Alamo Colleges

Telecommunications Infrastructure Standards

ALAMO COLLEGES

For

New Facility Construction or Renovations

Version 2010.8.5

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REVISION LOG

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VERSION	**TITLE**	**OWNER**	**DIRECTOR OF INFORMATION TECHNOLOGY SERVICES**	**ASSOCIATE VICE CHANCELLOR OF FACILITIES OPERATION AND CONSTRUCTION MANAGEMENT**	**SUMMARY OF CHANGES FROM PREVIOUS VERSIONS**	**DATE PUBLISHED**
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PART 1 - DOCUMENT PURPOSE

1.01 The Alamo Colleges Telecommunications Infrastructure Standard is a guideline for structured cabling infrastructure systems and spaces to be applied by the design team for new or renovated facilities. Information herein is applicable to the technical designer, Architect, MEP, and contractors, and shall be taken into account for each project by all team members.

A. The standard sets forth parameters for the technical system in addition to the site and building requirements to facilitate a properly-installed standards-compliant cabling plant, organized as follows:

1. Telecommunications Spaces; Architectural, HVAC, Power, Entrance Pathways and Conduits

2. System Requirements; Cable Management in Telecommunications Spaces, Cable Support in Pathways, Backbone Cabling, Horizontal Cabling, Grounding, Labeling, Testing, and As-Built Documentation.

3. Telecommunications Diagrams

1.02 The standard addresses infrastructure for non-specialty campus buildings and is not intended for the design of data centers or specialty facilities, of which should be considered on a case-by-case basis.

1.03 Designers shall not deviate from this standard without explicit written approval from the owner.

1.04 Any deviations shall immediately be brought to the attention of the owner's representative in writing for resolution.

1.05 Where specific product brands are mentioned, an equal equivalent will be considered following an official submission of product literature and acceptance by the Alamo Colleges Information Technology Services (ITS) Department.

1.06 Where means, methods, and best practices are mentioned, contractor shall follow the manufacturers' and owner's requirements, industry standards, or code, which ever is most stringent.

1.07 Basic contractor qualifications are set forth, but may be made more stringent as applicable to each project based upon size and scope.

PART 2 - DOCUMENT HISTORY

2.01 This document supersedes all previous standards which have been fully reevaluated and described herein by the Alamo Colleges Information Technology Services Department, and Facilities Operations and Construction Management department.

2.02 The contents of the standard were derived by the assembly and input from ITS and Facilities Operations and Construction Management members.

PART 3 - INDUSTRY STANDARDS

3.01 The following industry standards shall be adhered to unless specifically directed otherwise by Alamo Colleges. The list is not all-inclusive and does not alleviate compliance with applicable standards, codes, and best practices:

A. TIA-568-C.0 Generic Telecommunications Cabling for Customer Premises

B. TIA-568-C.1 Commercial Building Telecommunication Cabling Standards – Part 1 General Requirements (2008)

C. TIA-568-C.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standard (2009)

D. TIA-568-C.3 Optical Fiber Cabling Components Standard (2009)

E. TIA-569-B Commercial Building Standard for Telecommunications Pathways and Spaces - (October 2004)

F. TIA-598-C Optical Fiber Cable Color Coding - (January 2005)

G. TIA/EIA-606-A Administration Standard for Commercial Telecommunications Infrastructure - (May 2002)

H. ANSI J-STD-607-A Commercial Building Grounding and Bonding Requirements for Telecommunications - (October 2002)

I. TIA-758-A Customer-owned Outside Plant Telecommunications Infrastructure Standard - (August 2004)

J. TIA-598-C Optical Fiber Cable Color Coding - (January 2005)

K. TIA-526-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant – OFSTP-7 - (February 2002)

L. TIA-526-14-A Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant – OFSTP-14 - (August 1998)

M. AIA

N. Local

O. NEC

P. ISO

Q. ANSI

R. FCC

S. UL

T. OSHA

U. NFPA

V. NEMA

W. Plenum Applications

X. Applicable Flame Test: UL 910 (NFPA 262 1990).

PART 4 - CONTRACTOR QUALIFICATIONS

4.01 Contractor shall be certified by the manufacturer of all products to furnish a 20-year performance certification for cabling and connectivity, and applicable manufacturer warranties for the remaining products.

4.02 Contractor shall have experience with and references for projects of similar size and scope to that of the owner's.

4.03 Specific project contractual documents and or requirements developed by the A/E design team for construction shall supersede this standards document.

PART 5 - NOMENCLATURE

5.01 In many cases industry nomenclature is used, but is blended with outdated industry and district-specific terms to best suit the College's needs.

A. Industry Specific

1. MDF – Main Distribution Frame, main point of connection for service providers, houses the backbone terminations and telecommunications equipment for crossconnection and distribution to Intermediate Distribution Frames, and crossconnection to user workstations.

2. IDF – Intermediate Distribution Frame, houses the backbone terminations and telecommunications equipment for crossconnection and distribution to user workstations.

B. Alamo Colleges Specific

1. Campus MDF – MDF that serves the entire campus by distributing backbone connections to the first IDF in each other building on campus and to the IDF-2s of the building in which it resides, and crossconnection to user workstations.

2. Building MDF – MDF that that distributes backbone cables to the IDF-2s in the building in which it resides, and crossconnection to user workstations. Applies to stand alone single-buildings.

3. IDF-1 – the first IDF in every other campus building that distributes backbone cabling to the IDF-2s of the building in which it resides, and cross connects to user workstations. Does not apply to the building with the Campus MDF or stand alone single buildings with a Building MDF.

4. IDF-2 – IDFs that are not serving as an IDF-1, receive backbone cabling from the Campus MDF, Building MDF, or IDF-1, cross connects to user workstations.

PART 6 - DISTRICT INFRASTRUCTURE STANDARDS

6.01 Telecommunications Spaces

A. Campus MDF (does not apply to a stand-alone single-building facility)

1. Description

a. The Campus MDF is a Telecommunications space that serves a multi-building facility or campus. There is only (1) on each campus.

b. The Campus MDF houses the entrance conduits, terminations, and cross connections for all incoming inter-building backbone cabling from the IDF-1s in other buildings on the campus and the intra-building backbone cabling from the IDF-2s of the building in which it resides, and cross connects to user workstations.

c. Wall and floor space shall be reserved for service provider demarcation equipment and incoming infrastructure terminations.

d. Campus distribution network equipment, servers, and other centralized telecommunications related equipment will reside in the Campus MDF; the Campus MDF is not intended to support academic or district servers, which will reside in separate space.

e. The Campus MDF may share space with other systems such as security panels, fire alarm panels, paging systems, CATV, and building control panels.

f. The Campus MDF shall not be used for storage, serve as a mechanical or electrical distribution space, nor shall it have within its space main electrical feeds, water or sprinkler main lines.

g. The layout of racks, cabinets, wall fields, and cable management shall be as indicated on the attached diagrams.

2. Architectural (Campus MDF)

a. The Campus MDF shall me a minimum of 600 square feet with a minimum clear lineal wall length of at least 30 feet, all walls shall go to deck.

b. The floor is not required to be raised; floor finish shall be sealed bare concrete.

c. The Campus MDF shall not contain windows.

d. Campus MDF shall have an exterior wall that is within 50 feet of the building exterior, and not be located adjacent to or below restrooms or other water-based facilities, or sources of EMI and mechanical vibration.

e. All walls of the Campus MDF shall be covered with AC Grade ¾" Fire Retardant Plywood, aligned vertically starting at 12 inches above the finished floor. The plywood shall not be painted.

f. The room shall be without a ceiling if possible or a lift-out tile ceiling when required. Cables or devices penetrating the ceiling tiles shall not pass through a bare ceiling tile but shall be routed through adequately sized bushings. The ceiling shall be a minimum of 24 inches above the highest rack or cable runway, 36 inches is recommended

g. Entry to the space shall be through a minimum 42-inch by 80-inch clear door opening that swings outward. Door shall be solid core or steel with shatter-proof window if equipped. The door shall securely lock and access shall only be by Alamo Colleges-approved personnel. The door shall open to an interior hall way or space, it is not recommended that the door open to the exterior of the building.

h. When an access control security system is available, the entrance to the Campus MDF shall be equipped with a proximity card reader and electrified door hardware. When a surveillance system is available the Campus MDF shall be equipped with at least (1) camera.

i. Fire suppression for the Campus MDF shall be sprinklers in the MDF when the remainder of the building is equipped with a sprinkler system.

1) A pre-action fire suppression system shall be considered by the design team on a case-by-case basis.

3. HVAC (Campus MDF)

a. The Campus MDF shall be serviced by a dedicated unit that is part of the building's main system. The unit shall maintain a constant 24/7 cooled environment between 68° and 75° F with humidity of 41.9°F Dew Point to 60% RH and 59°F Dew Point, or the current ASHRAE recommendations at the time of construction.

b. The minimum HVAC load shall be designed to displace 20KW of power, or 6 Tons, and shall be designed to load if the known load is greater at the time of design.

c. It is recommended that the Campus MDF maintain the stated temperature and humidity in the event of building power outages or primary HVAC system failure.

d. Air delivery shall be aligned in the front of the equipment rows and returns at the rear of the equipment rows.

4. Lighting (Campus MDF)

a. Florescent light fixtures shall be at least 12 inches above the top of the highest rack or cable runway, 18 inches is recommended.

Lighting shall be a minimum of 40 foot candles at 2 feet above the floor in the entire space.

b. The Campus MDF shall be equipped with emergency lighting to keep the space lit during power outages.

5. Power (Campus MDF)

a. Power for the Campus MDF shall be in two categories: dedicated and convenience.

b. Dedicated

1) The Campus MDF shall be equipped with (2) dedicated 208 volt 3-phase 150 Amp circuits, 4-wire (2PH + N +G), hardwired to the UPS(s). The originating electrical panel will be equipped with (2) 150 AMP breakers. Conductors shall be routed from the panel in conduit to the UPS wiring terminals.

2) The Campus MDF shall be equipped with a minimum of (1) APC Symmetra LX 16kVA Scalable to 16kVA N+1 Ext. Run Tower, 208/240V, to provide 30 minutes of run time at full load. An additional circuit and space is allocated should the load exceed 16kVA and a second UPS be required.

3) Additional power circuits to be allocated to security, fire alarm, CATV, building controls, and service provider equipment shall be considered and coordinated at the time of building design.

4) Power distribution to the racks and cabinets shall be achieved by installing PDUs which are not within the scope of this document and are to be provided by the Alamo Colleges network department.

c. Convenience

1) The Campus MDF shall be equipped with 20 Amp Duplex NEMA 5-20R receptacles, with maximum (6) receptacles on each circuit. The originating electrical panel shall be equipped with a 20 Amp breaker per circuit.

2) A Duplex receptacle shall be spaced at least 1 foot from an adjacent wall and every 6 feet thereafter. A minimum of (1) Duplex receptacle shall be placed in each wall and be flush mounted to the finished wall surface at 18 inches above finished floor.

6. Racks and Cable Management (Campus MDF)

a. The Campus MDF shall be equipped with (4) Standard Equipment Racks.

1) Each rack shall be equipped with a vertical cable manager on both sides of the rack. Adjacent racks may share a vertical wire manager between them.

2) Each rack shall be equipped with a horizontal wire manager above and below each horizontal patch panel.

b. The Campus MDF shall be equipped with (2) Server Cabinets. Cabinets shall be bayed together with sides removed when mounted adjacently. The fronts of the cabinets shall face the front of the future cabinet row to allow for a hot row cold row configuration.

1) Space shall be allocated for an additional (7) future Server Cabinets.

2) Space equivalent to (2) Server Cabinets shall be allocated for service provider equipment.

c. The Campus MDF shall be equipped with cable runway encircling the room at 86 inches above the finished floor, and crossing the room parallel to the rack rows (3) times.

1) Cable runway shall attach to the tops of Standard Equipment Racks utilizing rack-to-runway hardware kits.

2) Cable runway shall suspend above Server Cabinets and be supported overhead by all thread to the building structure utilizing manufacturer-approved hardware and methods.

3) A vertical section of cable runway shall be attached to the wall board to manage backbone and service provider cables as they transition from the entrance conduits to the overhead cable runway.

B. Building MDF (does not apply to a multi-building campus facility)

1. Description

a. The Building MDF is a Telecommunications space that serves a single stand-alone building that is not part of a multi-building campus. There is only (1) in each stand-alone building.

b. The Building MDF houses the entrance conduits, terminations, and cross connections for all incoming intra-building backbone cabling from the IDF-2s of the building in which it resides, and cross connects to user workstations.

c. Wall and floor space shall be reserved for service provider demarcation equipment and incoming infrastructure terminations.

d. Building distribution network equipment, servers, and other telecommunications related equipment will reside in the Building MDF.

e. The Building MDF may share space with other systems such as security panels, fire alarm panels, paging systems, CATV, and building control panels.

f. The Building MDF shall not be used for storage, serve as a mechanical or electrical distribution space, nor shall it have within its space main electrical feeds, water or sprinkler main lines.

g. The layout of racks, cabinets, wall fields, and cable management shall be as indicated on the attached diagram.

2. Architectural (Building MDF)

a. The Building MDF shall me a minimum of 400 square feet with a minimum clear lineal wall length of at least 25 feet, all walls shall go to deck.

b. The floor is not required to be raised; floor finish shall be sealed bare concrete.

c. The Building MDF shall not contain windows.

d. Building MDF shall have an exterior wall that is within 50 feet of the building exterior, and not be located adjacent to or below restrooms or other water-based facilities, or sources of EMI and mechanical vibration.

e. All walls of the Building MDF shall be covered with AC Grade ¾" Fire Retardant Plywood, aligned vertically starting at 12 inches above the finished floor. The plywood shall not be painted.

f. The room shall be without a ceiling if possible or a lift-out tile ceiling when required. Cables or devices penetrating the ceiling tiles shall not pass through a bare ceiling tile but shall be routed through adequately sized bushings. The ceiling shall be a minimum of 24 inches above the highest rack or cable runway, 36 inches is recommended

g. Entry to the space shall be through a minimum 42-inch by 80-inch clear door opening that swings outward. Door shall be solid core or steel with shatter-proof window if equipped. The door shall securely lock and access shall only be by Alamo Colleges-approved personnel. The door shall open to an interior hall way or space, it is not recommended that the door open to the exterior of the building.

h. When an access control security system is available, the entrance to the Campus MDF shall be equipped with a proximity card reader and electrified door hardware. When a surveillance system is available the Building MDF shall be equipped with at least (1) camera.

i. Fire suppression for the Building MDF shall be sprinklers in the MDF when the remainder of the building is equipped with a sprinkler system.

1) A pre-action fire suppression system shall be considered by the design team on a case-by-case basis.

3. HVAC (Building MDF)

a. The Building MDF shall be serviced by a dedicated unit that is part of the building's main system. The unit shall maintain a constant 24/7 cooled environment between 68° and 75° F with humidity of 41.9°F Dew Point to 60% RH and 59°F Dew Point, or the current ASHRAE recommendations at the time of construction.

b. The HVAC load shall be designed to displace a minimum of 12KW of power, or 3.5 Tons, and shall be designed to load if the known load is greater at the time of design.

c. It is recommended that the Building MDF maintain the stated temperature and humidity in the event of building power outages or primary HVAC system failure.

d. Air delivery shall be aligned in the front of the equipment rows and returns at the rear of the equipment rows.

4. Lighting (Building MDF)

a. Florescent light fixtures shall be at least 12 inches above the top of the highest rack or cable runway, 18 inches is recommended. Lighting shall be a minimum of 40 foot candles at 2 feet above the floor in the entire space.

b. The Building MDF shall be equipped with emergency lighting to keep the space lit during power outages.

5. Power (Building MDF)

a. Power for the Building MDF shall be in two categories: dedicated and convenience.

b. Dedicated

1) The Building MDF shall be equipped with (2) dedicated 208 volt 3-phase 150 Amp circuits, 4-wire (2PH + N +G), hardwired to the UPS(s). The originating electrical panel will be equipped with (2) 150 AMP breakers. Conductors shall be routed from the panel in conduit to the UPS wiring terminals.

2) The Building MDF shall be equipped with a minimum of (1) APC Symmetra LX 16kVA Scalable to 16kVA N+1 Ext. Run Tower, 208/240V, to provide 30 minutes of run time at full load. An additional circuit and space is allocated should the load exceed 16kVA and a second UPS be required.

3) Additional power circuits to be allocated to security, fire alarm, CATV, building controls, and service provider equipment shall be considered and coordinated at the time of building design.

4) Power distribution to the racks and cabinets shall be achieved by installing PDUs which are not within the scope of this document and are to be provided by the Alamo Colleges network department.

c. Convenience

1) The Building MDF shall be equipped with 20 Amp Duplex NEMA 5-20R receptacles, with maximum (6) receptacles on each circuit. The originating electrical panel shall be equipped with a 20 Amp breaker per circuit.

2) A Duplex receptacle shall be spaced at least 1 foot from an adjacent wall and every 6 feet thereafter. A minimum of (1) Duplex receptacle shall be placed in each wall and be flush mounted to the finished wall surface at 18 inches above finished floor.

6. Racks and Cable Management (Building MDF)

a. The Building MDF shall be equipped with (4) Standard Equipment Racks.

1) Each rack shall be equipped with a vertical cable manager on both sides of the rack. Adjacent racks may share a vertical wire manager between them.

2) Each rack shall be equipped with a horizontal wire manager above and below each horizontal patch panel.

b. The Building MDF shall be equipped with (1) Server Cabinet. The fronts of the cabinets shall face the row of equipment racks.

1) Space shall be allocated for an additional (3) future Server Cabinets.

a) Cabinets shall be bayed together with sides removed when mounted adjacently.

2) Wall space at the back of the Building MDF shall be allocated for service provider equipment.

c. The Building MDF shall be equipped with cable runway encircling the room at 86 inches above the finished floor, and crossing the room parallel to the rack rows (2) times.

1) Cable runway shall attach to the tops of Standard Equipment Racks utilizing rack-to-runway hardware kits.

2) Cable runway shall suspend above Server Cabinets and be supported overhead by all thread to the building structure utilizing manufacturer-approved hardware and methods.

3) A vertical section of cable runway shall be attached to the wall board to manage backbone and service provider cables as they transition from the entrance conduits to the overhead cable runway.

C. IDF-1 and IDF-2

1. Description

a. IDF-1

1) An IDF-1 is a Telecommunications space that resides in each building that is part of a multi-building campus. There is only (1) in each building that is part of a multi-building campus (other than the building housing the Campus MDF.)

2) An IDF-1 houses the entrance conduits, terminations, and cross connections for all incoming inter-building cabling from the Campus MDF and all intra-building backbone cabling from the IDF-2s of the building in which it resides.

3) An IDF-1 houses the terminations and cross connections for the horizontal user workstation cabling in the area of the building that it serves.

4) An IDF-1 does not exist in a single-stand alone building.

b. IDF-2

1) An IDF-2 is a Telecommunications space that resides in each building that requires more than a single closet from which to terminate horizontal workstation cables. There may be multiple IDF-2s in each building as required to maintain horizontal cable distances of 295 feet for the permanent link.

2) An IDF-2 houses the terminations, and cross connections for all incoming intra-building cabling from the MDF or IDF-1 of the building in which it resides.

3) An IDF-2 houses the terminations and cross connections for the horizontal user workstation cabling in the area of the building that it serves.

c. Building workstation access network equipment will reside in the IDFs.

d. The IDF may share space with other systems such as security panels, CATV cabling, and paging system cabling.

e. The IDF shall not be used for storage, serve as a mechanical or electrical distribution space, nor shall it have within its space main electrical feeds, water or main sprinkler lines.

f. The layout of racks, wall fields, and cable management shall be as indicated on the attached diagrams.

2. Architectural (IDF-1 and IDF-2s)

a. The IDF shall be a minimum of 108 square feet with minimum clear lineal wall lengths of at least 9 feet by 12 feet, all walls shall go to deck.

b. Floor finish shall be bare concrete.

c. Windows are not recommended.

d. IDFs shall be arranged in a stacked formation in multi-story buildings, and not be located near sources of EMI and mechanical vibration.

e. All walls of the IDF shall be covered with AC Grade ¾" Fire Retardant Plywood, aligned vertically starting at 12 inches above the finished floor. The plywood shall not be painted.

f. The room shall be without a ceiling.

g. Entry to the space shall be through a minimum 36-inch by 80-inch clear door opening that swings outward. Door shall be solid core or steel with shatter-proof window if equipped. The door shall securely lock and access shall only be by Alamo Colleges-approved personnel.

h. When an access control security system is available, the entrance to the IDF shall be equipped with a proximity card reader and electrified door hardware. When a surveillance system is available an IDF shall be equipped with at least (1) camera.

3. HVAC (IDF-1 and IDF-2s)

a. The IDF shall be serviced by the building HVAC system and be equipped with Split DX system through the wall above the door which cools only when the building HVAC is inadequate or not running. The system or unit shall maintain a constant 24/7 cooled environment between 68° and 75° F with humidity of 40% to 55%.

b. The minimum HVAC load shall be designed to displace 2KW of power, or 0.6 of a Ton, and be designed to load if the load is greater and known at the time of design.

4. Lighting (IDF-1 and IDF-2s)

a. Florescent light fixtures shall be at least 12 inches above the top of the highest rack or cable runway, 18 inches is recommended. Lighting shall be a minimum of 20 foot candles at 2 feet above the floor in the entire space.

5. Power (IDF-1 and IDF-2s)

a. Power for the IDF shall be in two categories: dedicated and convenience.

b. Dedicated

1) The IDF shall be equipped with (2) dedicated 120 volt 20 Amp circuits, each with a simplex NEMA L5-20R receptacle. The originating electrical panel will be equipped with 20 AMP breakers. Conductors shall be routed from the panel in conduit along the cable runway to a metallic back box clipped to the rail of the Cable Runway, facing the rear of the racks.

2) The IDF shall be equipped with (1) APC Symmetra SmartUPS 2200 SUA2200R2X106 with a single NEMA L5-20P power cord to provide 5 minutes of run time at full load.

3) Additional power circuits to be allocated to security and CATV shall be considered and coordinated at the time of building design.

4) Power distribution shall be achieved by the installation of PDUs which are outside the scope of this document and furnished by the network department.

c. Convenience

1) The IDF shall be equipped with 20 Amp Duplex NEMA 5-20R receptacles, maximum (6) per circuit. The originating electrical panel shall be equipped with a 20 Amp breaker per circuit.

2) A Duplex receptacle shall be spaced at least 1 foot from an adjacent wall and every 6 feet thereafter. A minimum of (1) Duplex receptacle shall be placed in each wall and be flush mounted to the finished wall surface at 18 inches above finished floor.

6. Racks and Cable Management (IDF-1 and IDF-2s)

a. The IDF shall be equipped with (2) Standard Equipment Racks.

1) Each rack shall be equipped with a vertical cable manager on both sides of the rack. Adjacent racks may share a vertical wire manager between them.

2) Each rack shall be equipped with a horizontal wire manager above and below each horizontal patch panel. An equal number of horizontal wire managers shall be furnished for the network switches and installed as directed by the owner.

a) Space shall be reserved for an additional rack and vertical wire manager

b) A third rack and vertical wire manager shall be installed in IDFs that serve equipment racks located in Lab(s).

b. The IDF shall be equipped with cable runway encircling the room at 84-86 inches above the finished floor, and crossing the room parallel to the rack rows (1) time.

1) Cable runway shall attach to the tops of Standard Equipment Racks utilizing rack-to-runway hardware kits.

2) A vertical section of cable runway shall be attached to the wall board to manage backbone cables as they transition from floor sleeves to the overhead cable runway.

6.02 Entrance Pathways and Conduits

A. Design Principles

1. Pathways and conduits are described herein with regard to capacity, function, and basic design principles and shall be designed by the MEP in accordance with NEC and EIA/TIA-758, Customer Owned Outside Plant Telecommunications Cabling.

2. Telecommunications Conduit Systems shall:

a. Contain no more than the equivalent (2) 90 degree bends between pull boxes.

b. Maintain a minimum bend radius of 10 times the diameter of the conduit.

c. Not exceed 40 percent fill ratio for multiple cables.

d. Be placed at a minimum depth of 24 inches from the top of the conduit to the finished grade.

e. Be interrupted by an adequately sized pull box at least every 600 feet for sections containing up to (1) 90 degree of bend, and at least every 350 feet for sections with the equivalent of (2) 90 degree bends.

1) Pull boxes shall be of adequate depth for conduits to enter from the side of the pull box and not be required to sweep up into the box.

f. Stub up into the MDF between 1 and 3 inches above the finished floor.

g. Contain a pulling tape, be fitted with bushings, and sealed appropriately at both ends.

B. Service Provider Conduits

1. Minimum of (4) 4-inch conduits shall route underground from the MDF to the edge of the property Right of Way and terminate as required by the service provider. Additional conduits shall be added as required.

2. Manholes and pull boxes shall be utilized as required for a telecommunications-compliant conduit distribution system.

3. Where the service provider termination location is unidentified at the time of design, the conduits shall route from the MDF to an adequately-sized pull box or manhole at least 30 feet from the building edge.

C. Campus Serving Conduits

1. Minimum of (2) 4-inch conduits shall route underground from the Campus MDF to the IDF-1 of each additional building on the campus. Additional conduits shall be added as required if fill capacity exceeds 40 percent.

2. Manholes and pull boxes shall be utilized as required for a Telecommunications-compliant conduit distribution system.

3. Where only the first building of a campus is being designed, (2) 4-inch conduits for each additional future building shall route from the campus MDF to an adequately-sized pull box or man hole at least 30 feet from the building edge.

D. Building Entrance for Large Campus

1. For large campuses, the MEP and Structural Engineer shall consider a conduit entrance vault as part of the Campus MDF sub floor.

6.03 Cable Management In Telecommunications Spaces

A. Racks

1. Racks shall be black aluminum Standard Equipment Racks with EIA 19-inch rails, 84-inch (45 RMU) overall height, 3-inch rail depth, dual floor mounting flanges, and rack mount unit markings engraved on the rails.

2. Racks shall be bolted to the concrete floor and to the overhead cable runway utilizing manufacturer-recommended hardware and methods.

B. Server Cabinets

1. Server Cabinets shall be 24 inches by 42 inches by 84 inches with adjustable front and rear EIA 19” rail kits, enclosed with ventilated front and rear locking doors, adjustable leveling feet, vertical cable manager for one rail, and grounding kit.

2. Cabinets shall be set directly on the finished floor but not bolted unless set on a raised floor. Adjacent cabinets shall be bayed together with the sides removed.

C. Overhead Cable Management

1. Overhead Cable Management shall be 18-inch (MDF) or 12-inch (IDF) Universal Cable Runway made of 3/8” x 1-1/2” x .065” wall rectangular steel tubing with cross members welded at 12-inch intervals.

a. Cable Runway shall be installed utilizing appropriate hardware to support, join, or attach sections to structures, and shall be supported at a minimum of 5 foot intervals.

D. Vertical Cable Managers

1. Vertical cable managers shall be black double-sided, 6 inches wide, 12.75 inches deep, and 84 inches tall, no doors, and include formed cabling sections, lockable cabling latches at 12-inch intervals, and protective edge guards.

a. Bolt vertical cable managers to the racks with included hardware kit.

E. Horizontal Cable Managers

1. Horizontal cable managers shall be black double-sided, 19 inches wide, 11.73 inches deep, and 2 RMU, cable guide fingers at 1.75” intervals, flanged pass-through slots, and snap-on, hinged door/cover.

a. Attach horizontal cable managers to the rack rails with included screws.

6.04 Cable Support in Pathways

A. Main Cable Pathway

1. Main cable pathway shall be designed by the MEP, shown on the electrical drawings, and be installed by the electrical contractor. Cable Tray shall be Electro Zinc Wire Mesh Basket Tray, minimum 12 inches wide by 2 inches tall, size shall be scaled to the application not to exceed 40 percent fill ratio.

2. Basket Tray shall be installed utilizing appropriate hardware to support, join, or attach sections to structures, shall be supported at a minimum of 5-foot intervals, and grounded as a single-conductor system.

B. Sleeves and Penetrations

1. Sleeves and Penetrations are described herein with regard to capacity, function, and basic design principles and shall be designed by the MEP in accordance with NEC and EIA/TIA-569-B, Commercial Building Standard for Telecommunications Pathways and Spaces.

2. All sleeves shall be equipped with nylon bushings.

3. Scale the quantity of sleeves to maintain a 40 percent fill ratio in each sleeve.

4. Above MDFs or IDFs install minimum of (4) 4” EMT sleeves through the partition wall between the MDF or IDF overhead space and the main cabling pathway.

5. Between directly aligned vertically stacked MDF and IDFs install minimum of (2) 4” EMT sleeves into bored penetrations through the upper floor structure.

6. Between slightly skewed vertically stacked MDF and IDFs install minimum of (2) continuous 4” EMT conduits from the outside wall of the upper to the outside wall of the lower IDF.

7. Between completely skewed MDFs and IDFs on adjacent floors, install minimum of (2) 4” EMT sleeves through the floor the upper IDF into the accessible ceiling space below and utilize above-ceiling pathways to route cabling into the IDF or MDF on the lower floor.

C. Workstation Rough-ins and local power

1. At each wall-mounted workstation location, install a 4 inch by 4 inch by 2-1/8 inch double-gang back box with double-gang mud ring at 18 inches above the finished floor, at 42 inches for emergency wall phones, 6 inches below the ceiling grid for wireless access points and IP cameras, and at appropriate height for above-counter and millwork locations.

   a. Install a 1 inch conduit from the rough-in box to the cable tray.

   b. Terminate the conduit above the edge of the cable tray and install nylon bushings and pull string, the conduit is not required to be bonded to the cable tray.

      1) Conduit shall be installed in accordance with EIA/TIA-569-B, contain no more than the equivalent of (2) 90 degree bends and or 98.4 feet between pull boxes, and maintain a bend radius of 6 times the diameter of the conduit.

2. At floor-mounted workstation locations, install a floor box or poke-thru specifically designed for the application and environment adequately sized to accommodate the quantity of installed horizontal data cables.

   a. Install (1) 1 inch conduit for every (6) cables from the floor box to the cable tray.

      1) For poke-thrus, route the conduit to the cable tray in the floor below.

      2) Floor-mounted outlets should be avoided and all other possible design solutions shall be considered.

3. For modular furniture workstations, a rough-in pathway shall be considered and designed according to the furniture type, quantity of cables, and location as required for each furniture system.

   a. The use of power poles shall be considered only on a case-by-case basis.

4. For above ceiling-mounted outlets such as Wireless Access Points or IP Cameras, no rough-in is required, the data cable will terminate into a surface-mount box secured to the structure above the ceiling grid.

5. The electrical engineer shall design at a minimum (1) duplex NEMA 5-15R receptacle within 18" of each workstation outlet location.

6.05 Backbone Cabling

A. Inter-building Backbone Cabling (Campus)

1. Copper

a. Inter-building Backbone Copper Cabling shall be 50-pair PE-39 24 AWG flooded UTP from the Campus MDF to the IDF-1 in each of the buildings on the campus. Provide a 10-foot service loop at both ends of each cable stored on the wall above or below the cable runway. Provide a 30-foot service loop in each manhole or pull box. Cables shall be secured with Hook-and-loop tie-wraps in the MDF or IDF.

b. Inter-building Backbone Copper Cabling shall terminate on UL-listed 50-pair 110 IDC in/out lightning protection panels equipped with UL-listed 5-pin solid state quick-acting protector modules. The secondary side of the panel shall be connected to a 50-Pair 110 Block with legs. Panels and blocks shall be wall mounted.

2. Fiber

a. Inter-building Backbone Fiber Optic Cabling shall be loose tube outdoor-rated composite 12-Strand Single Mode / 24-Strand 50 micron OM3 (up to 300 meters) or OM4 (over 300 meters) Multi Mode from the Campus MDF to the IDF-1 in each of the buildings on the campus, installed in 1-inch outdoor-rated innerduct, and dressed with fan-out kits as required. Provide a 10-foot service loop at both ends of each cable stored on the wall above or below the cable runway. Provide a 30-foot service loop in each manhole or pull box. Cables shall be secured with Hook-and-loop tie-wraps in the MDF or IDF.

b. Terminate all strands of each fiber optic cable on LC connectors. Connect terminated LC connectors to the back of coupler panels placed into 19 inch rack-mounted fiber optic termination housings.

B. Intra-building Backbone Cabling

1. Copper

a. Intra-building Backbone Copper Cabling shall be 25-pair Category 3 plenum rated 24 AWG UTP from the MDF or IDF-1 to each of the IDF-2s in the building. Provide a 10-foot service loop at both ends of each cable stored on the wall above or below the cable runway. Cables shall be secured with Hook-and-loop tie-wraps in the MDF or IDF.

b. Intra-building Backbone Copper Cabling shall terminate on a 50-Pair 110 Block with legs, blocks shall be wall mounted.

2. Category 6 Network Uplinks

a. Category 6 network uplinks shall be (6) Category 6 UTP plenum rated blue sheath, between the Special Systems patch panels in MDF and IDFs on adjacent floors that are vertically stacked, and between IDF-2s on the same floor, where the permanent link of the Category 6 cable does not exceed 295 feet.

3. Fiber

a. Intra-building Backbone Fiber Optic Cabling shall be tight buffered plenum-rated composite 6-Strand Single Mode / 12-Strand 50 micron OM3 (up to 300 meters) or OM4 (over 300 meters) Multi Mode, encased in orange interlocking armor. Provide a 10-foot service loop at both ends of each cable stored on the wall above or below the cable runway. Cables shall be secured with Hook-and-loop tie-wraps in the MDF or IDF and in the cable tray.

b. Terminate all strands of each fiber optic cable on LC connectors. Connect terminated LC connectors to the back of coupler panels placed into 19 inch rack-mounted fiber optic termination housings.

6.06 Horizontal Cabling

A. Workstation Cable

1. Horizontal Data Cabling shall be Category 6 UTP, minimum factory sweep tested to 550 MHz, plenum rated, blue sheath, installed from the patch panel in the MDF or IDF to the workstation location not to exceed 295 feet for the permanent link. Provide a 10’ service loop in the MDF or IDF, and 1-foot of slack behind the faceplate. Cable bundles shall be secured with Hook-and-loop tie-wraps in the MDF or IDF and in the cable tray.

2. At the workstation, each Category 6 cable shall be terminated in a gray Category 6 modular jack insert and snapped into a 2-gang, furniture, floor box or poke-thru faceplate. Faceplates shall be equipped with desi-windows for labeling and blank inserts in unused ports. Wall phone workstations shall be equipped with a studded wall phone faceplate capable of accepting a modular jack insert. All faceplate colors shall be coordinated with the Architect or owner at the time of installation.

3. In the MDF or IDF, each Category 6 cable shall be terminated on the back of Category 6 48-port IDC patch panels which are mounted in the 19-inch racks.

4. Category 6 cable shall be terminated with the EIA-568B sequence.

B. Patch Cables

1. In each MDF or IDF, furnish to the owner at the time of final inspection (1) Category 6 modular non-booted patch cord for each terminated horizontal data cable plus 25 percent, 50 percent of the total quantity shall be blue and the other 50 percent shall be green in the following proportions:

    a. Blue

        1) 33% 7-foot

        2) 33% 5-foot

        3) 33% 3-foot

    b. Green

        1) 33% 7-foot

        2) 33% 5-foot

        3) 33% 3-foot

    c. Yellow 7-foot – (24) for WAPs

    d. Red 10-foot – (8) for Fire Alarm or Security Panels

    e. Orange 7-foot – (4) for Copper Uplinks

2. Workstation patch cables shall be furnished by each user group.

3. Fiber optic patch cables shall be furnished by the ITS Network Department.

C. Workstation Configurations (data outlets)

1. Office Workstation

    a. Install (2) Category 6 cables terminated on gray jack inserts into a double gang flush faceplate.

        1) Furnish a minimum of (1) 2-port workstation on each of (3) walls in each office.

        2) Modular furniture clusters shall be designed to accommodate the user requirements at the time of construction.

2. Classroom Instructor Workstation

    a. Install (2) Category 6 cables terminated on gray jack inserts into a double gang flush faceplate.

    b. Furnish a minimum of (2) 2-port instructor workstations in each classroom oriented in the front and back of each room.

3. High-Density Workstation

a. Install up to (8) Category 6 cables terminated on gray jack inserts into a double gang flush faceplate.

4. Emergency Wall-Phone Outlet

a. Install (2) Category 6 cables terminated on a gray jack insert into a double gang faceplate mounted at the Architect's designated height for emergency phones.

5. Ceiling-mounted Projector Outlet

a. Install (2) Category 6 cables terminated on a gray jack insert into a single gang faceplate at the projector plate.

6. Wireless Access Point Outlet

a. Install (2) Category 6 cables with 20-foot slack loops at each workstation, terminated on gray jack inserts into a double gang flush faceplate or surface mount box secured to the building structure when mounted above the ceiling.

1) When a Wireless Access Point workstation is installed above the ceiling grid, a label identical to the label on the surface mount box shall be permanently attached to the ceiling grid directly below the surface mount box.

2) At the time of construction the designer shall take into account the user requirements for wireless coverage and include a sufficient quantity of WAP workstations to enable said coverage.

7. IP Camera Outlet

a. Install (2) Category 6 cable with 20-foot slack loop at each workstation, terminated on a gray jack insert into a double gang flush faceplate or surface mount box when mounted above the ceiling.

1) When a Wireless Access Point workstation is installed above the ceiling grid, a label identical to the label on the surface mount box shall be permanently attached to the ceiling grid directly below the surface mount box.

2) The designer shall coordinate with the security engineer to determine quantities and locations of IP Cameras.

8. Emergency Stanchion (Blue Light/Phone)

a. Install (1) 4-pair voice-grade PE-39 flooded 22 AWG UTP cable from the closest MDF or IDF to each stanchion-mounted blue light phone location. Terminate the cable on a 4-pair lighting protection module at each end.

6.07 Grounding

A. Grounding shall be designed and installed in accordance with ANSI-J-STD-607-A.

1. Install a Telecommunications Main Grounding Busbar (TMGB) (per building) in the MDF and IDF-1s, and a Telecommunications Grounding Busbar (TGB) in each IDF-2.

2. Install a Telecommunications Bonding Backbone (TBB), #3/0 AWG stranded green insulated copper conductor in a star topology between the TMGB and each TGB in each building. When IDFs are stacked a single TBB can be daisy-chained between TGBs back to the TMGB.

3. Install an Equipment Bonding Conductor (EBC), #6 AWG green insulated conductor from the TMGB or TGB as applicable to each cable runway system, equipment rack, cabinet, lightning protector, or multi-pair cable with a metallic element.

   a. Install a #3/0 AWG stranded green insulated copper conductor from the TMGB to the main building electrical service ground in each building.

   b. In a metal frame (structural steel) building, where the steel framework is readily accessible within or external to the room; each TGB and TMGB shall be bonded to the vertical steel metal frame using a minimum #6 AWG conductor. The connection to building steel does not eliminate the requirement for the TBB or BC to the service ground.

4. Install a Grounding Equalizer Conductor, #3/0 AWG stranded green insulted copper conductor to interconnect multiple TBBs on the top floor and every 3rd floor when required by ANSI J-STD-607-A.

5. When exceeding 13 feet the conductors shall be sized at 2 kcmil per linear foot of conductor length up to a maximum of 3/0 AWG.

6.08 Labeling

1. Verify room numbers and confirm the final room numbering scheme prior to generating labels.

2. Horizontal Cables shall be labeled within 12 inches from the termination point inside the MDF/IDF.

3. Horizontal Cables shall be labeled within 6 inches from the termination point at the workstation end and on the faceplate.

4. Backbone Fiber and Copper Cables shall be labeled within 12 inches of the visible end of the jacket.

5. Fiber Innerduct shall be labeled within 12 inches of the point of entry of the fiber optic enclosure.

6. Cables shall be labeled identically at both ends.

7. MDFs and IDFs Room shall be labeled (signage) with the permanent room designations that match the final building signage for cable labeling.

8. Equipment racks in each MDF or IDF shall be labeled in sequential numeric order. Labels shall be centered on the top front of the equipment rack.

9. Fiber optic backbone cable labels shall contain the cable origin room number, the cable destination room number, fiber strand numbers, and type (i.e. MDFA150-IDFC126-50MM001-024/SM001-012).

10. Fiber optic enclosures shall be labeled alpha-numeric starting with the 1st fiber optic enclosure in the top of the 1st equipment rack. A label for each terminated strand shall be securely placed inside each fiber optic enclosure.

11. Fiber optic couplers panels in fiber enclosures shall be labeled at each end by strand denoting MDF and/or IDF the cable comes from, and Strand number to and from respectively (i.e. IDFC126-50MM001-012).

12. Copper backbone cable labels shall contain the cable origin room number, the cable destination room number, and cable pairs (i.e. MDFA150-IDFC126/001-025).

13. Horizontal cables shall be labeled identically at each end with the destination end and origin room number, patch panel number, and port number. (i.e. IDFC126-C115-B5).

14. Patch panels in each closet shall be uniquely alphabetically labeled sequentially starting with the first Patch Panel in the top of the first equipment rack (i.e. A, B, C, D, E, etc.). Each MDF or IDF starts with A and shall not repeat a letter.

15. 110-type blocks shall contain the origin room number, destination room number, and pair numbers, under each pair termination. (i.e. MDFA150-IDFC126-PR 1-25). 110-type block labels shall be printed on product-specific label strips and placed into label holders.

16. Workstation Faceplates shall be labeled denoting origin MDF/IDF Room Number, patch panel, and port number (i.e. IDFC126-B5).

    a. When a Wireless Access Point or IP Camera workstation is installed above the ceiling grid, a label identical to the label on the surface mount box shall be permanently attached to the ceiling grid directly below the surface mount box.

6.09 Testing

A. Terminated fiber optic strands shall be tested bi-directionally end to end be and certified in accordance with applicable industry standards with a light meter and OTDR field tester(s) that are within their calibration period.

B. Terminated backbone copper cable links shall be tested in accordance with applicable industry standards for attenuation, continuity, and pin-mapping with approved field tester(s) that are within their calibration period.

C. Terminated Category 6 UTP cable links shall be tested in accordance with applicable industry standards for Category 6 compliance with approved field tester(s) that are within their calibration period.

6.10 As-Built Documentation

A. Produce drawings depicting the condition of the Structured Cabling System as installed produced in AutoCAD 2007 or higher and provided in hardcopy, electronically in .DWG and .PDF format, and a laminated set in each MDF or IDF-1. Include the exact dimensions and locations of MDF and IDF layouts, wall elevations, equipment rack elevations, cable runways, cable tray, sleeves, backbone and horizontal cable pathways, workstation locations, and numbering and labeling scheme.

B. Produce cable records for the Structured Cabling System as installed to include a list of all horizontal and backbone cables produced in an Excel format and provided in hardcopy and electronic format indicating cable number, unique cable label, cable type, origin and destination, length, termination method, and pass/fail result.

C. Produce (3) hard copies of all test results for each cable, to include technician's name and date stamp, a list of tested cables, and the individual results for each cable tested. Test results shall be furnished on CD ROM to include native file format and .PDF format.

PART 7 - SUMMARY and SYNOPSIS OF STANDARDS

7.01 Summary

A. All aspects of this Alamo Colleges Telecommunications Infrastructure Standards shall be applied to the design process for both new and renovated facilities.

B. A Division 27 10 00 specification and T-Series drawings shall be commissioned and issued by the Architect during the design phases for each facility or project.

7.02 Synopsis

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A. Facility Standards

SPACE	CAMPUS MDF	BUILDING MDF	IDF-1 AND IDF-2
ARCHITECTURAL	Minimum of 600 square feet, minimum clear lineal wall length 30 feet, walls to deck, floor sealed bare concrete, no windows, exterior wall within 50 feet of building exterior, not be located adjacent to or below restrooms or other water-based facilities, or sources of EMI and mechanical vibration, all walls covered with plywood, without a ceiling or a lift-out tile ceiling, minimum 42-inch by 80-inch clear door opening, door not open to the exterior of the building, proximity card reader and electrified door hardware, at least (1) camera, sprinkler system, consider pre-action.	Minimum of 400 square feet, minimum clear lineal wall length 25 feet, all walls to deck, floor sealed bare concrete, no windows, exterior wall that is within 50 feet of the building exterior, not be located adjacent or below restrooms or other water-based facilities, or sources of EMI and mechanical vibration, all walls covered with plywood, without a ceiling or a lift-out tile ceiling, minimum 42-inch by 80-inch clear door opening, door not open to the exterior of the building, proximity card reader and electrified door hardware, at least (1) camera, sprinkler system, consider pre-action.	Minimum of 108 square feet, minimum clear lineal wall lengths of at least 9 feet by 12 feet, all walls to deck, floor sealed bare concrete, windows are not recommended, IDFs shall be arranged in a stacked formation in multi-story buildings, and not be located near sources of EMI and mechanical vibration, all walls covered with plywood, the room shall be without a ceiling, minimum 36-inch by 80-inch clear door, proximity card reader and electrified door hardware, at least (1) camera.
HVAC	Dedicated unit that is part of the building's main system, maintain a constant 24/7 cooled environment between 68° and 75° F with humidity of 41.9°F Dew Point to 60% RH and 59°F Dew Point, minimum HVAC load shall be designed to displace 20KW of power, or 6 Tons, maintain temp and humidity in the event of building power outages or main unit failure.	Dedicated unit that is part of the building's main system, maintain a constant 24/7 cooled environment between 68° and 75° F with humidity of 41.9°F Dew Point to 60% RH and 59°F Dew Point, minimum HVAC load shall be designed to displace 12KW of power, or 3.5 Tons, maintains temp and humidity in the event of building power outages or main unit failure.	Serviced by the building HVAC system and equipped with Split DX system that cools only when the building HVAC is inadequate, maintain a constant 24/7 cooled environment between 68° and 75° F with humidity of 40% to 55%, minimum HVAC load shall be designed to displace 2KW of power, or 0.6 of a Ton.
LIGHTING	Minimum of 40 foot candles at 2 feet above the floor in the entire space. Equipped with emergency lighting to keep the space lit during power outages, fixtures 18 inches above top of the highest rack or cable runway.	Minimum of 40 foot candles at 2 feet above the floor in the entire space. Equipped with emergency lighting to keep the space lit during power outages, fixtures 18 inches above top of the highest rack or cable runway.	Minimum of 20 foot candles at 2 feet above the floor, fixtures 18 inches above top of the highest rack or cable runway.
POWER	(2) dedicated 208 volt 3-phase 150 Amp circuits, 4-wire (2PH + N +G), hardwired to the UPS(s), originating electrical panel will be equipped with (2) 150 AMP breakers, minimum of (1) APC Symmetra LX 16kVA Scalable to 16kVA N+1 Ext. Run Tower, 208/240V, to provide 30 minutes of run time at full load. A Duplex receptacle shall be spaced at least 1 foot from an adjacent wall and every 6 feet thereafter, minimum of (1) Duplex receptacle shall be placed in each wall.	(2) dedicated 208 volt 3-phase 150 Amp circuits, 4-wire (2PH + N +G), hardwired to the UPS(s). The originating electrical panel will be equipped with (2) 150 AMP breakers, minimum of (1) APC Symmetra LX 16kVA Scalable to 16kVA N+1 Ext. Run Tower, 208/240V, to provide 30 minutes of run time at full load. A Duplex receptacle shall be spaced at least 1 foot from an adjacent wall and every 6 feet thereafter, minimum of (1) Duplex receptacle shall be placed in each wall.	(2) dedicated 120 volt 20 Amp circuits, each with a simplex NEMA L5-20R receptacle. The originating electrical panel will be equipped with 20 AMP breakers. Conductors shall be routed from the panel in conduit along the cable runway to a metallic back box clipped to the rail of the Cable Runway, facing the rear of the racks, minimum (1) APC Symmetra SmartUPS 2200 SUA2200R2X106 with a single NEMA L5-20P power cord to provide 5 minutes of run time at full load. A Duplex receptacle shall be spaced at least 1 foot from an adjacent wall and every 6 feet thereafter, minimum of (1) Duplex receptacle shall be placed in each wall.
RACKS AND CABLE MANAGEMENT	(4) Standard Equipment Racks, vertical cable manager on both sides of the rack, horizontal wire manager above and below each horizontal patch panel. (2) Server Cabinets, space shall be allocated for an additional (7) future Server Cabinets. Space equivalent to (2) Server Cabinets shall be allocated for service provider equipment. Cable runway encircling the room at 86 inches above the finished floor, and crossing the room parallel to the rack rows (3) times, vertical section of cable runway from the entrance conduits to the overhead cable runway.	(4) Standard Equipment Racks, vertical cable manager on both sides of the rack, horizontal wire manager above and below each horizontal patch panel. (1) Server Cabinet, space shall be allocated for an additional (3) future Server Cabinets. Wall space at the back of the Building MDF shall be allocated for service provider equipment. Cable runway encircling the room at 86 inches above the finished floor, and crossing the room parallel to the rack rows (2) times, vertical section of cable runway from the entrance conduits to the overhead cable runway.	(2) Standard Equipment Racks, vertical cable manager on both sides of the rack, horizontal wire manager above and below each horizontal patch panel, an equal number of horizontal wire managers shall be furnished for the network switches. Space reserved for additional rack and vertical wire manager, a third rack and vertical wire manager IDFs that serve equipment racks located in Lab(s). Cable runway encircling the room at 84-86 inches above the finished floor, and crossing the room parallel to the rack rows (1) time, vertical section of cable runway from floor sleeves to the overhead cable runway.

B. Technical Standards

TECHNOLOGY	STANDARDS	
ENTRANCE PATHWAYS AND CONDUITS	Service Provider Conduits; Minimum of (4) 4-inch conduits from the MDF to the edge of the property Right of Way. Campus Serving Conduits: Minimum of (2) 4-inch conduits shall route underground from the Campus MDF to the IDF-1 of each additional building on the campus. Building Entrance for Large Campus: MEP and Structural Engineer shall consider a conduit entrance vault.	
CABLE MANAGEMENT IN TELECOM SPACES	Racks black aluminum Standard Equipment Racks with EIA 19-inch rails, 84-inch (45 RMU) overall height, 3-inch rail depth, dual floor mounting flanges, and rack mount unit markings engraved on the rails. Server Cabinets 24 inches by 42 inches by 84 inches with adjustable front and rear EIA 19" rail kits, enclosed with ventilated front and rear locking doors, adjustable leveling feet, vertical cable manager for one rail, and grounding kit. Overhead Cable Management 18-inch (MDF) or 12-inch (IDF) Universal Cable Runway made of 3/8" x 1-1/2" x .065" wall rectangular steel tubing with cross members welded at 12 inch intervals. Vertical cable managers black double-sided, 6 inches wide, 12.75 inches deep, and 84 inches tall, no doors, and include formed cabling sections, lockable cabling latches at 12-inch intervals, and protective edge guards. Horizontal cable managers black double-sided, 19 inches wide, 11.73 inches deep, and 2 RMU, cable guide fingers at 1.75" intervals, flanged pass-through slots, and snap-on, hinged door/cover.	
CABLE SUPPORT IN PATHWAYS AND LOCAL POWER	Main cable pathway support shall be Electro Zinc Wire Mesh Basket Tray Above MDFs or IDFs install minimum of (4) 4" EMT sleeves through the partition wall. Between MDF and IDFs install minimum of (2) 4" EMT sleeves Wall-mounted workstation location, double-gang back box with double-gang mud ring,1-inch conduit from the rough-in box to the cable tray, terminate the conduit above the edge of the cable tray, conduit not required to be bonded to the tray. At floor-mounted workstation locations (1) 1 inch conduit for every (6) cables from the floor box to the cable tray. For poke-thrus, route the conduit to the cable tray in the floor below. For modular furniture workstations, a rough-in pathway shall be considered and designed according to the furniture type, quantity of cables, and location as required for each furniture system. The electrical engineer shall design a duplex NEMA 5-15R receptacle within 18" of each workstation outlet location.	
INTER-BUILDING BACKBONE CABLING	Copper Cabling 50-pair PE-39 24 AWG flooded UTP from the Campus MDF to the IDF-1 in each of the buildings on the campus, terminate on lightning protection and 110 blocks Fiber Optic Cabling loose tube outdoor-rated composite 12-Strand Single Mode / 24-Strand 50 micron OM3 Multi Mode from the Campus MDF to the IDF-1 in each of the buildings on the campus, installed in 1-inch outdoor-rated innerduct, terminate with LC connectors.	
INTRA-BUILDING BACKBONE CABLING	Copper Cabling 25-pair Category 3 plenum rated 24 AWG UTP from the MDF or IDF-1 to each of the IDF-2s in the building, terminate on 110 blocks. Category 6 network uplinks (6) Category 6 UTP plenum rated blue sheath, between the Special Systems patch panels in MDF and IDFs on adjacent floors that are vertically stacked, and between IDF-2s on the same floor, where the permanent link of the Category 6 cable does not exceed 295 feet. Fiber Optic Cabling shall be tight buffered plenum-rated composite 6-Strand Single Mode / 12-Strand 50 micron OM3 or OM4 Multi Mode, encased in orange interlocking armor, terminate with LC connectors.	
HORIZONTAL CABLING	Horizontal Data Cabling shall be Category 6 UTP, minimum factory sweep tested to 550 MHz, plenum rated, blue sheath, terminated in a gray Category 6 modular jack insert and snapped into a 2-gang, furniture, floor box or poke-thru faceplate, terminated on Category 6 48-port IDC patch panels with the EIA-568B sequence, Category 6 modular non-booted patch cords. Office Workstation: (2) Category 6 cables terminated on gray jack inserts into a double gang flush faceplate. Classroom Instructor Workstation: (2) Category 6 cables terminated on gray jack inserts into a double gang flush faceplate. High-Density Workstation: up to (8) Category 6 cables terminated on gray jack inserts into a double gang flush faceplate. Emergency Wall-Phone Outlet: (2) Category 6 cables terminated on a gray jack insert into a double gang faceplate. Ceiling-mounted Projector Outlet: (2) Category 6 cables terminated on a gray jack insert into a single gang faceplate. Wireless Access Point Outlet: (2) Category 6 cables with 20-foot slack loops at each workstation, terminated on gray jack inserts into a double gang flush faceplate or surface mount box when mounted above the ceiling. IP Camera Outlet: (2) Category 6 cable with 20-foot slack loop at each workstation, terminated on a gray jack insert into a double gang flush faceplate or surface mount box when mounted above the ceiling. Emergency Stanchion (Blue Light/Phone): (1) 4-pair voice-grade PE-39 flooded 22 AWG UTP cable from the closest MDF or IDF to each stanchion-mounted blue light phone location. Terminate the cable on a 4-pair lighting protection module at each end.	
GROUNDING	Grounding shall be designed and installed in accordance with ANSI-J-STD-607-A. Install a Telecommunications Main Grounding Busbar (TMGB) (per building) in the MDF and IDF-1s, and a Telecommunications Grounding Busbar (TGB) in each IDF-2. Install a Telecommunications Bonding Backbone (TBB), #3/0 AWG stranded green insulated copper conductor in a star topology between the TMGB and each TGB in each building. When IDFs are stacked a single TBB can be daisy-chained between TGBs back to the TMGB. Install an Equipment Bonding Conductor (EBC), #6 AWG green insulated conductor from the TMGB or TGB as applicable to each cable runway system, equipment rack, cabinet, lightning protector, or multi-pair cable with a metallic element. Install a #3/0 AWG stranded green insulated copper conductor from the TMGB to the main building electrical service ground in each building. In a metal frame (structural steel) building, where the steel framework is readily accessible within or external to the room; each TGB and TMGB shall be bonded to the vertical steel metal frame using a minimum #6 AWG conductor. Install a Grounding Equalizer Conductor, #3/0 AWG stranded green insulted copper conductor to interconnect multiple TBBs on the top floor and every 3rd floor when required by ANSI J-STD-607-A.	

PART 8 - TELECOMMUNICATIONS DIAGRAMS

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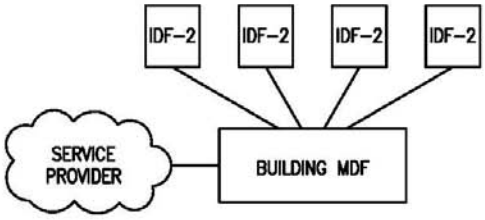

2 / xx Single Stand-Alone Builidng Topology Diagram

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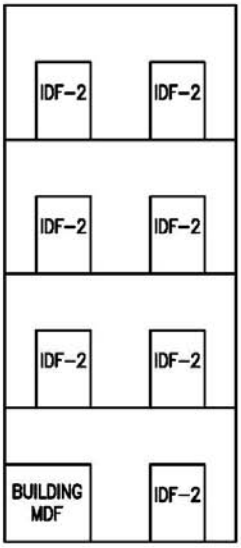

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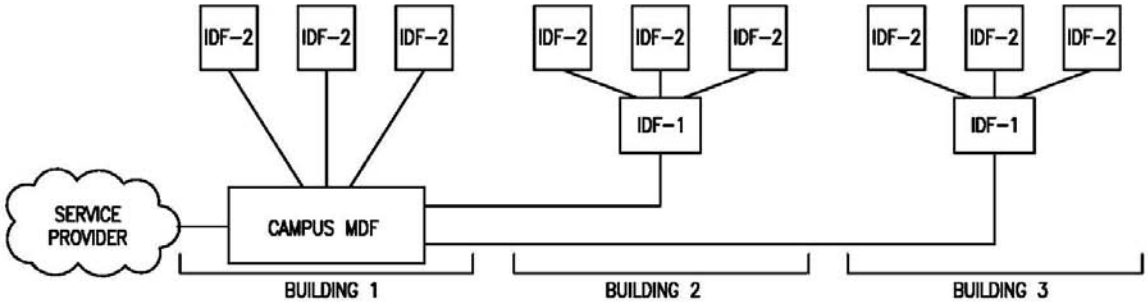
Single Building Topology and Block Diagram



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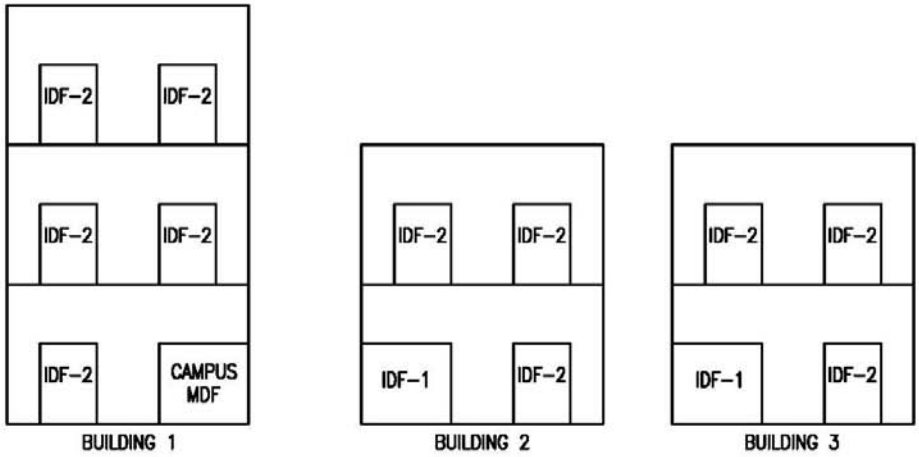
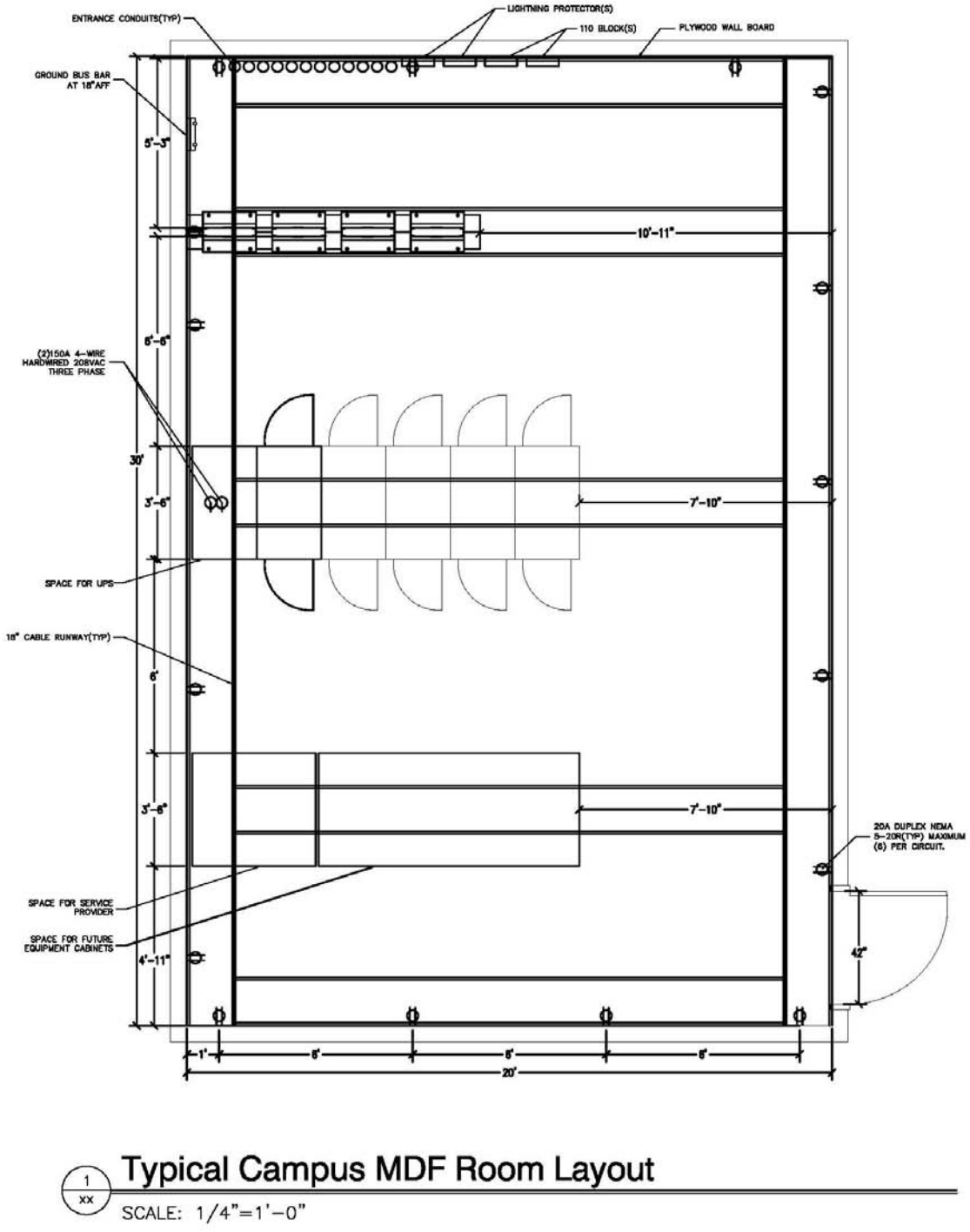


1 / xx Campus Block Diagram

SCALE: N.T.S.

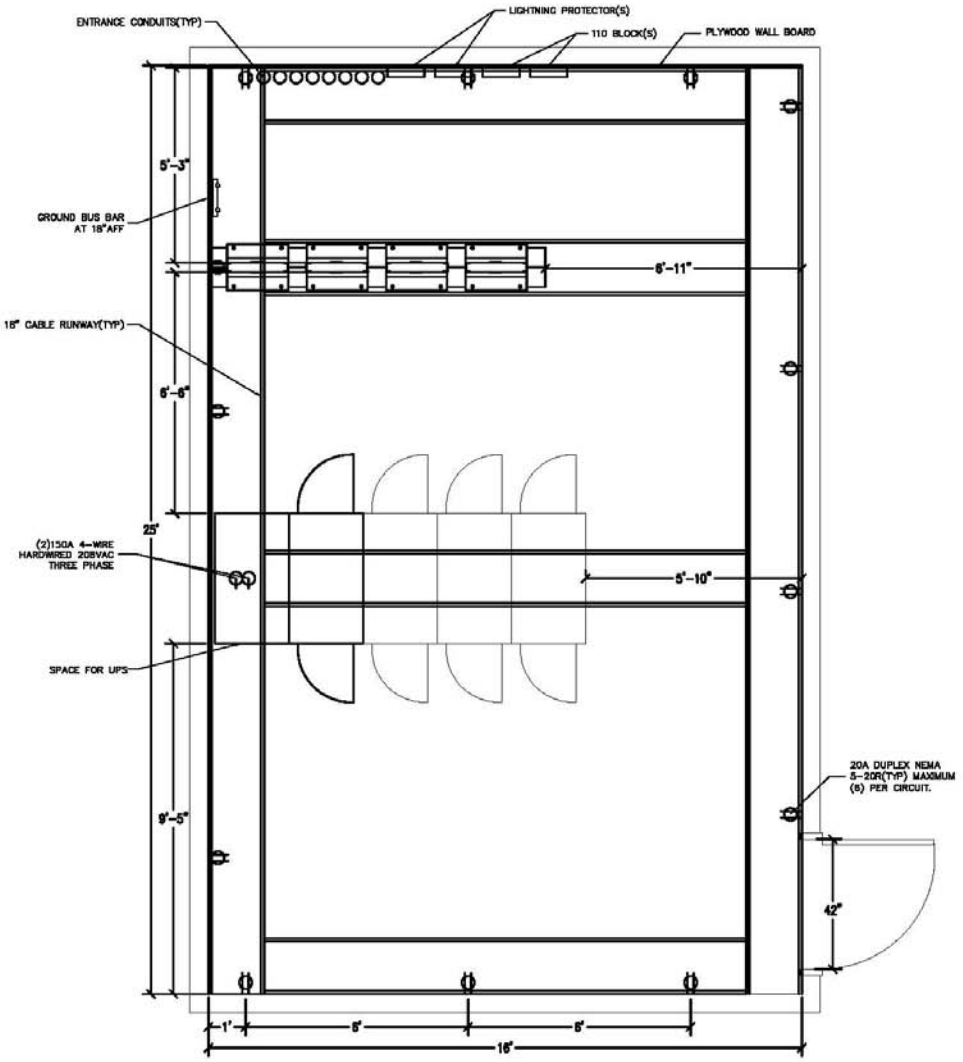
Campus Topology and Block Diagram



1/XX Typical Campus MDF Room Layout

SCALE: 1/4"=1'-0"

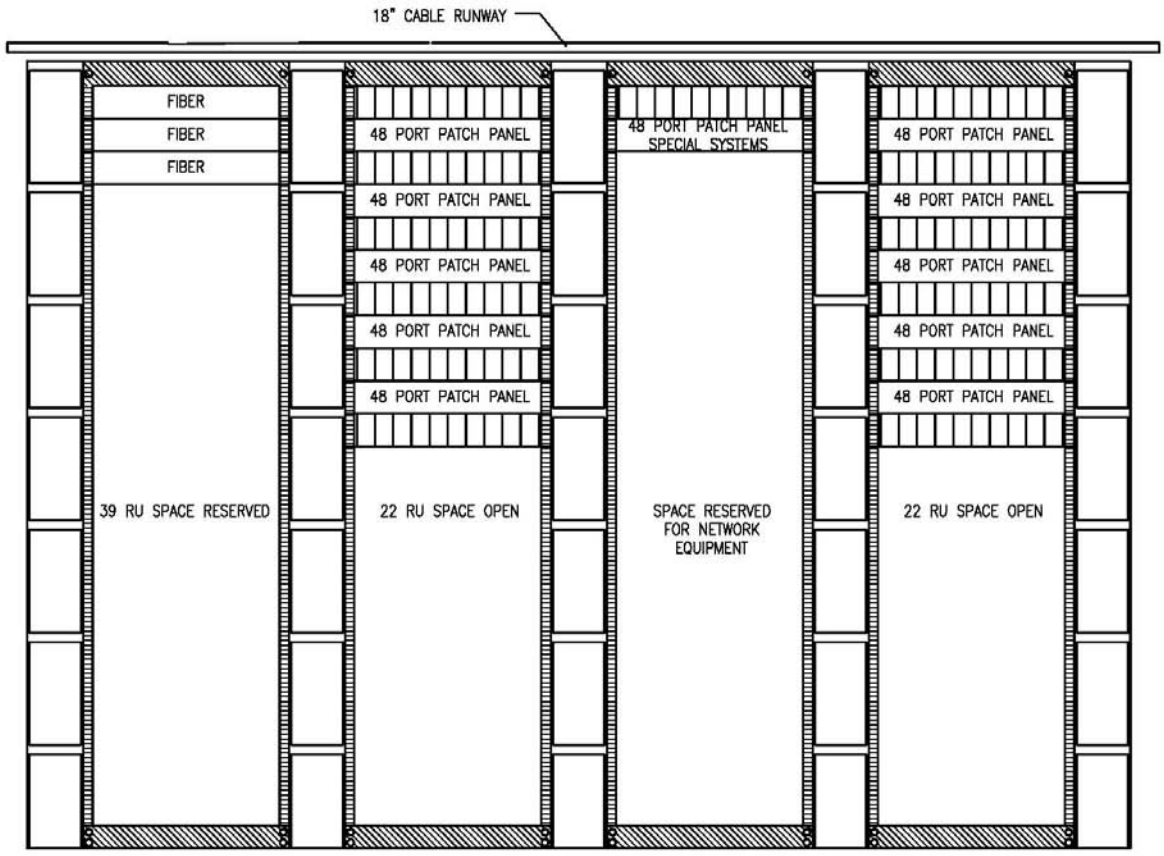
Typical Campus MDF Room Layout



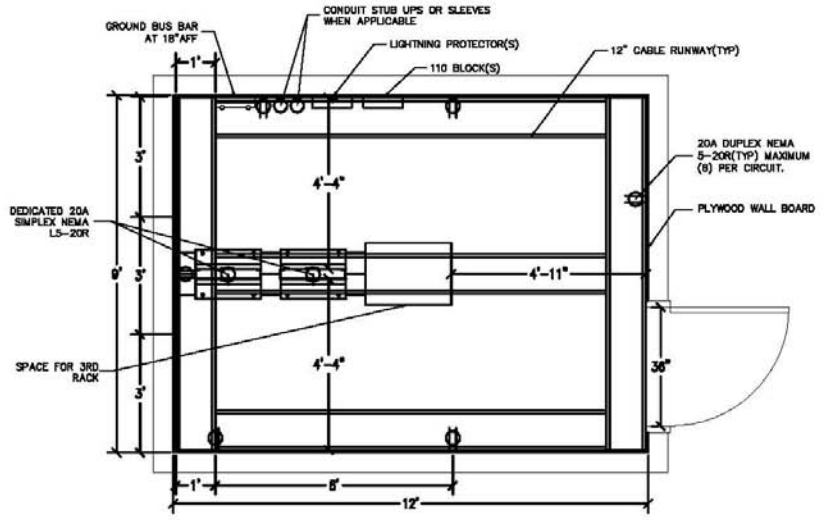
1/XX Typical Building MDF Room Layout

SCALE: 1/4"=1'-0"

Typical Building MDF Room Layout



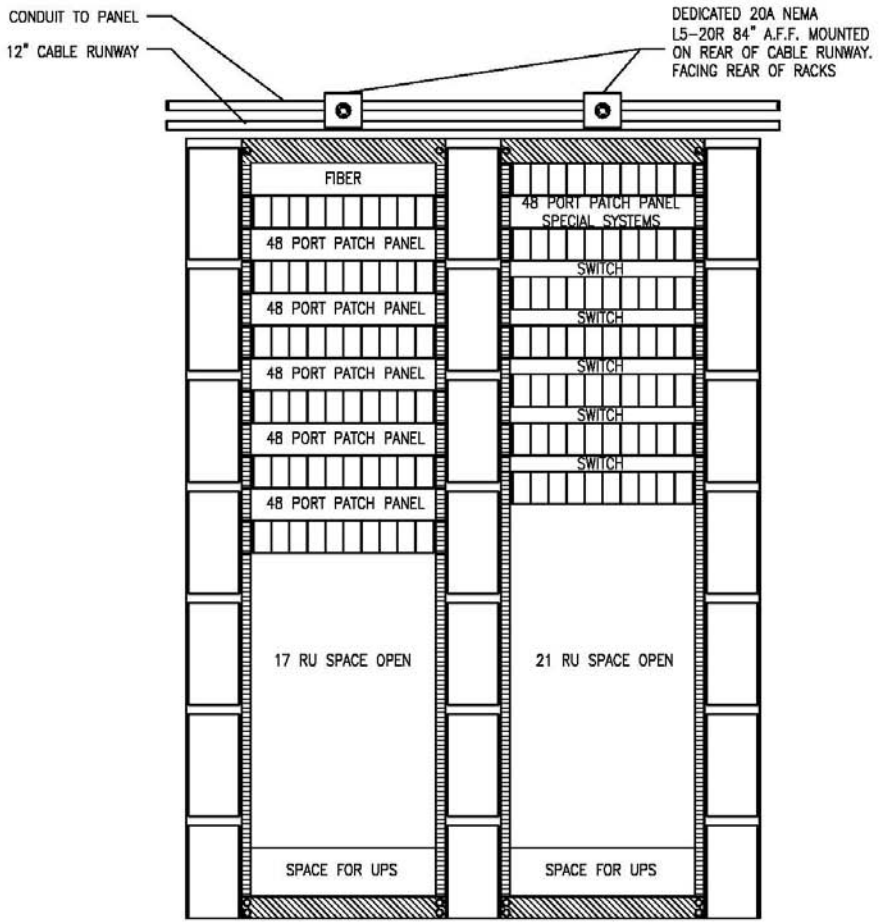
Typical MDF Rack Elevation



1/XX **Typical IDF Room Layout**

SCALE: 1/4"=1'-0"

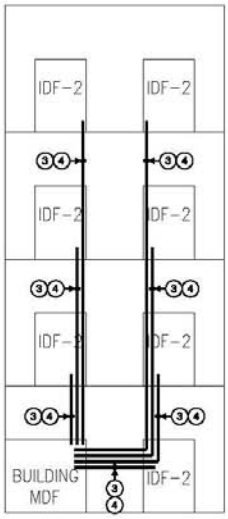
Typical IDF Room Layout



1/xx Typical IDF Rack Elevation

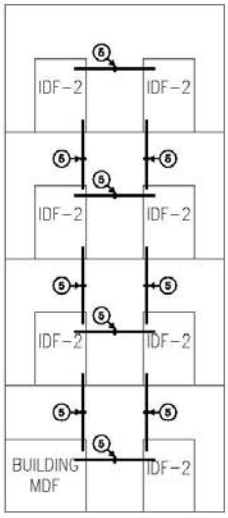
SCALE: 3/4"=1'-0"

Typical IDF Rack Elevation



1 / xx **Single Stand-Alone Builidng Riser Diagram**

SCALE: N.T.S.

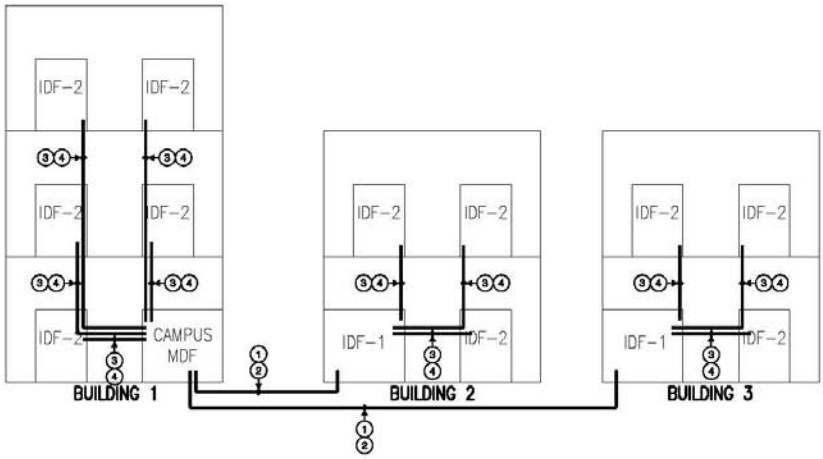


2 / xx **Single Stand-Alone Builidng Uplink Diagram**

SCALE: N.T.S.

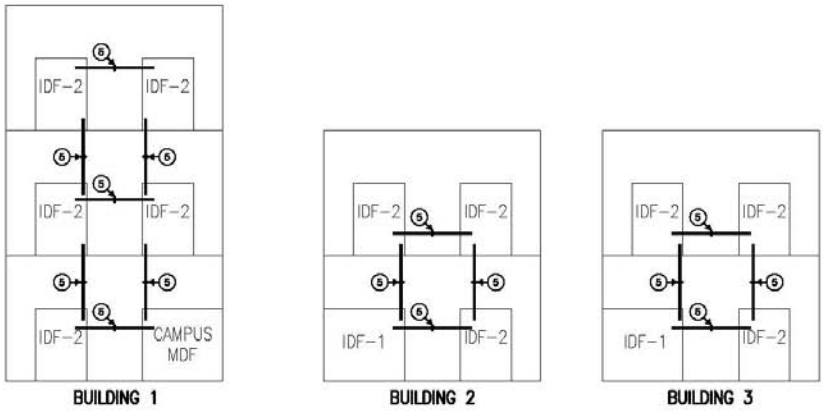
1. 24–STR 50 MICRON OM3 MULTI–MODE/12–STR 9 MICRON SINGLE MODE FIBER
2. 50–PAIR PE–39 OSP COPPER UTP
3. 12–STR 50 MICRON OM3 MULTI–MODE/6–STR 9 MICRON SINGLE MODE ARMORED
4. 25–PAIR CATEGORY 3 UTP
5. (6) CATEGORY 6 UTP, PATCH PANEL TO PATCH PANEL

Single Stand Alone Building Riser and Uplink Diagram



1/xx Campus Riser Diagram

SCALE: N.T.S.

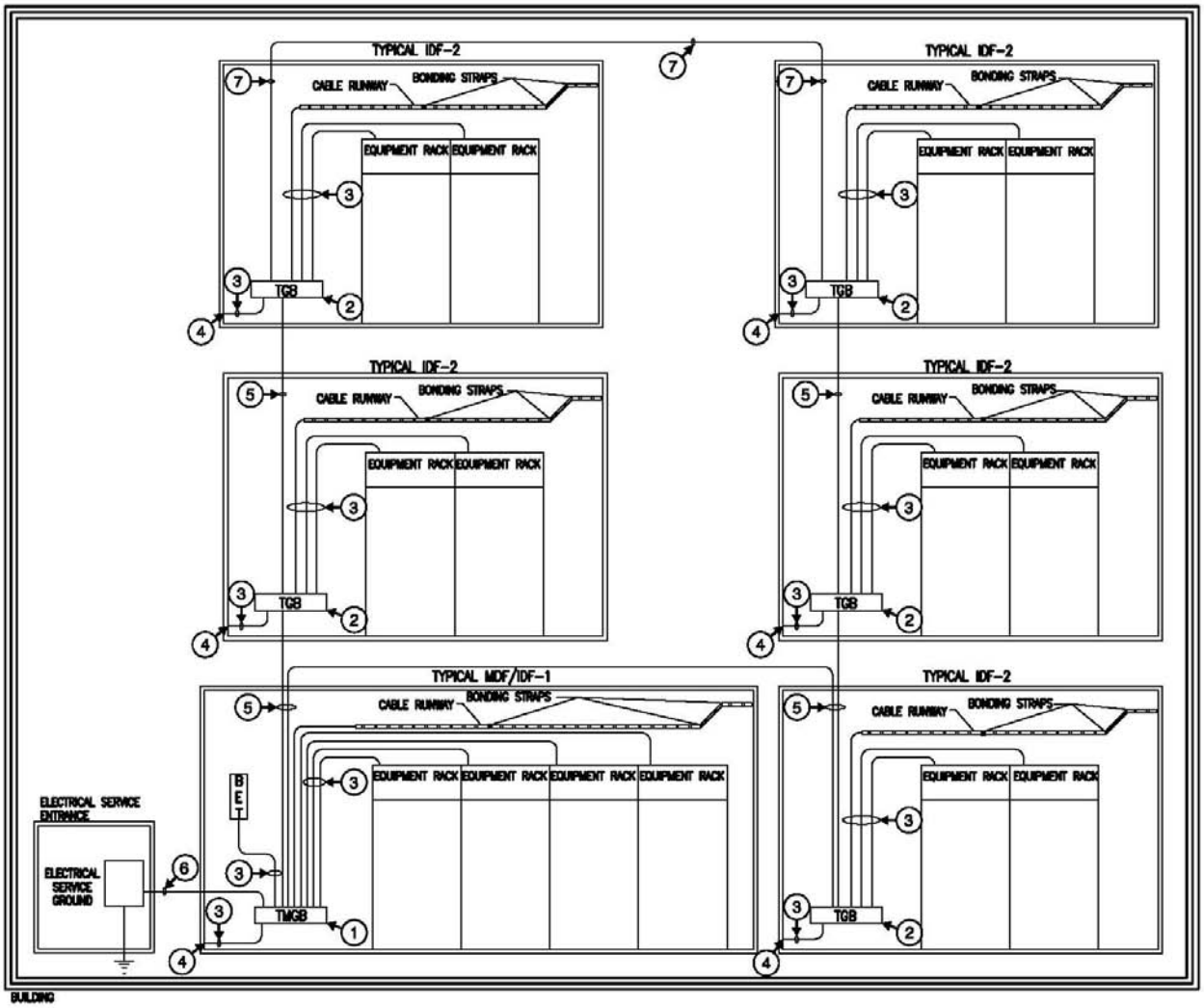


2/xx Campus Uplink Diagram

SCALE: N.T.S.

1. 24-STR 50 MICRON OM3 MULTI-MODE/12-STR 9 MICRON SINGLE MODE FIBER
2. 50-PAIR PE-39 OSP COPPER UTP
3. 12-STR 50 MICRON OM3 MULTI-MODE/6-STR 9 MICRON SINGLE MODE ARMORED
4. 25-PAIR CATEGORY 3 UTP
5. (6) CATEGORY 6 UTP, PATCH PANEL TO PATCH PANEL

Typical Campus Riser and Uplink Diagram

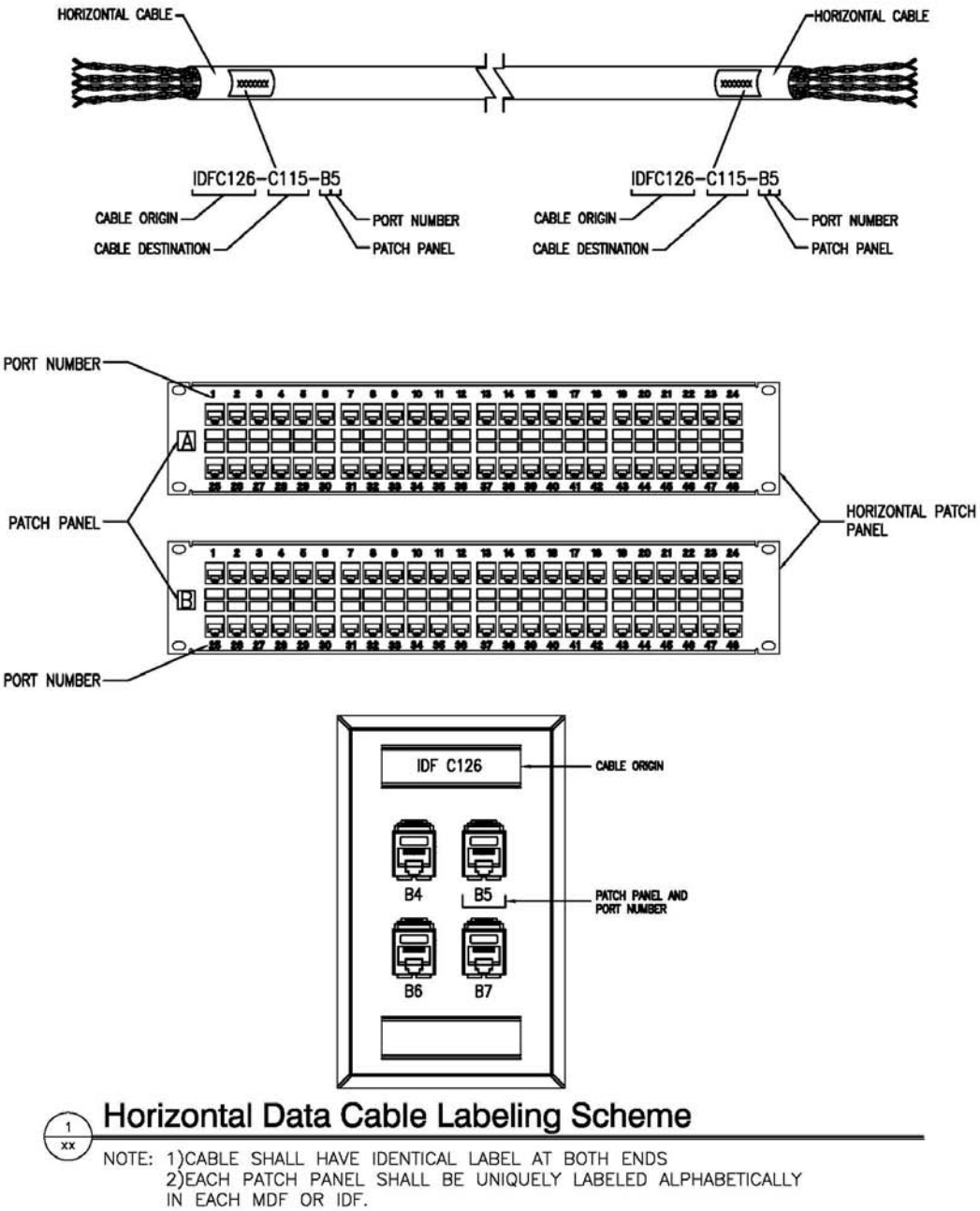


1 / XX Typical Grounding Diagram, Provided by Cabling Contractor U.N.O.

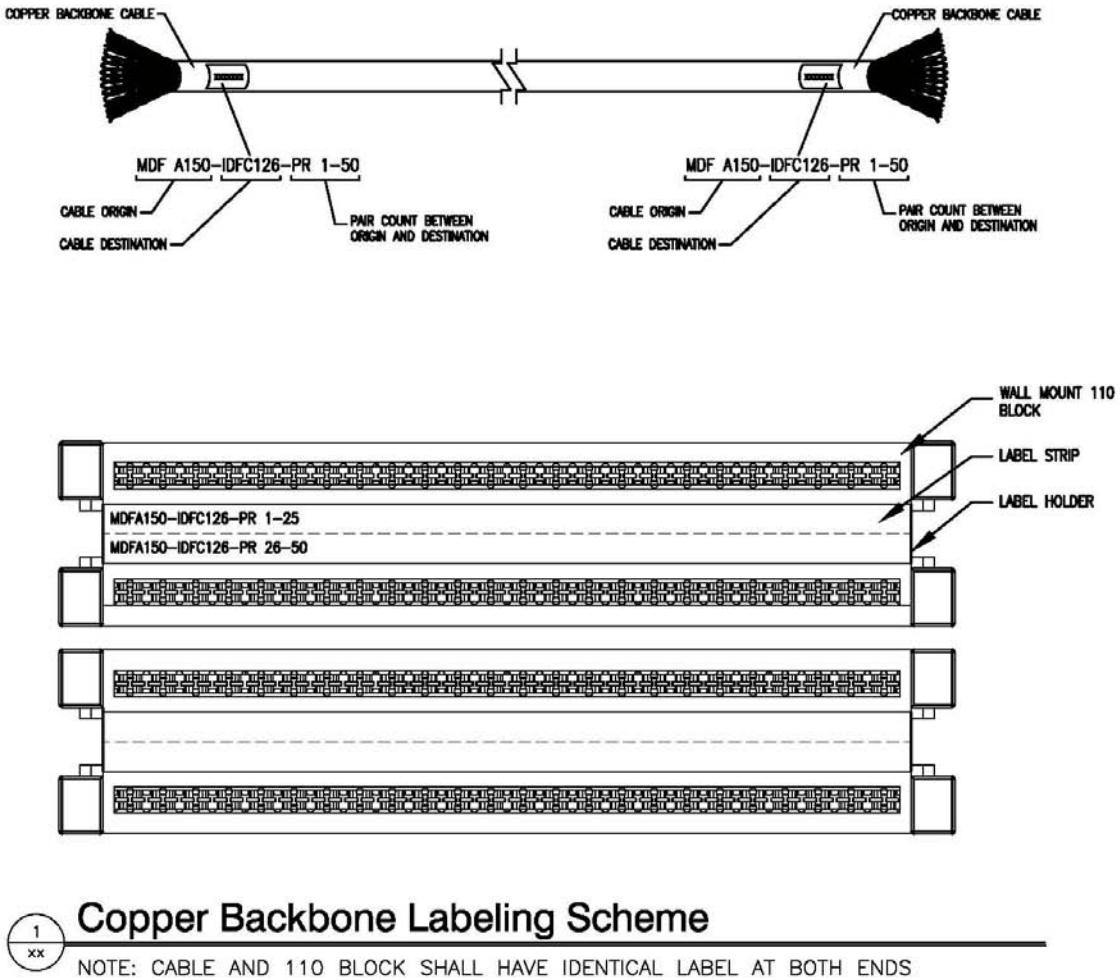
SCALE: N.T.S.

1. TELECOMMUNICATIONS MAIN GROUNDING BUS BAR (TMGB)
2. TELECOMMUNICATIONS GROUNDING BUS BAR (TGB)
3. TELECOMMUNICATIONS BONDING CONDUCTOR (TBC) #6 AWG
4. CONNECT TO GROUNDED BUILDING STEEL WHEN EXPOSED IN ROOM.
5. TELECOMMUNICATIONS BONDING BACKBONE (TBB) #3/0 AWG
6. TELECOMMUNICATIONS BONDING CONDUCTOR (TBC) #3/0 AWG BY ELECTRICAL CONTRACTOR
7. GROUNDING EQUALIZER CONDUCTOR (GEC) #3/0 AWG

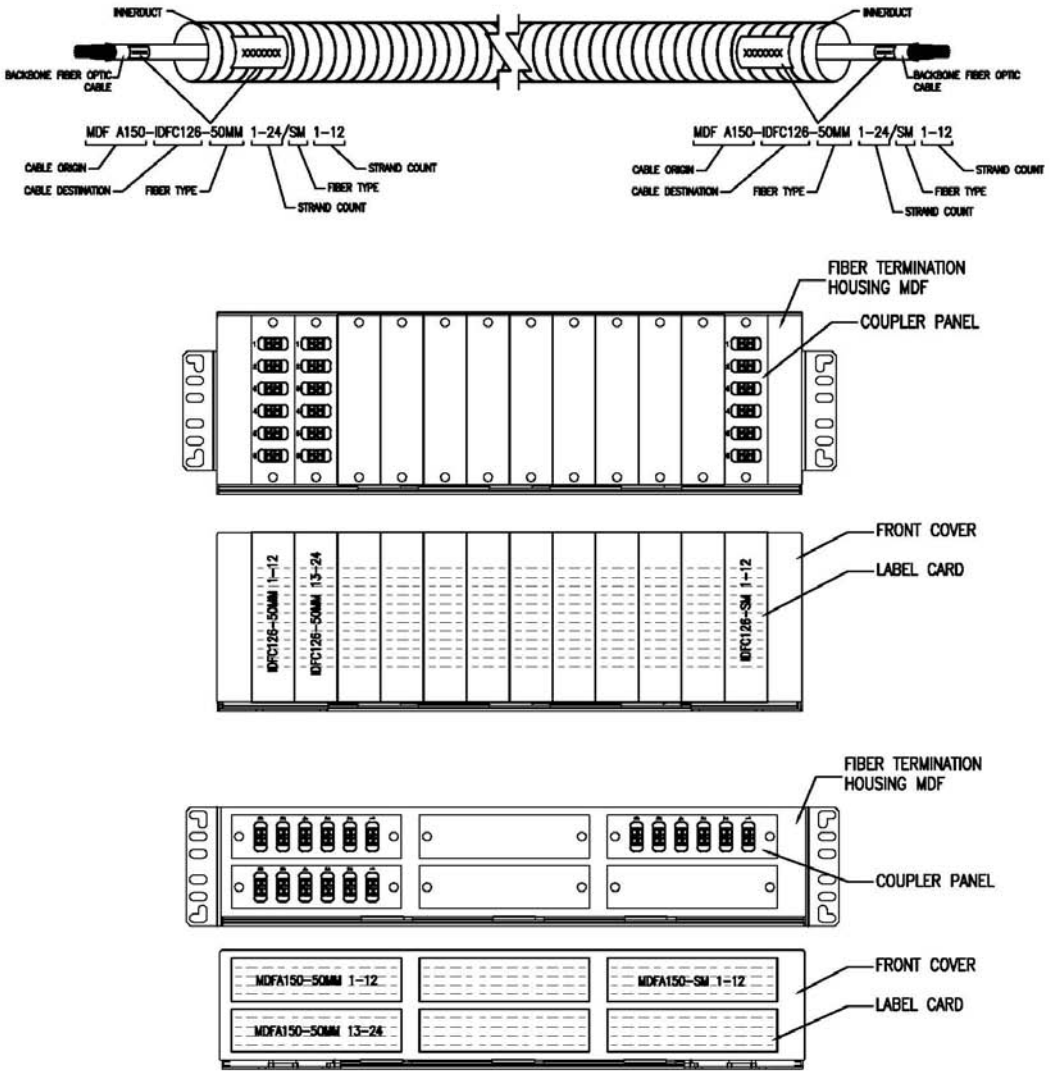
Typical Grounding Diagram



Horizontal Data Cable Labeling Scheme



Copper Backbone Labeling Scheme



1 / XX Fiber Backbone Labeling Scheme

NOTE: CABLE AND INNERDUCT SHALL HAVE IDENTICAL LABEL AT BOTH ENDS

Fiber Backbone Labeling Scheme

END OF STANDARD

SECTION 271000 (Specification Section may vary due to revisions in MasterSpec Format)

TELECOMMUNICATION INFRASTRUCTURE CABLING SYSTEM - CATEGORY 6 (550MHz) / 50 Micron

1.0 G E N E R A L

1.1 Quality Assurance

A. Within this specification, “Owner” shall refer to the Alamo Colleges, “System Designer” shall refer to the company or firm hired by the Owner to design and document the telecommunications infrastructure cabling system, and “Cabling Contractor” shall refer to the company selected by the Owner or general contractor, through the appropriate proposal and/or bid process, to provide installation of the telecommunications cabling system in accordance with the project specifications.

B. An acceptable Cabling Contractor for the installation of the equipment within these specifications must have personnel with the experience, training, skill, and certification to install a complete and working telecommunications cabling system as described within. The eligible Cabling Contractors shall be capable of furnishing a 20-year performance certification on the structured cabling components and may be pre-qualified by the District and selected for award based upon the criteria developed per the bid solicitation documents released.

C. Cabling Contractor personnel selected to install any equipment proposed under these specifications must have demonstrable experience and training on the specific equipment to be furnished and installed. The Cabling Contractor shall furnish acceptable evidence of manufacturer's training and experience of having participated in a minimum of three (3) similar system installations.

D. During the installation of the cabling system, the Owner and/or their representative will conduct periodic inspections to verify that the Project and installation is proceeding according to the letter and intent of this specification. The Cabling Contractor will promptly correct any deficiencies found and documented in the Designer’s Site Visit Reports at no additional expense to the Owner and with no negative impact to the project schedule.

E. At the time of design and construction, the Designer and Contractor shall adhere to the Alamo Colleges Telecommunications Infrastructure Standards unless directed otherwise by the Owner.

1.2 Scope of Work (SOW)

A. The Cabling Contractor shall provide and install all required materials and install telecommunications infrastructure cable systems to provide network-attached communications for the building and/or campus at the proposed and agreed upon fixed price. The Cabling Contractor shall be responsible for accurately determining the required quantities for all cable, termination hardware, supporting systems, and all ancillary materials required for a complete and working telecommunications infrastructure system as described in the project documents.

B. Where described in the contract drawings, installation of inter-building conduit, and/or conduit ductbank, innerduct, and manholes, handholes, and/or pullboxes with required splicing and support hardware shall be included in the project SOW. Inter-building cables

shall be pulled in, protected, terminated, completely labeled and tested, with test documentation and as-builts provided as described herein.

C. Each campus shall contain one MDF, typically within the Administration Building. Connectivity to the MDF and between buildings shall be provided via underground duct bank. IDF rooms shall be allocated on each floor of each building. Contractor shall provide cable tray, conduit, or sleeves as detailed on the drawings. IDF rooms are identified with the prefixes "IDF-1" and "IDF-2", followed by the architectural room number. An IDF-1 serves as the entrance facility for a building. Only one IDF-1 exists per building. Subsequent distribution in the building is routed through the IDF-2's. One or more IDF-2's are typically present on each floor. The Cabling Contractor shall build-out MDF and IDF-1 and IDF-2 space(s) as described within the Contract Drawings. The Cabling Contractor shall provide and install equipment racks, enclosures and cabinets, cable runway, patch panels, wire managers, and miscellaneous hardware as shown on the drawings as part of the complete and working telecommunications cabling system.

D. Intra-building cable required to support network connectivity shall be installed within the plenum space, in conduit, duct and cable support accessories such as cable tray, cable ladder, surface mounted raceway, and/or power pole type assemblies.

E. The Cabling Contractor shall furnish and install horizontal station cables which meet or exceed the electrical performance criteria for Category 6 as published within the TIA/EIA 568 standards documents, and be factory sweep tested and certified to 550 MHz. Quantities of cables and terminations shall be per the Outlet Configuration and Types as defined in the Alamo Colleges Telecommunications Infrastructure Standards, specified herein, and as shown on the T-Drawings. Horizontal cables shall be homerun to the nearest MDF, IDF-1, or IDF-2 unless specifically indicated otherwise on the floorplans. Connectors within offices, classrooms, laboratories, etc. shall be placed within Cabling Contractor supplied faceplates molded for the appropriate connector and mounted in the wall-mounted boxes or plaster rings. Faceplates shall be marked with system designators and cable identifiers as described in the Alamo Colleges Telecommunications Infrastructure Standards. Cables shall be installed, terminated, tested, labeled, and documented as part of the Cabling Contractor’s SOW.

F. A limited amount of broadband analog video distribution (CATV) cabling will be required as part of the SOW if identified on the drawings. In these instances, inter-building video signals are to be distributed via single-mode optical fiber cables and broadband coaxial cable using traditional CATV techniques within the buildings as defined on the project drawings. Plenum rated RG-6 coaxial cables shall be homerun from the serving area MDF, IDF-1, or IDF-2 to video outlet locations and installed within cable tray and/or conduit. All broadband distribution passive devices, labeling, testing and balancing, etc. shall be included as part of the Cabling Contractors SOW.

G. Grounding and bonding for all equipment racks, cabinets, enclosures, termination hardware and related telecommunications equipment shall be furnished and installed by the Cabling Contractor. The telecommunications grounding backbone system within each building shall be a separately derived system with a single point of termination at the Building Electrical Service Entrance Ground per the National Electrical Code. The Cabling Contractor shall complete all bonding and grounding of telecommunications equipment within the MDF, IDF-1, and IDF-2(s) and interconnect with the grounding backbone system. The system shall be completed by the Cabling Contractor to be in compliance with and meet all requirements of latest release of ANSI/TIA/EIA-607 and related sections of the locally adopted version of the National Electrical Code.

H. Cabling Contractor shall install firestopping at all fire rated walls, floors, or other fire rated systems penetrated for utilization by the telecommunications systems.

I. The Cabling Contractor shall label and test the entire telecommunications cabling system as required for the acceptance of each individual component and the complete telecommunication cabling system. The Cabling Contractor is responsible for ensuring that the cable and equipment being installed in the system is without flaw and that no damage to the cable or equipment occurred in shipment or installation. The Cabling Contractor shall replace any defective cables or equipment prior to completion with no additional cost to the owner and in such a time frame that it does not affect the project schedule.

J. The Cabling Contractor shall correct, in a timely manner, any installation deficiencies or unacceptable equipment uncovered by the Owner's, System Designer's, or manufacturer's quality assurance inspection. If necessary or required, a re-examination of any portion of the installation shall be performed.

K. It is the intent of this specification to describe a level of quality for products and workmanship but not to describe all of the technical requirements essential to the functioning of a cabling system, nor to set forth those requirements adequately covered by applicable codes, industry standards, and accepted telecommunications trade practices. The selected Cabling Contractor is expected to be familiar with all applicable codes, industry standards, and accepted telecommunications trade practices as well as their execution to the benefit of the project and the project Owner.

L. In the case of a building renovation, all unused cabling shall be removed from accessible areas as defined by the locally adopted version of the National Electrical Code. Unused cabling required to remain shall be clearly and obviously labeled as being for future use.

1.3 Contract Drawings

A. The intent of the drawings is to establish the type of system and functions, but not to set forth each item essential to the functioning of the system. The drawings are generally diagrammatic and show approximate location and extent of the work. In case of doubt of work intended, it is the responsibility of the Cabling Contractor to request instructions from the Owner.

B. Cabling Contractor shall review all drawings before commencing work. Where discrepancies occur, Cabling Contractor shall immediately notify the Owner and request clarification.

C. Contractor shall review the project plan set and project manual to verify his understanding of the project requirements and coordination with other disciplines and trades.

1.4 Reference Standards

A. The latest published edition of the following codes, standards, and references shall be adhered to throughout the project. Where any specified element is in conflict with a reference listed below, the more stringent requirement shall apply.

B. The codes and standards set forth minimum requirements which may be exceeded by the Cabling Contractor if, in Contractor's judgment and with Owner's approval, superior or more economical designs or materials are available for successful and continuous operation of the equipment as required by this specification.

(1) Code of Federal Regulations, Title 29, Chapter XVII, Part 1910 (OSHA).

(2) ASTM E814, and UL 1479 concerning the assembly and installation of fire stop systems.

(3) UL 467 Concerning Bonding and Grounding Equipment.

(4) CCITT - International Telegraph and Telephone Consultative Committee V-Series and X-Series.

(5) TIA-568-C.0 Generic Telecommunications Cabling for Customer Premises

(6) TIA-568-C.1 Commercial Building Telecommunication Cabling Standards – Part 1 General Requirements (2008)

(7) TIA-568-C.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standard (2009)

(8) TIA-568-C.3 Optical Fiber Cabling Components Standard (2009)

(9) TIA-569-B Commercial Building Standard for Telecommunications Pathways and Spaces - (October 2004)

(10) TIA-598-C Optical Fiber Cable Color Coding - (January 2005)

(11) TIA/EIA-606-A Administration Standard for Commercial Telecommunications Infrastructure - (May 2002)

(12) ANSI J-STD-607-A Commercial Building Grounding and Bonding Requirements for Telecommunications - (October 2002)

(13) TIA-758-A Customer-owned Outside Plant Telecommunications Infrastructure Standard - (August 2004)

(14) TIA-598-C Optical Fiber Cable Color Coding - (January 2005)

(15) TIA-526-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant – OFSTP-7 - (February 2002)

(16) TIA-526-14-A Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant – OFSTP-14 - (August 1998)

(17) All relevant IEEE 802.3 standards to include but not be limited to 10/100/1000BaseT Standard and Alamo Colleges adopted 1000Base-X network backbone technologies.

(18) IEEE 802.4 Broadband Applications and 802.7 Broadband Specifications Standard.

(19) NFPA 70 National Electrical Code with revisions and additions as dictated by the local municipality having jurisdiction.

(20) ANSI C80.3 Specification for Zinc-coated Electrical Metallic Tubing.

(21) ANSI/UL 797 Electrical Metallic Tubing.

(22) NEMA VE1 Cable Tray Systems.

(23) FCC Rules and Regulations, Part 68.

(24) All local codes (i.e., City of San Antonio Fire Code, City of San Antonio Electric Code, City of San Antonio Mechanical Code, etc.)

(25) Basic Building Code (BOCA).

(26) Uniform Building Code (ICBO).

(27) Standard Building Code (SSBC).

(28) NFPA 101 - Life Safety Code.

(29) NFPA 258 - Standard Test Method for Measuring Smoke Generated by Solid Materials.

1.5 Product Requirements

A. Materials and equipment furnished must be new products of manufacturers regularly engaged in the production of such products.

B. Products must be UL listed where a UL test procedure is applicable.

C. Telephone system materials and equipment shall be FCC Type-accepted and certified as such by supplier.

1.6 Related Work

A. Applicable sections of project General and Supplemental Conditions and Electrical Systems (Division 26) plans and specifications are to be referred and adhered to during the installation of telecommunications cabling, including:

(1) General Requirements.

(2) Basic Requirements, Materials, and Methods.

(3) Raceways.

(4) Cable Tray.

(5) Wiring Devices.

(6) Boxes, Wall and Floor.

(7) Cabinets.

(8) Supporting Devices.

(9) Elevator Equipment Wiring.

(10) Fire Alarm and Detection Systems.

1.7 Pre-Project Submittals

A. Three (3) bound sets of Pre-Project Submittals, divided into sections as described below and with the product cut-sheet portion following the order of the Products section of this Specification, shall be provided by the Cabling Contractor to the Architect Pre-Project Submittals are due no later than 30 days after notice of award has been issued or as required by the specific project schedule.

B. Prior to the purchase of products, Cabling Contractor shall prepare and submit the following deliverables for review and acceptance by the Architect and Owner. Products purchased prior to review and acceptance of the Pre-Project Submittals are subject to rejection by the Owner or Designer and shall be replaced with approved products at no cost to the Owner and with no delay in the project schedule.

(1) Provide product cut-sheet and shop drawing submittals. Manufacturers cut sheets or brochures of all products, systems, or assemblies to be provided for the project may be original or photocopied. Cut sheets shall include complete dimensions, material descriptions, color choices, and shall be highlighted or otherwise identified where more than one product or part number appears on the cut sheet. Shop drawings shall be submitted showing panels, workstations, faceplates, labeling strips detailing all nomenclature, engraving, finish, and color. Cabling Contractor outlet, cable, and connecting hardware labeling schemes shall comply with the TIA/EIA-606 Standard, UL 969, and the Alamo Colleges Telecommunications Infrastructure Standards.

(2) Provide test procedures including a list of test equipment to be used for cable testing, and sample test result formats.

(3) Sketches or cut sheets of UL Listed firestop systems shall be provided to reflect the actual installation conditions of the project.

(4) Cabling Contractor prepared schedule of activities to be followed throughout the project. The schedule shall minimally describe project start date, date upon which telecommunications pathways shall be completed, date upon which telecommunications spaces are to be prepared, estimated time to install inter-building cables, estimated time to install riser cables, estimated time to install horizontal cables, estimated time to terminate cables, estimated time and date to test and label all cabling and workstation outlets, and estimated date of delivery of Post Project Completion Deliverables.

(5) A listing of information required by the Cabling Contractor from the Owner and when the information is needed to ensure timely completion of the project.

(6) Cabling Contractor shall provide written confirmation that the project jobsite has been inspected, that all related drawings and specifications have been reviewed, and that the Cabling Contractor possesses a thorough understanding of the project requirements and schedule.

C. Pre-Project submittals will be reviewed by the Architect for general compliance with the intent of the drawings and specifications. Completeness of the submittal, rejection in part or whole, acceptance, or acceptance with comment shall not relieve the Cabling Contractor of providing a complete and working system as described on the drawings, within the specifications, or can be reasonably expected based upon accepted industry standards and practices.

1.8 Post Project Deliverables

A. Test Results

(1) Test results shall be performed, documented, and submitted as specified within the Testing Portion of Section 3.0 - EXECUTION herein.

(2) Cabling Contractor shall include all factory provided test results for cabling purchased for the project.

B. Record Drawings

(1) Contractor shall maintain one set of drawings on site to continually maintain an accurate record of the as-constructed work. The mark-up drawings shall accurately indicate location of equipment, pull-boxes, conduits, cable types and labeling based upon as-built conditions.

(2) Upon completion of the project, Cabling Contractor shall provide drawings depicting the cabling system as installed. The original telecommunications drawings shall be provided for use as a basis for creating Record Drawings. Record Drawings shall minimally include all revisions to, or deviations from the original drawings as well as final dimensions, cable routes, cable and outlet identification, allocation of used and quantity of spare pairs and strands, and remaining capacity of cable pathways.

(3) The Owner and System Designer will review an initial set of the Record Drawings. Comments will be provided to the Cabling Contractor in cases where revisions to the Record Drawings are required to ensure accuracy and completeness. The Cabling Contractor shall respond to the comments and revise the Record Drawings accordingly.

(4) Upon acceptance of the Record Drawings as final, Cabling Contractor shall provide the Owner the original field marked “red-line” drawings and with a read/write Compact Disk (CD) containing Auto-Cad Release 2007 or later .dwg formatted As-Built drawings which shall identify/label all cabling, equipment, outlets, and cabling pathways as marked in the field for the completed project. Cabling Contractor shall plot and laminate both the cabling floorplans and Riser Diagrams for mounting within the respective serving MDF/IDF-1/IDF-2 Room(s).

(5) Manufacturers warranty and certification documents describing the duration of all warranties as well as procedures for notification of cabling system failures and associated remedies.

1.9 Acceptance and Guarantee

A. In addition to guarantee of equipment by manufacturer, the Contractor shall also guarantee such equipment, which shall include tests, adjustments and/or replacements of defective equipment, Materials, and workmanship for a period of one (1) year from date of substantial completion.

B. The guarantee shall be written included as part of the project manual. Defects appearing within one year shall be repaired by the Contractor without cost to the Owner.

C. The cabling system shall be accepted as being complete and working at no time prior to resolution of all punch list items and receipt of all Post Project Completion Deliverables.

D. Manufacturer and installer provided warranty and certification shall commence upon Owners acceptance and functional use of the cabling system.

E. All post project deliverables are due within 30 days of issuance of certificate of substantial completion.

2.0 P R O D U C T S

2.1 Copper Cable

A. Outside Plant (OSP) Inter-building Copper Cable

(1) General: Multi-conductor cable shall be used for connectivity between buildings. Cable will be run in underground duct between buildings and through conduit within the building.

(2) Cable shall be Rural Utilities Service (RUS) 7 CFR 1755.390 (REA PE-39) listed and ISO 9002 Certified.

(3) Conductors shall be #24 AWG solid annealed copper twisted to form individual pairs. The twisted pairs shall be color-coded using standard telephone industry color codes.

(4) The cable core assembly shall be entirely filled with water displacing compound and non-hygroscopic dielectric tape shall be applied longitudinally with overlap.

(5) The cable shall have an aluminum shield of corrugated, copolymer coated aluminum tape and adhesive water blocking compound applied longitudinally with overlap.

(6) Cable jacket shall be black low density polyethylene.

(7) The total number of cable pairs supplied in each run shall equal the total pair count as shown on the drawings.

(8) Acceptable Product:

(a) BICC General Filled Solid QUALPETH PE-39 AL Spec. 2002.

(b) Approved equivalent.

B. Intra-building Backbone Copper Cabling

(1) General: Copper backbone cable shall be used to provide voice connectivity between the MDF or IDF-1 and IDF-2 Spaces. Cable shall be installed within conduits, sleeves/cores and/or the cable tray system between spaces.

(2) Codes and standards: Multi-conductor cable shall be acceptable for IEEE 802.3 applications. Cables shall be type CMP (communications plenum cable) or type CMR (communications riser cable) as required per the installation environment and as outlined in NEC Sections 800-51(a) and 800-51(b) respectively. Cable shall also conform to Bell Laboratories specification L-780011 and be UL listed.

(3) Conductors: Conductors shall be #24 AWG solid annealed copper twisted to form individual non-shielded pairs. The twisted pairs shall be color-coded using standard telephone industry color codes.

(4) Insulation: Polyvinylchloride skin over polyethylene or a Teflon material as required per the installation.

(5) Jacket: Riser rated cable jacket shall be of fire resistant riser rated material equivalent to polyvinylchloride plastic or better. Cable jacket shall enclose an overlapped corrugated aluminum shield. Plenum rated cable jacket shall be of fire resistant plenum rated material equivalent to a copolymer or better.

(6) The total number of cable pairs supplied in each run shall equal the total pair count as shown on the drawings.

(7) Acceptable Manufacturer/Product:

(a) Systimax 1010 (Riser Rated) and 2010 (Plenum Rated) Cables.

(b) Approved equivalent.

C. Station Cabling

(1) Category 6 rated 4-pair horizontal cables shall be used for network connectivity between individual workstation outlets and their serving telecommunications space. Horizontal cables shall be rated Category 6 per the most recently published TIA/EIA standards, and be sweep tested and certified to 550MHz by the manufacturer.

(2) Cable shall be type CMP as required per the installation environment and as outlined in NEC Sections 800-51(a). Cable shall also conform to Bell Laboratories specification L-780011 and be UL listed.

(3) Limited combustible cable shall be provided and installed in areas where required by the local authority having jurisdiction.

(4) Conductors shall be #24 or # 23 AWG solid annealed copper twisted to form non-shielded pairs. The twisted pairs shall be color-coded using standard telephone industry color codes.

(5) Acceptable Product:

(a) Mohawk 6 LAN Plus PN:M58801

(b) Approved equivalent.

D. Patch Cords

(1) Dual-ended RJ-45 UL-rated Category 6 rated non-booted copper patch cords shall be provided for patching between network equipment and patch panels in the MDF and the IDF-1 and IDF-2 rooms in quantities necessary to provide a single network connection for each data station port, and specified quantities of special-purpose patch cords. An additional twenty-five percent of the total number of patch cables required shall be provided as spare, in boxes suitable for storage by the Owner.

(2) Patch cord length shall be equal to the minimum factory produced length in colors and quantities indicated in Section 3.

(3) Electrical performance of data patch cords shall equal the electrical performance of the cable used within the system being patched interconnected, or cross-connected.

(4) Patch/Interconnect/Cross Connect cables shall by manufactured by the same manufacturer selected to provide horizontal termination equipment.

(a) Leviton 6D460-03L

(a) Leviton 6D460-05L

(a) Leviton 6D460-07L

(a) Leviton 6D460-03G

(a) Leviton 6D460-05G

(a) Leviton 6D460-07G

(a) Leviton 6D460-07Y

(a) Leviton 6D460-10R

(a) Leviton 6D460-07O

E. Grounding Conductor

(1) The grounding conductor shall be copper, and sized as required per ANSI-J-STD-607-A, a minimum of # 6AWG up to # 3/0 for lengths over 66 feet. The wire shall be insulated in a continuous outer cover of riser rated PVC or plenum rated material acceptable for use in the installation environment for which it is placed.

(2) The installed wire shall conform to applicable requirements of the National Electric Code and shall meet all local codes and restrictions.

(3) Cable jacket shall be green in color.

(4) Acceptable Manufacturers:

(a) BICC/General Cable.

(b) Approved equivalent.

2.2 Fiber Optic Cable

A. Outside Plant (OSP) Inter-building Fiber Optic Cable

(1) General: Loose tube fiber optic backbone cable shall be used for connectivity between buildings. Cable will be run within innerduct in underground conduit between buildings and within the building.

(2) Fiber construction shall consist of both single mode and OM3 (up to 300 meters) or OM4 (over 300 meters) multi-mode with a core/cladding size of 9/125 micron single mode and 50.0/125 micron multi-mode in a composite cable. Contractor shall furnish and install the appropriate fan out or breakout materials as required and dictated by the application and fiber optic cable type.

(3) The total number of fibers supplied in each cable run shall equal the total number of fibers shown on the contract drawings. The cable structure shall be such that the fibers are grouped for easy handling. The cable shall contain appropriate strength members to satisfy the mechanical and environmental specifications provided herein.

(4) The core shall consist of filled buffer tubes surrounding a central dielectric strength member. Water-Swellable and Flame Retardant Tape and yarns shall surround the fibers to provide further weather and mechanical protection. The Contractor shall ensure that the core construction of the cable proposed for installation is such that the environmental and mechanical requirements of the installation are met.

(5) The maximum attenuation of loose tube fiber optic strands shall be:

(a)	50.0/125 multi-mode	(850 nanometers):	3.0 dB/km
		(1300 nanometers):	1.0 dB/km
(b)	9.0/125 single-mode	(1310 nanometers):	0.4 dB/km
		(1550 nanometers):	0.3 dB/km

(6) The minimum OFL bandwidth of OM3 multi-mode cable shall not be less than 1500 MHz-km @ 850 nm and 500 MHz-km @ 1300 nm.

(7) The minimum OFL bandwidth of OM4 multi-mode cable shall not be less than 3000 MHz-km @ 850 nm and 500 MHz-km @ 1300 nm.

(8) The minimum Laser bandwidth of OM3 multi-mode cable shall not be less than 2000 MHz-km @ 850 nm and 500 MHz-km @ 1300 nm.

(9) The minimum Laser bandwidth of OM4 multi-mode cable shall not be less than 4700 MHz-km @ 850 nm and 500 MHz-km @ 1300 nm.

(10) All finished fibers must be color-coded by the manufacturer for identification. The fibers shall be connectorized utilizing field-installed terminations or spliced pigtails. The nominal connector loss using either termination method shall not be greater than 0.40 dB per mated pair.

(11) The fiber cable shall be able to withstand a short-term tensile load of 2700 N (600 lbf.) and a long-term tensile load of 600 N (135 lbf.) with maximum elongation of less than 0.5% and no breakage of fibers.

(12) The minimum static or no load (0-180 lb.) bending radius for the cable shall be no less than 10 times the outside diameter of the cable. Cables shall be able to withstand being flexed at their minimum static bending radius +/- 90 degrees for at least 20 cycles at 20-40 cycles per minute at 20 degrees C. The minimum dynamic or loaded (181-600 lb.) bending radius shall be no greater than 20 times the outside diameter of the cable.

(13) The cable shall be able to withstand twisting of +/-360 degrees over a length of 2 meters for at least 10 cycles at 10 cycles per minute. The cable shall be able to withstand storage and operating temperatures of -40 to +70 degrees C. The cable shall withstand a compressive force of 600 N/cm without breakage, and there shall be no attenuation increase after the force is removed.

(14) Acceptable Product:

(a) Corning FREEDM

(b) Approved equivalent.

B. Intra-building Backbone Fiber Optic Cable

(1) Fiber optic cables shall be general purpose and rated OFNR or OFNP per the requirements of NEC Article 770, and encased in flexible metallic armor.

(2) Intra-building fiber construction shall consist of both single mode and OM3 (up to 300 meters) or OM4 (over 300 meters) multi-mode with a core/cladding size of 9/125 micron single mode and 50.0/125 micron multi-mode in a composite armored cable. Contractor shall furnish and install the appropriate fan out or breakout materials as required and dictated by the application and fiber optic cable type.

(3) Maximum attenuation of tight buffered fiber optic strands shall be:

(a)	50.0/125 multi-mode	(850 nanometers):	3.5 dB/km
		(1300 nanometers):	1.25 dB/km
(b)	9.0/125 single-mode	(1310 nanometers):	0.8 dB/km
		(1550 nanometers):	0.5 dB/km

(4) The minimum OFL bandwidth of OM3 multi-mode cable shall not be less than 1500 MHz-km @ 850 nm and 500 MHz-km @ 1300 nm.

(5) The minimum OFL bandwidth of OM4 multi-mode cable shall not be less than 3000 MHz-km @ 850 nm and 500 MHz-km @ 1300 nm.

(6) The minimum Laser bandwidth of OM3 multi-mode cable shall not be less than 2000 MHz-km @ 850 nm and 500 MHz-km @ 1300 nm.

(7) The minimum Laser bandwidth of OM4 multi-mode cable shall not be less than 4700 MHz-km @ 850 nm and 500 MHz-km @ 1300 nm.

(8) All finished fibers must be color-coded by the manufacturer for identification. The fibers shall be connectorized utilizing field-installed terminations or spliced pigtails. The nominal connector loss using either termination method shall not be greater than 0.40 dB per mated pair.

(9) The fiber cable shall be able to withstand a short-term tensile load of 440 N (99 lbf.) and a long-term tensile load of 132 N (38 lbf.) with maximum elongation of less than 0.5% and no breakage of fibers.

(10) The minimum static or no load (0-180 lb.) bending radius for the cable shall be no greater than 10 times the outside diameter of the cable. Cables shall be able to withstand being flexed at their minimum static bending radius +/- 90 degrees for at least 20 cycles at 20-40 cycles per minute at 20 degrees C. The minimum dynamic or loaded (181-600 lb.) bending radius shall be no greater than 20 times the outside diameter of the cable.

(11) The cable shall be able to withstand twisting of +/-360 degrees over a length of 2 meters for at least 10 cycles at 10 cycles per minute. The cable shall be able to withstand storage and operating temperatures of -40 to +70 degrees C. The cable shall withstand a compressive force of 600 N/cm without breakage, and there shall be no attenuation increase after the force is removed.

(12) The cable shall be able to withstand storage and operating temperatures of -40 to +70 degrees C.

(13) The number of fibers supplied in each cable shall be the number of fibers required per the contract drawings. The cable structure shall be such that the fibers are grouped for easy handling.

(14) The cable shall contain appropriate strength members to satisfy the above mechanical and environmental specifications. The core shall consist of loose tubes around a central dielectric strength member. The cable jacket shall be medium density polyethylene or similar and provide suitable moisture resistance for installation in underground ducts. The cable sheath shall be of a non-armored non-metallic material.

(15) Acceptable product:

(a) Corning MIC Series Riser and Plenum Armored Fiber Optic Cables

(b) Approved equivalent.

C. Fiber Optic Patch Cords

(1) Duplex fiber optic patch cables shall be factory assembled and tested. Patch cables shall be manufactured using fiber optic cable of quality equal to, or better than the specifications listed above for fiber optic cable. Connectors shall be as specified elsewhere in this section.

(2) Fiber Optic Patch Cord length shall be determined by the final installed configuration of network electronics, fiber optic termination panels, and wire management hardware. Patch cord length shall be equal to the minimum factory produced length that will allow cross connection and interconnection to be accomplished by the owner without hindrance while allowing minimum bend radius and adequate strain relief to be maintained at all times.

(3) Fiber optic patch cord quantity to be delivered shall be as dictated by the Owner.

(4) The same manufacturer selected to provide fiber optic riser cable shall manufacture the fiber optic patch cables.

2.3 Coaxial Cable (when applicable)

A. RG-6 Coaxial Station Drop Cable

(1) RG-6 coaxial cable shall be used for video connectivity from the video system main trunk cable to the individual CATV or broadcast outlet. The cable shall be placed within the cable tray system and shall be UL Listed CMP Plenum rated.

(2) Center conductor shall be nominal 18AWG minimum, solid bare copper. The dielectric insulation shall be foam FEP. The outer conductor or shield shall be aluminum foil and 95% coverage tinned copper braid. Outer jacket shall be CommFlex V with minimum 80 degree Celsius temperature rating and white in color.

(3) Maximum attenuation of the cable @ 20degrees Celsius shall be 6.05dB/100feet @ 720MHz. Velocity of Propagation shall be 84% NOMINAL. Nominal impedance shall be 75Ω ± 2Ω.

(4) Acceptable Product:

(a) Uniprise

2.4 Cable Tray for Main Pathways

A. Refer to related section of Project Electrical Plans and Specifications

2.5 Cabling Connectivity, Termination, Cable Management, and Equipment Support

A. Equipment Racks and Cabinets

(1) Racks shall be black aluminum Standard Equipment Racks with EIA 19-inch rails, 84-inch (45 RMU) overall height, 3-inch rail depth, dual floor mounting flanges, and rack mount unit markings engraved on the rails. Racks shall be bolted to the concrete floor and to the overhead cable runway utilizing manufacturer-recommended hardware and methods.

(2) Server Cabinets shall be 24 inches by 42 inches by 84 inches with adjustable front and rear EIA 19" rail kits, enclosed with ventilated front and rear locking doors, adjustable leveling feet, vertical cable manager for one rail, and grounding kit. Cabinets shall be set directly on the finished floor but not bolted unless set on a raised floor. Adjacent cabinets shall be bayed together with the sides removed.

(3) Acceptable Manufacturers:

(a) Chatsworth Products Industries (CPI)

(b) Cooper/B-Line

(c) APC

(d) Approved equivalent.

B. Overhead Cable Support

(1) Construction: Overhead Cable Management shall be 18-inch (MDF) or 12-inch (IDF) Universal Cable Runway made of 3/8" x 1-1/2" x .065" wall rectangular steel tubing with cross members welded at 12 inch intervals. Cable Runway shall be installed utilizing appropriate hardware to support, join, or attach sections to structures, and shall be supported at a minimum of 5 foot intervals.

(2) Acceptable Manufacturers:

(a) Chatsworth Products Industries (CPI)

(b) Cooper/B-Line

(c) Approved equivalent

C. Vertical Cable Managers

(1) Vertical cable managers shall be black double-sided, 6 inches wide, 12.75 inches deep, and 84 inches tall, no doors, and include formed cabling sections, lockable cabling latches at 12-inch intervals, and protective edge guards. Bolt vertical cable managers to the racks with included hardware kit.

(3) Acceptable Manufacturers:

(a) Chatsworth Products Industries (CPI)

(b) Approved equivalent

D. Horizontal Cable Managers

(1) Horizontal cable managers shall be black double-sided, 19 inches wide, 11.73 inches deep, and 2 RMU, cable guide fingers at 1.75" intervals, flanged pass-through slots, and snap-on, hinged door/cover. Attach horizontal cable managers to the rack rails with included screws.

(3) Acceptable Manufacturers:

(a) Chatsworth Products Industries (CPI)

(b) Approved equivalent

E. Category 6 Patch Panels

(1) Rack-mounted modular patch panels shall be provided and installed within the MDF and each IDF-1 and IDF-2 room as indicated on the project plans. Patch panels shall be rated EIA/TIA Category 6 providing 48-port RJ-45 terminations.

(2) Acceptable Product:

(a) Leviton 69586-U48

(b) Approved equivalent

F. Lightning Protectors

(1) Protector Terminal Blocks

(a) Construction: Protector terminal blocks shall be 50-pair, suitable for use with plug-in, 5-pin solid state tube protectors. Blocks shall be equipped with 110 in and 110 out IDC connectors.

(b) Protector shall be Circa 1880ENA1/NSC-50 or approved equivalent.

(2) Protector Modules

(a) Construction: Protector Modules shall be plug-in, 5-pin type solid state units and shall be installed on each incoming copper backbone cable pair, whether active or spare.

(b) Acceptable Products: Protectors shall be solid-state type units for all cable pairs to be used for data transmission; Circa 3B1S-300 or approved equivalent.

G. Copper Backbone Termination Blocks

(1) Construction: Termination blocks shall be 4 row disconnect type with punch down clips. Blocks shall be basic, non-connectorized type with 100 two-prong clips.

(2) Mounting: All termination blocks shall be mounted on metal panels or backboards, equipped with 4 type 89B brackets. Panels shall be AT&T 183A1 style or approved equivalent and be the industry standard color for the type of service. Panels shall be securely fastened to plywood telephone backboard(s) in IDF rooms.

(3) Acceptable Products:

(a) Leviton GigaMax 5e Series 50-pair, PN 41AW1-050

(b) Approved Equivalent.

H. Wall-mounted Workstation Outlets

(1) Construction: Outlets shall be of modular component design. Each outlet shall consist of a modular faceplate, either Leviton 42080-4IP at 2 or 4 port outlet locations or Leviton 42080-8IP at 6 or 8 port outlet locations, installed on an existing 4" square outlet box with snap-in modular jack inserts for the termination of the horizontal Category 6 cables. Modular jack inserts shall be:

(a) Acceptable Products

1. Category 6 data module, gray, Leviton 61110-RG6

2. Blank module covers, Leviton 41084-BIB

3. Approved Equivalent

(2) Refer to T-Drawings for outlet locations.

I. Floor-mounted Workstation Outlets

(1) Construction: Outlets shall be of modular component design. Each outlet shall consist of a custom faceplate installed in a floor outlet box with snap-in modular jack inserts for the termination of horizontal Category 6 cables (refer to electrical section for floor box and duplex outlet specifications). Modular jack inserts shall be:

(a) Acceptable Products

1. Category 6 data module, gray, Leviton 61110-RG6

2. Blank module covers, Leviton 41084-BIB

3. Approved Equivalent

(2) Refer to drawings for outlet locations.

J. Ceiling-mounted Workstation Outlets

(1) Construction: Outlets shall be of modular component design. Each outlet shall consist of a 2-port Leviton 41089-2IP surface mount box with snap-in modular jack inserts for the termination of horizontal Category 6 cables. Modular jack inserts shall be:

(a) Acceptable Products

1. Category 6 data module, gray, Leviton 61110-RG6

2. Blank module covers, Leviton 41084-BIB.

(2) Refer to T-Drawings for outlet locations.

K. Fiber Optic Distribution Centers / Termination Housings

(1) Fiber Optic Distribution Centers shall be self-contained, rack-mountable units suitable for the termination, splicing, and distribution of fiber optic cables. Each unit shall consist of a cabinet and a suitable number of splice trays and connectors to terminate the specified number of fiber strands.

(2) The cabinet shall consist of a factory painted steel casing and contain the necessary hardware to allow rack mounting.

(3) Distribution centers shall contain splice trays to allow fusion splicing of the specified number of fiber strands.

(4) Distribution centers shall contain fiber optic coupler panels to facilitate the connection of patch cables to the fiber optic strands.

(4) Connectorized fiber pigtails shall be provided between the splice trays and the connector panels. Coupler Panels and Connectors shall be **LC** type, with an insertion loss of not greater than 0.3 dB. Connectors and pigtails shall match the fiber size and mode type of the cable strands to which they are spliced. Connectors of like type (single-mode or multi-mode) shall be grouped onto common coupler panels.

(5) Acceptable Products:

(a) Corning Closet Connector and Splice Housing (CCS) Series.

(b) Approved equivalent.

L. Fiber Optic Connectors

(1) Fiber optic connectors shall be small form factor (**LC**-type) for single mode and multi-mode fiber optic cables. Connectors shall have an insertion loss of not greater than 0.3 dB per connector.

(2) Loose tube fibers shall be terminated using spliced pigtails or directly connectorized with the addition of fan-out tubing or per the Manufacturer's recommended method of termination.

(3) The connector shall be rated by the Manufacturer to withstand at least 1,000 couplings with a variance in insertion loss within $\pm$ 0.25 dB.

(4) The connector shall enclose the outermost coating of the single fiber strand and be able to be mated or unmated without using any tool. The connector shall be field installable.

(5) Acceptable Products:

(a) Corning

(b) Approved equivalent

M. Video Coaxial Cable Connectors, Type "F" (when applicable)

(1) Connectors shall be used on RG 6 video drop coax cable.

(a) Connectors shall be two-piece compression type "F" rated for regular indoor use. Connectors shall be for use with and match the cable requirements specified for RG 6 coax cable per this specification.

(b) Acceptable Products:

1. Gilbert GF-UE-6 or GF-UE-6Q

1. Approved equivalent

N. Innerduct

(1) Non-metallic, flexible raceway system manufactured specifically for routing of fiber optics cables. The raceway system shall be suitable for use in underground ducts. It should exhibit low smoke generation and flame spread characteristics, and have a very high temperature service tolerance and UV resistance. Overall construction shall be of corrugated PVC material.

(2) Tensile strength at yield shall be at least 10,800 pounds per square inch.

(3) Elongation at break shall be at least 25%.

(4) Acceptable Manufacturers:

(a) Carlon

(b) Pyramid

(c) Approved equivalent.

O. Firestop Material

(1) Firestopping shall be a material, or combination of materials, installed to retain the integrity of time-rated construction by maintaining an effective barrier against the spread of flame, smoke, and gases. It shall be used in specific locations as follows:

(2) Firestopping materials shall be asbestos free and capable of maintaining an effective barrier against flame, smoke, and gasses in compliance with requirements of ASTM E 814, and UL 1479. Only listed firestopping material acceptable to the City of San Antonio Fire Marshal shall be used within each of the following conditions:

(a) Duct, cables, conduit, piping, and cable tray penetrations through floor slab and through time-rated partitions or fire walls.

(b) Openings between floor slab and curtain walls, including inside hollow curtain walls at the floor slab.

(c) Penetrations of vertical service shafts.

(d) Openings and penetrations in time-rated partitions of fire walls containing fire doors.

(e) Locations where specifically shown on the drawings or where specified in other sections of the project manual.

(f) The rating of the installed firestop system shall in no case less than the rating of the time-rated floor or wall assembly.

(3) Description.

(a) Elastomeric silicone materials by Dow Corning.

(b) Elastomeric, intumescent materials by 3M Brand Fire Barrier.

(c) Asbestos-free, semi-refractory fiber material by Fibrex.

(4) Acceptable Products.

(a) Manufacturers acceptable contingent upon products' compliance with the specifications and City of San Antonio requirements:

1. 3M Brand Caulk CP-25.

2. 3M Brand Putty 303.

3. 3M Brand Wrap/Strip FS-195.

4. 3M Brand Composite Strip CS-195.

5. 3M Brand Penetrating Sealing Systems 7900 Series.

6. Dow Corning Fire Stop Foam, liquid component Part A (black) and liquid component Part B (off-white).

7. Dow Corning Fire Stop Sealant.

8. Fibrex Safing Insulation.

(b) Damming Materials permitted are those products compatible with the above materials as certified by the manufacturer in their respective published data.

P. Grounding Busbars

(1) Grounding Busbars shall be constructed of hard-drawn electrolytic tough pitch 110 alloy solid copper and be in accordance with ANSI-J-STD-607-A. Hole patterns on Busbars shall accommodate two-hole lugs per the recommendation of BICSI and ANSI/EIA/TIA-607. Mounting brackets shall be manufactured from high-quality 300 series stainless steel. Mounting holes shall be 3/8" diameter spaced 5.75" apart. Busbar shall be 4”W x 1/4”H x 20”L for TMGB and 2”W x 1/4”H x 10”L for TGBs. Ground bars shall be furnished with wall mounting brackets for attachment directly to plywood backboards unless otherwise shown on the drawings.

(5) Acceptable Manufacturers:

(a) Chatsworth Products Inc (CPI)

(b) Approved equivalent

2.7 Labeling Products

A. Label all applicable cables and components with a self-laminating vinyl industrial grade marking system. Labels shall be machine/electronically produced; hand written labels will not be accepted. Size used shall be in accordance with the cable or component to be marked. Font shall be no smaller that 12pt in any case.

3.0 E X E C U T I O N

3.1 Installation Requirements - Contractor shall:

A. Furnish all labor, materials, equipment, tools, utilities, and services necessary for the proper execution and completion of a standards-compliant Telecommunications Cabling System, regardless if specifically enumerated in this specification

B. Acquire all required permits and give notice to all agencies requiring advance notification and comply with all regulations specified by all governing agencies having jurisdiction over the performance of the work.

C. Coordinate with Owner's representative to insure that any interference or interruptions of Owner's operations are anticipated and scheduled.

3.2 Installation Methods

A. General - Contractor shall:

(1) Install an integrated cabling system infrastructure as detailed by the contract drawings, details, and specifications. Where specific cable layout and locations are detailed it is the contractor's responsibility to install as specified or provide complete information justifying alternatives before installation.

(2) Use the maximum possible bending radius on all cables during installation. Minimum-bending radius of the cable per the manufacturer's specifications shall always be maintained.

(3) All cables shall be continuously lubricated during the pulling-in process. Maximum pulling tensions specified by the cable manufacturers shall not be exceeded. Monitor cable-pulling tension with a mechanical tension-meter.

(4) Use tools and equipment specifically designed for the purpose. The contractor shall implement installation practices that insure the highest quality installation. Contractor shall make all cutting, splicing, pulling and termination of cables using equipment specifically designed for that purpose.

(5) Install hook and loop tie wraps using a tension controlling cutting device to prevent over-tightening. Tie wraps and other securing hardware shall be rated as required for the installation environment (i.e.; tie wraps will be approved for use in a plenum area when installed in a return air space).

(6) Fill cable tray or conduit with cables with the following guidelines:

(a) Where cable trays or conduits are stacked, fill the top raceway to its maximum fill ratio first and then move to the next raceway below it and so on.

(b) Where multiple conduits are being used, fill one conduit to its maximum fill ratio before going onto the next conduit. Wherever possible, leave as many spare conduits available as possible.

(c) The maximum fill ratios for typical raceway supporting communications cabling are as follows:

Ladder type cable tray	50%
Solid bottom cable tray	40%
EMT type conduit	40%.

(d) All spare conduits or conduits filled with less than the maximum allowed fill ratio shall have a pull string installed and left for future pulling in of cable. Clearly label as "pulling line" indicating opposite end location.

(e) All telecommunications outlets shown on the plans shall be served with a dedicated 1" conduit from the nearest cable tray.

(7) Install the telecommunication cabling system as detailed in the contract drawings in the location and layout shown.

(8) Install cable trays in accordance with NEC Article 318 and manufacturers' recommendations.

(9) Install connectors in conformance with manufacturer recommended stripping and crimping procedures. Use special tools designed for this purpose.

(10) Label all cables at both ends. The label shall be permanent. Labels shall be typed (not handwritten) and individual number strips are unacceptable. All cable labeling shall include numeric designation, source, destination, and cable type.

(11) All boxes and outlet plates shall be installed neatly and square with floor and walls.

(12) Installations shall conform strictly with the TIA/EIA Telecommunications Building Wiring Standards to ensure a quality system that meets the transmission rate criteria.

(13) All recyclable packaging material, boxes, and waste shall be recycled or deposited in an approved recycling container.

B. Fiber Optic Cable Installation

(1) The fiber optics raceway system must be continuous between pull boxes and junction boxes. Raceway components and inner duct must enter and be secured to all endpoint enclosures.

(2) The fiber optics raceway system shall be routed with largest bend radius possible. Bends in the fiber optics raceway system shall be accomplished with large radius pre-formed ells. Field bending shall be in accordance with NEC minimum radii

requirements. Use only equipment specifically designed for the material and size involved.

(3) The entire fiber optics raceway system shall be complete and the raceway interior cleaned prior to the installation of the fiber optics cables.

(4) Securely fasten the fiber optics raceway to the cable tray, or walls when routed inside buildings, using clamps and clips designed for this purpose.

(5) Provide a nylon or polyethylene pulling line in all fiber optics raceways. Clearly label as "pulling line", indicating opposite end location.

(6) Openings around fiber optics raceway penetrations shall maintain the fire resistance rating required. See NEC 300-21.

(7) All fiber optics cables are to be run as efficiently as possible, minimizing the amount of cable required.

(8) All fiber optics cables shall be continuously lubricated during the pulling-in process. The maximum pulling tensions specified by the cable manufacturers shall not be exceeded. Monitor cable pulling tension with a mechanical tension meter.

(9) Fiber optics cables passing through pull boxes shall be neatly arranged to afford maximum clearance between the several cable types within the box.

(10) As fiber optics cables emerge from intermediate-point pull boxes, coil the cable in a figure eight pattern with loops not less than two feet in diameter.

(11) Label all fiber optic cables at both ends in accordance with the Alamo Colleges Telecommunications Infrastructure Standard. The label shall be permanent. Labels shall be typed (not handwritten) and individual number strips are unacceptable. All cable labeling shall include numeric designation, source, destination, and cable type as per the drawings or shall minimally meet the labeling requirements of TIA/EIA 606 – Administration Standard for Commercial Telecommunications Infrastructure.

(12) Fiber optics raceways shall be clearly marked at each pull box indicating type and number of cables within.

C. Firestopping

(1) Clean surfaces to be in contact with firestopping materials of dirt, grease, oil, loose materials, rust, or other substances that may affect proper fitting of the required firestop system.

(2) Install firestopping materials as indicated, in accordance with manufacturers instructions.

(3) Seal all holes or voids made by penetrations to ensure an effective smoke barrier.

(4) Unless protected from possible loading or traffic, install firestopping materials in floors having void openings of 4 inches or more to support the same floor load requirements.

(5) Examine firestopped areas to ensure proper installation prior to concealing or enclosing firestopped areas.

(6) Areas of work shall remain accessible until inspection (and approval) by the applicable code authorities.

3.3 Cable and Raceway Marking

A. Provide legible and indelible marking on all cables during installation.

B. Enclosed raceways shall be clearly marked at each pull box indicating type and number of cables within.

3.4 Grounding

A. Cabling Contractor shall provide and place specified copper ground bars, and cables to provide a common single-point termination of all ground conductors for the telecommunications cabling system bonded to the Building Electrical Service Entrance ground in accordance with ANSI-J-STD-607-A.

B. All equipment racks, cabinets, enclosures, and equipment within the MDF and each IDF shall be connected to the grounding system using #6AWG insulated copper conductor. The Telecommunications Grounding Busbars shall be bonded to the Telecommunications Main Grounding Busbar with #3/0 AWG insulated copper conductotr. Manufactured connectors, bonding straps, and/or ground lugs, designed for the purpose of securely bonding each busbar, rack, cabinet; section of cable runway and other required telecommunications appurtenances to the facility grounding system shall be utilized.

C. Ground wire shall be placed within cable tray and runway to avoid sharp bends and areas where the cable may be damaged in the course of reconfiguring termination equipment, ongoing maintenance, or traffic within the space. Cable runway or ladder rack sections shall be bonded together utilizing a copper bonding jumper securely attached to each section utilizing a star washer or other similar device to insure electrical continuity exists between the metal surfaces.

3.5 Testing

A. Testing and Measurement Equipment

(1) The Cabling Contractor shall provide all tools and test equipment required for testing. Test equipment will be maintained in an accurate calibration and will display the dates of the last calibration and next scheduled calibration. Test equipment shall be fully charged prior to each day's testing. Test instrument shall be Level-III compliant.

(2) Example of acceptable test equipment is Fluke DSP-4000.

B. Reports

(1) Test results shall document each installed cable pair for pass/fail, problems encountered in the case of a failure, and the procedure required to result in a cleared pair. Test reports shall be submitted in hardcopy and electronic format. Hand-written test reports are not acceptable. All test documents shall be dated and signed by the personnel performing the testing.

(2) Hardcopy reports shall be submitted in labeled 3 ring binders with an attached affidavit verifying passing execution of all tests. Hardcopy summary reports shall contain the following information on each row of the report: circuit ID, test specification used, length, date of test, and pass/fail result.

(3) Electronic reports shall be submitted on CD format. If proprietary “reader” software is required, disk or CD shall contain the necessary software required to view the results. If the results are delivered in a standard format like Excel, Access, CSV, .pdf files, etc. then software to read these files need not be provided. Electronic reports must be accompanied by a Certificate signed by an authorized representative of the Contractor warranting the truth and accuracy of the electronic report. Certificate must reference traceable circuit numbers that match the electronic record.

(4) The Cabling Contractor shall provide (2) copies of the complete test report to the Designer and Owner within one (1) week of completion of the testing.

C. Copper Cable.

(1) All twisted pair cable shall be tested for continuity, crosses, shorts and grounds, and to ensure that pin-outs are in accordance with the drawings and these specifications. Test results shall document each installed cable pair for pass/fail, problems encountered in the case of a failure, and the procedure required to result in a cleared pair.

(2) All installed horizontal station cabling must minimally meet the performance specifications as outlined in ANSI/TIA/EIA-568C.1 and C.2 for Category 6 compliance. These tests shall be performed in a swept frequency manner from 1 MHz to 250 MHz or the highest relevant frequency, using a swept frequency interval that is consistent with TIA and ISO requirements.

(3) Information shall be provided for all pairs or pair combinations and in both directions when required by the appropriate standards. Any individual test that fails the relevant performance specification shall be marked as a FAIL. Test results shall document for each installed cable pair the measured quantities listed below, any problems encountered in the case of a value being unacceptable, and the procedure required to result in a compliant link.

(a) Continuity, Shorts/Crosses, Grounds, Opens, Split Pairs

(b) Pair Map

(c) Length

(d) Resistance and Attenuation

(e) NEXT and PSNEXT

(f) ACR and PSACR

(g) ELFEXT and PSELFEXT

(h) Return Loss

(4) Contractor shall perform in-progress testing to reveal any faults in the voice/data cable system installation. Contractor shall perform standard tests for correct station identification and termination.

D. Fiber Optic Cable

(1) Pre-Installation Testing. The Contractor shall ensure the integrity and serviceability of all new cable prior to installation. This assurance may be provided by using vendor verification documents, testing, or other methods selected by the Cabling Contractor. As a minimum for the fiber optic cable, the Contractor must supply evidence of verification for attenuation and bandwidth parameters.

(2) In-Progress Testing. Standard tests for correct fiber identification and termination shall be performed during the installation to ensure proper installation and cable placement. Owner and/or Designer may, at their discretion, perform tests in addition to those specified herein if there is any reason to question the condition of the material as furnished or installed. All testing accomplished shall be documented by the party conducting the test. These test results shall be submitted to Owner and/or Designer.

(3) Final Testing. A final test of the working installed fiber optic system shall be performed to demonstrate the acceptability of the project as installed. Testing shall be performed in accordance with a test plan supplied by the Cabling Contractor and approved by Owner and Designer. The Contractor shall furnish all labor, equipment, and instruments required to conduct the test. Any defective workmanship or material shall be corrected by the Cabling Contractor and re-tested. As a minimum, final testing for the fiber optic cable system, including spare cable, shall verify the conformance of attenuation, length, and bandwidth parameters with the performance specifications and meet or surpass all related portions of ANSI/TIA/EIA-568B.3.

(4) An optical Light Source and Power Meter such as Corning Optical Meter/Source Model LTK-400 or approved equivalent shall be employed for the testing of signal strength and optical connectivity.

(5) The Contractor shall be responsible for recording all test results and shall submit copies of these test results to the System Designer for review prior to acceptance.

(6) Testing Procedures

(a) On short links of less than 330 feet, continuity of each fiber shall be verified by inserting a measured light source at one end of the fiber and measuring the intensity of light using a power meter at the opposite end of the fiber.

(b) An end-to-end (including all connectors, filers, and jumpers) attenuation test shall be performed on all fiber strands by comparing the optical power at the input of a fiber with the output. This shall be accomplished by Insertion Loss Testing using a "one jumper reference" to include the connector losses. Testing shall be in accordance with EIA-455-53.

(c) This tested actual loss value shall be compared to the theoretical loss calculated using the following attenuation criteria:

LC Type connectors (per mated pair):

Multi-mode - 0.5 dB
Single-mode - 0.8 dB

Fiber cable:

Multi-mode - Manufacturer claimed loss of installed cable

Single-mode - Manufacturer claimed loss of installed cable

OSP Single-mode - Manufacturer claimed loss of installed cable

(d) The Contractor shall calculate the theoretical loss using installed cable lengths, compare and contrast this loss with the actual measured loss for each fiber, and submit these test results and comparisons to the Owner for review.

(e) If the actual loss exceeds the theoretical loss then the fiber shall be considered to have failed the acceptance criteria. Contractor shall, at the System Designer's direction, perform one of the following based on the requirements of the system and project schedules:

1. Re-test to insure accurate readings from the first test. Both results shall be shown in the test results with the remedy performed resulting in acceptable value.

2. Properly isolate the fiber from use in the system. Under no circumstances shall the remaining quantity of fibers be less than the specified amount.

3. Replace the defective fiber optic cable.

E. Coaxial cable

(1) The contractor shall perform pre-installation tests and in-progress tests in addition to the final acceptance test. Pre-installation testing shall be performed if the materials inspection uncovers damage. A qualified technician, provided by the contractor shall perform, but is not limited to, Time Domain Reflectometry (TDR) tests on any suspect cable and performance testing on any suspect equipment.

(2) The contractor shall also perform in-progress tests for serviceability during splicing and connection equipment to determine if any faults have developed during the cable installation and continuity tests on all cable after installation but before splices are sealed and equipment cases closed to include opens and shorts. TDR tests shall be performed on any cable that may have been damaged during installation.

(3) The contractor shall perform final acceptance tests to demonstrate the acceptability and performance of the system.

- END -

CAMPUS MDF		SD	CD	100%
ARCHITECTURAL				
A.C-MDF.1	Minimum of 600 square feet, minimum clear lineal wall length 30 feet	☐	☐	☐
A.C-MDF.2	Walls to deck	☐	☐	☐
A.C-MDF.3	Floor sealed bare concrete	☐	☐	☐
A.C-MDF.4	No windows	☐	☐	☐
A.C-MDF.5	Exterior wall within 50 feet of building exterior	☐	☐	☐
A.C-MDF.6	Not be located adjacent to or below restrooms or other water-based facilities	☐	☐	☐
A.C-MDF.7	Not be located near or sources of EMI and mechanical vibration	☐	☐	☐
A.C-MDF.8	All walls covered with plywood	☐	☐	☐
A.C-MDF.9	Without a ceiling or a lift-out tile ceiling	☐	☐	☐
A.C-MDF.10	Minimum 42-inch by 80-inch clear door opening	☐	☐	☐
A.C-MDF.11	Door not open to the exterior of the building	☐	☐	☐
A.C-MDF.12	Proximity card reader and electrified door hardware	☐	☐	☐
A.C-MDF.13	At least (1) camera	☐	☐	☐
A.C-MDF.14	Sprinkler system, consider pre-action	☐	☐	☐
HVAC				
H.C-MDF.1	Dedicated unit that is part of the building's main system	☐	☐	☐
H.C-MDF.2	Maintain a constant 24/7 cooled environment between 68° and 75° F	☐	☐	☐
H.C-MDF.3	Humidity of 41.9°F Dew Point to 60% RH and 59°F Dew Point	☐	☐	☐
H.C-MDF.4	Minimum HVAC load shall be designed to displace 20KW of power, or 6 Tons	☐	☐	☐
H.C-MDF.5	Maintain temp and humidity in the event of building power outages or main unit failure	☐	☐	☐
LIGHTING				
L.C-MDF.1	Minimum of 40 foot candles at 2 feet above the floor in the entire space	☐	☐	☐
L.C-MDF.2	Equipped with emergency lighting to keep the space lit during power outages	☐	☐	☐
L.C-MDF.3	Fixtures 18 inches above top of the highest rack or cable runway	☐	☐	☐
ELECTRICAL				
E.C-MDF.1	(2) dedicated 208 volt 3-phase 150 Amp circuits, 4-wire (2PH + N +G), hardwired to the UPS(s)	☐	☐	☐
E.C-MDF.2	Originating electrical panel will be equipped with (2) 150 AMP breakers	☐	☐	☐
E.C-MDF.3	Minimum of (1) APC Symmetra LX 16kVA Scalable to 16kVA N+1	☐	☐	☐
E.C-MDF.4	Ext. Run Tower, 208/240V to provide 30 minutes of run time at full load	☐	☐	☐
RACKS AND CABLE MANAGEMENT				
R.C-MDF.1	(4) Standard Equipment Racks	☐	☐	☐
R.C-MDF.2	Vertical cable manager on both sides of the rack	☐	☐	☐
R.C-MDF.3	Horizontal wire manager above and below each horizontal patch panel	☐	☐	☐
R.C-MDF.4	(2) Server Cabinets	☐	☐	☐
R.C-MDF.5	Space shall be allocated for an additional (7) future Server Cabinets	☐	☐	☐
R.C-MDF.6	Space equivalent to (2) Server Cabinets shall be allocated for service provider equipment	☐	☐	☐
R.C-MDF.7	Cable runway encircling the room at 86 inches above the finished floor	☐	☐	☐
R.C-MDF.8	Cable runway crossing the room parallel to the rack rows (3) times	☐	☐	☐
R.C-MDF.9	Vertical section of cable runway from the entrance conduits to the overhead cable runway	☐	☐	☐