack with T568B wiring.
 - ii. All faceplates and components shall be ivory or white in color.

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6. CABLE PATHWAYS

- a. The conduit for communications shall be EMT when working within the building and Schedule 40 PVC for outdoor and buried applications.
- b. All conduits shall be installed using factory sweeps providing a minimum bend radius of 10 times the outside diameter of the conduit (corners shall not be made using junction or pull boxes).
- c. Bushings should be installed and all conduit ends should be deburred to assure that the cabling is not damaged during installation.
- d. Conduits shall be installed to provide the shortest pathway and run perpendicular and parallel to the building columns.
- e. Install (1) pull box for every 100' of conduit run or every 180° of bends.
- f. Pull boxes shall provide adequate space for pulling of cables and maintaining cable bend radius.
- g. All conduits shall be installed with metered pull strings.
- h. All pull points in the conduit shall be accessible for pulling new cable.
- i. The design of the cable infrastructure should include cable trays or ladders for all major pathways for horizontal cabling and all backbone cabling not installed within conduit.
 - i. Cable trays shall be UL Classified rigid, welded steel wire mesh cable management systems.
 - ii. Trays/Ladders shall be sized based on the quantity of cables to be installed along the path plus 40% for future growth.
 - iii. All fittings (elbows, tees, crossings, and vertical rises) shall be field fabricated according to manufacturer specifications.
 - iv. Support the tray from the building structure using the appropriate manufacture brackets.
 - v. The contractor shall provide cable dropouts with a minimum 5" bend radius at each location where the cables exit the tray.
- j. Where cable trays or conduits are not available, the contractor shall support the cabling using wirehangers and J-hooks.
 - i. The J-hooks shall be installed at a maximum span of 5'. A minimum height of 6" shall be maintained above the drop tiles ceiling
- k. All wireways that are installed shall be Wiremold 4000 series raceway. Colors shall be coordinated to match room finishes.

7. TELECOMMUNICATIONS ROOM

- a. All telecommunications rooms, known from here out as IDF/MDF Rooms, should have a minimum room size of 10' x 15'.
 - i. IDF/MDF Rooms shall be sized to assure that all cabling and equipment will fit within the room and allow for future expansion.
 - ii. The formula for computing the room is in the ANSI/TIA/EIA -569A STANDARD
 - iii. Areas with high EMI and possible flooding shall be avoided.
 - iv. All IDF/MDF Rooms shall have finished walls along all four sides that extend to the building structure.
 - v. Each IDF/MDF Room shall have fully opening lockable doors (minimum size 36"x 80") without door sills or posts.
 - vi. The floor in the IDF/MDF Room should be sealed concrete or tile to minimize static electricity (no carpet).
 - vii. It is preferable to build IDF/MDF Rooms without ceilings, however, should a ceiling be required it should be a drop tile ceiling with a minimum height of 9'-0" above the finish floor.
- b. IDF/MDF Rooms should be located to minimize the horizontal cable length.
- c. The maximum cable length from switchport to network interface cards is 254'.
- d. Heating, ventilation and air conditioning that will maintain continuous and dedicated environmental control 24 hours per day, 365 days per year.

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- i. The temperature range shall be 64°F to 75°F with 30% to 55% relative humidity.
- e. Lighting within the IDF/MDF Room should provide a minimum of 50 foot-candles measured 3.3 ft. above the floor.
- f. Lighting fixtures should be located to provide a minimum of 5" clearance from all telecommunications cabling and equipment.
- g. Power distribution within the IDF/MDF Room shall be determined by the Network Team but will normally consist of (2) dedicated 120V, 30 amp NEMA L5-30R outlet at each equipment rack and 20 amp duplex outlets spaced every 6' around the walls.
 - i. The 30-amp outlet shall be installed behind the 6" vertical management unit at the bottom so as not to interfere with the installation of equipment.
- h. Equipment racks in each IDF/MDF Room shall have at least 36" around the front and back of all racks.
 - i. All equipment racks shall be freestanding 19"x 84" with EIA 5/8"-5/8"-1/2" hole patterns along each side of the vertical rails.
 - ii. Equipment racks will be securely mounted to the floor using the appropriate anchors.
 - iii. Additional power distribution may be specified and if so, shall be plugged into an owner provided UPS within the room.
- i. Install a minimum 9" wide telecom runway above the rack and backboard with a section connecting the two.
 - i. The runways shall be attached to the equipment racks and walls using appropriate brackets.
 - ii. Provide and install cable dropouts at the wall and racks with a minimum 5" bend radius to prevent kinking of cables exiting the runway.
- j. Patch panels installed need to meet the approved category compliant modular patch panels black in color.
 - i. In mixed use applications (Category 6/Category 6A F/UTP) install modular F/UTP patch panels capable of supporting both applications.
 - ii. The minimum TIA 568 performance test levels for Category 6 Link or Channel testing that establish a PASS/FAIL test report does constitute the minimum CMC network services team acceptable performance level for permanent links
 - iii. Each Telecommunication IDF/MDF Room shall contain patch panels as required to terminate all pairs on its respective floor or floors served
 - iv. Wire management to be mounted at the top and bottom of station cabling equipment racks and between every patch panel.
- k. Cable Management
 - i. Horizontal Wire Managers shall be black and 2 RU in size.
 - ii. Vertical Wire Managers shall be black in color, a minimum of 6" wide x 9.30" deep with a removable cover and shall also be compatible with the installed rack (CPI PN 12833-703 for reference).
 - iii. Cable support managers are required at the rear of all patch panels.