

EDIT NOTES:

1. **LAUSD INFORMATION TECHNOLOGY DIVISION IS THE ONLY AUTHORITY FOR CHANGES OR MODIFICATION OF THIS SPECIFICATION. NO CHANGES OR MODIFICATION SHALL BE MADE WITHOUT SPECIFIC WRITTEN AUTHORIZATION OF ITD.**
2. **BOLDED SECTIONS AND TEXT IN BOXES MUST BE REMOVED PRIOR TO ASSEMBLING PROJECT MANUAL.**
3. **USE THIS SPECIFICATION FOR NEW FACILITIES DESIGNED UNDER THE 2006 AND PRIOR DESIGN GUIDES, AND FOR EXISTING FACILITIES WITH 62.5 MICRON MULTIMODE OPTICAL FIBER BACKBONES AND CATEGORY 5 OR 5E UTP CABLES.**

SECTION 27 1013

STRUCTURED CABLING (EXISTING SITES)

EDIT NOTE: IT IS PROHIBITED TO MIX 50 MICRON AND 62.5 MICRON MULTI MODE OPTICAL FIBER ON THE SAME PREMISE. LIKEWISE, IT IS PROHIBITED TO MIX CATEGORY 5E AND CATEGORY 6 UTP CABLE AND RELATED HARDWARE TERMINATIONS. MODIFICATIONS OR ADDITIONS TO ANY CABLE PLANT MUST USE THE SAME CABLE TYPES USED FOR THE ORIGINAL CABLE PLANT. USE SPECIFICATION 27 1014 FOR ADDITIONS AND MODIFICATIONS TO CABLE PLANT FACILITIES WITH 50 MICRON MULTI MODE OPTICAL FIBER AND CATEGORY 6 UTP CABLING.

PART 1 - GENERAL

1.01 SUMMARY

- A. This specification describes the equipment provisioning, installation, integration, configuration, testing, and documentation of wiring/cabling and associated pathways for Local Area Networks, Signal Terminal Cabinets, and Telephone systems at the Los Angeles Unified School District (LAUSD). This specification uses 62.5 micron multi mode fiber and Category 5E UTP cable and shall be used for additions and modifications at facilities already using the same type of cable plant. Pertinent sections are broken down to reflect the requirements for each system individually.
 1. Comply with individual system specifications.
- B. Principal items of Work in this Section shall include labor and materials that consist of provisions, installing, terminating, testing, and documenting a complete and fully

functional communications structured cabling system. The work shall include the following:

1. Local Area Network Wiring:
 - a. The installation of either new LAN cabling or additional LAN cabling. Segments, new installations, and/or modifications shall not interfere with or disable any portion of existing, working LANs.
 - b. Provide a plan that includes coordination of required installation efforts with the Telecommunication and CATV Access Providers. This includes installation of new duct banks and vaults for telecommunications cable for Telecommunications and CATV.
 - c. Provide rack space to allow a 50 percent expansion of the number of network data drops provided at the time of initial configuration. This includes space for additional structured cable components as well as active Ethernet equipment. Calculate rack space for one 24 port switch per 20 Category 5E drops in IDFs and LDFs. Allow two rack units (1.75 inches per RU) per switch.
 - d. Conduct underground survey to ensure constructability of outside plant pathway routing.
 - e. Provide exterior and interior optical fiber and copper cabling. LAUSD uses a centralized optical cabling system in accordance with ANSI/TIA 568-C standards. Cabling system colors shall be coordinated using consistent colors for the same type of cabling as indicated elsewhere in this specification.
 - f. Install and connect Owner Furnished, rack mounted uninterruptible power supplies and Ethernet switches in equipment cabinets at locations with active equipment.
 - g. Furnish and install cabinets/racks, vertical power strips, cable trays and cable management at the MDF.
 - h. Furnish and install modular T-568-B patch panels for termination of UTP within the MDF, IDF, and LDF. Use fiber patch cabinets for fiber optic cable terminations located in the MDF, IDF, and LDF where copper drops are provisioned.
 - i. Furnish and install connectors and faceplates and terminate cable as specified.
 - j. Provide high impact plastic wall and/or faceplate covers and connector housings for communication systems outlet locations.

- k. Provide contiguous (home run cables with service loops) optical fiber and copper backbone, link and distribution cables. No splices are permitted between designated termination points.
- l. Furnish and install floor mounted equipment racks, with required CBC Seismic Design rated seismic bracing and associated accessories in telecommunications spaces where required.
- m. Furnish and install grounding and bonding of communications components per the CEC.
 - 1) Telecommunication Entrance Facilities, Minimum Point of Entry locations, and MDF locations shall be equipped with a telecommunications main grounding busbar or telecommunications grounding busbar as appropriate to the installation environment.
 - 2) Grounding Equalizers or Telecommunications Bonding Backbone Interconnecting Bonding Conductors are not required except in buildings exceeding two occupied stories which use building steel to ground electrical service panels.
 - 3) In buildings with two stories or less, where electrical panels are grounded using CEC compliant grounding conductors directly connected to the building ground electrode, IDFs, and LDFs equipment chassis; associated peripherals shall use local panel ground via the equipment branch circuit grounding conductor.
- n. Furnish and install full labeling of the entire installation prior to testing in accordance with Article 3.04 paragraph C of this specification.
- o. Premise cable shall be tested in compliance with Specification 27 0126. Testing of each LAN optical fiber element and connector with Power Meters and OTDR. For multi-pair copper communications cable, test pairs within counts and binder groups to ensure that no less than 99 percent of the pairs of a multi-pair cable achieve continuity and operation in voice band tests. For Category 5E copper cable, test and certify 100 percent of drops using test equipment certified for Level IIE test equipment.

2. Telephone Systems Wiring:

- a. Install and connect Owner furnished telecommunications equipment cabinet, attendant consoles, and telephone instruments as indicated on Drawings or in Scope of Work.

- b. Furnish, install, and connect ground wire and power supplies as specified and/or required. Coordinate provision of dedicated power outlets.
- c. Furnish and install connecting wiring and modular jacks to each individual phone location as indicated on Drawings. This also includes necessary cross connect blocks and cross connect wiring in cabinets/racks, as necessary to provide for functions and requirements specified. Cables shall be installed in conduits, cable trays, or raceways unless indicated otherwise on Drawings. Cabling system colors shall be coordinated using consistent colors for the same type of cabling as described in Article 2.04 of this specification.
- d. Provide and install pathway and inside cabling from the MDF to the Minimum Point of Entry (MPOE) and install pathway from MPOE to the property-line Public Switch Telephone Network demarcation.
- e. Provide infrastructure and facilities for interfacing the site's telecommunications infrastructure with public utilities telephone lines at the MPOE. Provide underground telephone service conduit from public utility serving location to main telephone terminal as indicated on Drawings and in compliance with requirements of access provider.
- f. Coordinate the installation and location of surge-protected outlets in equipment cabinets and enclosures where active equipment is scheduled.
- g. Furnish and install 110 type telephone punch blocks at PBX location using multi-pair cable for interconnection to the MDF and IDFs, as required.
- h. Provide coordination, testing, materials, and components required to provide a complete and operational installation.

C. Related Requirements:

- 1. Section 00 7000: General Conditions.
- 2. Division 01 - General Requirements.
- 3. Section 01 7700: Contract Closeout.
- 4. Section 06 1000: Rough Carpentry.
- 5. Section 26 0500: Common Work Results for Electrical.
- 6. Section 26 0513: Basic Electrical Materials and Methods.

7. Section 26 0526: Grounding and Bonding.
8. Section 26 0533: Raceways, Boxes, Fittings, and Supports.
9. Section 26 2416: Panelboards and Signal Terminal Cabinets.
10. Section 26 5000: Lighting.
11. Section 26 5200: Emergency Power Systems.
12. Section 27 0536: Cable Trays for Communications.
13. Section 27 4134: Television Systems – Coaxial Distribution.
14. Section 27 4135: Television Systems -Fiber Optic Distribution.
15. Section 27 5116: Public Address and Intercommunication Systems.
16. Section 27 5127: Public Address Systems (Small Gyms, Multipurpose Rooms) (ES).
17. Section 27 5128: Public Address Systems (Auditoriums, Performing Art, M-P Rooms) (MS and HS).
18. Section 27 5129: Public Address Systems (Gymnasiums).
19. Section 27 5130: Public Address Systems (Athletic Fields).
20. Section 28 1600: Intrusion Detection Systems.
21. Section 28 2313: Video Surveillance Systems (New Facilities).
22. Section 28 2314: Video Surveillance Systems (Existing Facilities).
23. Section 31 2323: Excavation and Fill for Utilities.

D. Acronyms: See Appendix 1.

E. Definitions: See Appendix 2.

1.02 SYSTEM REQUIREMENTS

EDIT NOTE: SPECIFICATION 27 0126 MUST ACCOMPANY THIS SPECIFICATION.

A. Local Area Networks:

1. This specification describes the design, installation, testing, and documentation of elements for premise wiring installations and should be read in conjunction with other applicable divisions and sections of the contract documents. Furnish

labor, supervision, tooling, miscellaneous mounting hardware, and consumables, including patch cables, for systems installed; in addition, provide construction and integration services to achieve connectivity for classrooms, computer laboratories, libraries, instructional areas, offices, and work areas, as specified by the LAUSD point of contact. Provide necessary labor and materials for a complete and operable installation.

B. Signal Terminal Cabinets:

1. Terminal cabinets shall be flush type, with two-inch trim or surface mounted type, as indicated on Drawings. Terminal cabinets shall be furnished with sections and barriers to separate each system. Sections over 24 inches in width shall be provided with double doors and locks. Terminal cabinets shall measure 12 inches wide by 18 inches high by 5 ¾-inches deep, unless otherwise indicated on Drawings. Trims for sectional cabinets shall be of one-piece construction.
2. Terminal cabinets shall be furnished with 3/4-inch thick plywood backboards within cabinets, fastened in place with machine screws. Backboards shall be largest size that cabinet and conduit terminations will permit.
3. Flush-mounted terminal cabinets shall be finished as specified for flush-mounted panelboard cabinets. Surface and semi-flush mounted terminal cabinets shall be finished as specified for surface-mounted panelboard cabinets.
4. Terminal Cabinets for exterior Ethernet drop locations shall be NEMA Type 3R continuous hinge cover enclosure with a pad lockable draw pull catch or cylinder lock on the opposite side. The enclosure and cover shall be built of 16 gage galvanized steel and shall carry a NEMA 3R rating. The enclosure shall be large enough to fit a weatherproof single gang deep box and an industrial type Category 5E patch cord 10 feet long as described in paragraph 2.02.N. of this specification. Provide a padlock or cylinder lock keyed to Corbin CAT 80 for each enclosure.

C. Telephone Systems:

1. The scope of this specification covers the conduits and supporting structure for system's cables but not the placement, installation, or termination of cables. These cables connect to the patch panel(s) either by means of Amphenol connectors or punch down connections. Cables shall be designated as follows:

CABLE DESIGNATION	
TYPE	DESCRIPTION
A	Service entrance cables installed by the service provider.
B	Interior grade, multi-pair PVC cables. To be terminated on 110-type blocks.
C	Interior PVC, multi-pair cables, or exterior shielded cables for installation on buried conduit.
D	Category 5E or 6 cables terminated on the patch panel on one end, and on an RJ-45 wall jack insert on the other end.

1.03 SUBMITTALS

- A. Materials list of items proposed to be provided under the specification.
- B. Furnish catalog cuts, technical data, and descriptive literature on components. Data shall be clearly marked and noted to identify specific ranges, model numbers, sizes, and other pertinent data.
- C. Shop Drawings shall indicate equipment locations, wiring and schematics, details, panel configurations, sizes and a point-to-point wiring diagram of circuits. Shop Drawings shall indicate interfaces to equipment furnished by others, identifying numbers of wires, termination requirements, and other pertinent details. Responsibility for each end of interfaces shall be noted on Shop Drawings.
 1. For Signal Terminal Cabinets: Shall include a front elevation indicating cabinet dimensions, make, location, and capacity of equipment, size of gutters, type of mounting, finish, and catalog number of locks. General layout of internal devices, wiring drawings with wire numbers and device connections, cut sheets of devices in enclosure and bill of materials listing description, manufacturer, part number, and quantity of items shall be included.
- D. Each submittal shall be bound and shall contain an index organized vertically by assembly and item number and horizontally by columns. The first assembly shall be the major head end equipment. The leftmost column shall be the item number; next shall be the description, followed by the applicable specification section number, and followed by the specified item, which is followed by the submitted item. The rightmost column shall be for notes, which shall be used to reference the reason for submitting items other than as specified.
- E. Each submittal shall contain product data sheets or catalog cut sheets for each item listed in the Index. These shall be arranged in the same order as the index and if more than one item is shown, the submitted items shall be highlighted or marked with an

arrow. The product data shall be sufficiently detailed to allow the engineer to evaluate the suitability of the product and to allow other trades to provide necessary coordination.

- F. Provide Shop Drawings, in the same size as the Drawings, prepared and signed by a BICSI Registered Communications Distribution Designer (RCDD). Shop Drawings shall be prepared in latest version of AutoCAD with three CD-ROM electronic copies submitted along with full sized Shop Drawings.
- G. Submit Shop Drawings prepared, signed, and sealed by structural engineer licensed in the State of California. Details shall be provided indicating the proposed means of support and attachment of wall and floor mounted racks. Calculations shall be based on the maximum seismic loads as determined by the CBC based on specifications provided by the cabinet manufacturer. MDF racks or cabinets shall support a minimum of 750 pounds of static weight. IDF racks or cabinets shall support a minimum of 250 pounds of static weight. LDF racks or cabinets shall support a minimum of 125 pounds of static weight.
- H. Provide a Network Protection Plan that defines how an existing school or campus Local Area Network (LAN) will remain in service during the installation of either new LAN cabling or additional LAN cabling segments in a manner that ensures the installation shall not interfere with or disable any portion of existing, working LANs during the project. This plan should be prepared by the Installer and approved by the Architect prior to the start of work.
- I. Samples: Provide samples of material and equipment as required by the Architect. If Samples are requested, they shall be submitted within ten days from date of request.
- J. Submit one electronic and one paper copy of cable records. Examples of the format for the required cable records are contained in Attachment 3 of this specification.

1.04 CODES AND STANDARDS

- A. Complete installation shall meet or exceed the latest edition of following standards:
 - 1. Underwriters Laboratories Inc. (UL): Applicable listings and ratings.
 - 2. UL 50, Cabinets and Boxes.
 - 3. UL 943, GFCI.
 - 4. UL 489, Molded Case Circuit Breakers.
 - 5. California Building Code.
 - 6. California Electrical Code.
 - 7. California Electrical Code, Article 384, 770, 800, latest issue.

8. National, State, and Local Occupational Safety and Health Administration (OSHA) building and fire codes.
9. NEMA PB1.
10. Federal Specifications W-P- 115C and WC-375B.
11. ANSI/TIA/EIA Telecommunications Building Wiring Standards.
12. ANSI/TIA-568-C, Commercial building telecommunications wiring standard and current addenda.
13. ANSI/TIA/EIA-568-C.3 Optical Fiber Cabling Components Standard.
14. ANSI/TIA/EIA-569-B, Commercial Building Standard for Telecommunications Pathways and Spaces, current issue.
15. ANSI/TIA/EIA-569-A-1, Commercial Building Standard for Telecommunications Pathways and Spaces Addendum 1 - Surface Raceways (March 2000).
16. ANSI/EIA/TIA-598-A, Optical Fiber Cable Color Coding, current issue.
17. ANSI/TIA/EIA-606-A, The Administration Standard for the Telecommunications Infrastructure of Commercial Building, current issue.
18. ANSI/TIA/EIA-607-A, Commercial Building Grounding and Bonding Requirements for Telecommunications, current issue.
19. ANSI/TIA/EIA-758-A, Customer-Owned Outside Plant Telecommunications Cabling Standard, current issue.
20. Institute of Electrical and Electronic Engineers (IEEE) 802.3 (Ethernet), 802.3Z (Gigabit Ethernet over optical fiber), 802.3ab (Gigabit Ethernet over 4 pair category 5 or higher), 802.11 (Wireless LAN).
21. BICSI Telecommunications Distribution Methods Manual, current issue.
22. FCC Part 68.50.
23. National Electrical Manufacturer's Association (NEMA).
24. National Fire Protection Association (NFPA), NFPA-70.
25. CCR Part 3 - California Electrical Code.
26. CCR Part 2 - Uniform Building Code.

1.05 SYSTEM DESCRIPTION

- A. Local Area Network Cabling Infrastructure: The network-cabling infrastructure at each school will utilize a star topology design consisting of horizontal cabling, backbone cabling, and various telecommunications cabling pathways and spaces. Schools will require design-engineering services to determine the best route and method for cable conveyance throughout the school in accordance with project requirements and applicable installation standards.
1. Proposed solutions shall be in compliance with TIA/EIA 568-C, centralized optical cabling, with the single exception of allowable cabling distance. TIA/EIA 568-C Annex A allows 300 meters as a maximum multi-mode optical fiber cable distance but District specification allows a maximum total length of 550 meters (450 meter backbone + 90 meter horizontal) using high grade laser optimized 62.5 micrometer multi-mode optical fiber. The installation of the backbone and horizontal cable plant shall include the following:
 - a. 62.5 micron multi-mode solutions which require mode-conditioning patch cords when using VCELS to launch in the 850 nm launch window shall not be accepted.
 - b. The interconnect or splice method as shown in figure 3 of ANSI/TIA 568-C shall be used in all cases. The pull through and splice methods are not acceptable.
 - c. Installation of optical fiber backbones in strand counts adequate to cross-connect active classroom, and instructional support location horizontal fiber to the BBS including a minimum of 10 percent spare strands, in multiples of six strands, in each backbone cable. Fiber termination units (FTU) are required to cross-connect backbone fiber at both the main equipment (MDF) cross-connect and at secondary (IDF) cross-connect locations throughout the campus.
 2. Backbone Cabling - The backbone cabling as a minimum, unless otherwise noted, shall be an indoor-outdoor, Riser rated hybrid multi-mode/single-mode fiber optic cable with a minimum composition of 12 strand multi-mode and six strand single-mode fiber optic cabling for inter-building and intra-building backbone cabling. Backbone cables shall meet or exceed the ICEA-S-104-696 Standard for Indoor-Outdoor Optical Fiber Cable. Connectors, distribution panels, ferrules, enclosures, and consumables shall be included to provide the backbone connectivity between MDFs and IDFs. Designer will show calculations and provide drawings illustrating distance limitations.
 3. Horizontal Cabling – Each data outlet unless otherwise noted shall consist of either one Category 5E cable or one Category 5E and four strands of fiber optic cable for classroom locations and six strands for connection to LDFs in locations such as computer labs, libraries and cafeteria.

- a. Each Category 5E cable shall be terminated on an eight-position, eight-conductor Category 5E jack wired in accordance with T568B. Associated faceplates shall accommodate two jacks at a minimum. Within classrooms and other open spaces, Category 5E cabling shall be routed via EMT conduit or surface mount raceway in walls, and in J-hook in accessible spaces above ceilings, cables shall be routed from the patch panel to a data outlet and placed as close to each workstation as practical. Supply Category 5E rated patch panels and same manufacturer patch cords for telecommunications closets and workstations to maintain an end-to-end Category 5E channel for - horizontal cabling.
 - b. Existing horizontal fiber terminated at a user station may be rerouted to new network cabinets. Remove any obsolete secondary backbone fiber with new cabling where appropriate.
4. Each campus shall receive a minimum of one Main Distribution Frame (MDF). Depending upon the size of the facility, provide one or more Intermediate Distribution Frames (IDFs), and Local Distribution Frames (LDF) are required. Telecommunications spaces will be located in secure areas with proper ventilation, HVAC, power, lighting, and grounding. MDFs and IDFs shall accommodate horizontal and backbone cabling termination equipment including: 19-inch free standing racks, wall-mounted racks, or cabinets, patch panels, vertical and horizontal wire management, patch cables, ladder racking, conduit sleeves, and data electronics. IDFs shall be located within the campus buildings in sufficient quantity to maintain compliance with the 90 meter horizontal cable running distance limitations as specified in ANSI/TIA 568-C.1. LDFs shall be located within every computer lab, student nutritional service area, multi-purpose room, and library to support ESM equipment.
5. If not in the same room, the MDF shall be located as close to the Minimum Point of Entry (MPOE) as practical.
6. WAN Cabling: If the MPOE is in a separate room from the MDF, furnished cabling between the MDF cabinet and the MPOE shall consist of:
 - a. Four separate four-pair 22AWG individually shielded cables with an outer sheath, properly terminated with RJ48C surface mount jacks at each end. Provide service loops of at least ten feet at the MDF and 25 feet at the MPOE cross-connect locations.
 - b. Fiber optic backbone WAN connection - unless otherwise noted, shall be an indoor-outdoor, riser rated multi-mode fiber optic cable with a minimum composition of six strands multi-mode fiber optic cable for inter-building and intra-building backbone cabling. Cables shall meet or exceed the ICEA-S-104-696 Standard for Indoor-Outdoor Optical

Fiber Cable. Connectors, distribution panels, ferrules, enclosures, and consumables shall be included to provide connectivity. Refer to Article 2.02 for multi-mode Optical Fiber type and performance requirements.

- c. WAN cables shall be clearly tagged in accordance with the requirements of this Specification. Provide a dedicated surface raceway and/or EMT conduit for this cable.

B. Signal Terminal Cabinets

1. Signal terminal cabinets shall conform to the Specifications in Section 26 2416, except as modified herein.
2. Terminal cabinets shall be flush or surface type with two-inch trim or surface mounted type, as indicated on Drawings. Terminal cabinets shall be provided in sufficient quantity to allow no more than one signal system per cabinet. Terminal cabinets shall measure a minimum of 12 inches wide by 18 inches high by 5 ¾-inches deep, unless otherwise indicated on Drawings. Trims for sectional cabinets shall be of one-piece construction.
3. Cabinet Boxes shall be fabricated of galvanized steel compliant with NEMA 250; unless otherwise noted. Boxes shall be flush or surface type with removable end-walls, and dimensioned as indicated on Drawings. Provide ¾-inch thick plywood backboard fastened in place with machine screws and painted matte white with fireproof paint for mounting terminal blocks. Backboards shall be largest size that cabinet and conduit terminations will permit.
4. Cabinet fronts shall be fabricated of steel compliant with NEMA 250, unless otherwise noted. Fronts shall be flush or surface type as indicated on Drawings, with screw cover front and gray baked enamel finish. Doors shall be cut true, and shall accurately fit opening and finish smoothly across joints. Rabbets shall be inside. Hinges shall be entirely concealed except for barrels and pins. Hinge flanges shall be welded to door and trim. Doors shall be equipped with flush type, spring-latching, Corbin locks for metal doors, keyed to Corbin No. 90 keys.
5. Provide protective pocket inside front cover with schematic diagram, connection diagram, and layout drawing of control wiring and components within enclosure.
6. Terminal Cabinets shall be located so they are readily accessible and not exposed to physical damage.
7. Cabinet locations shall provide sufficient working space around panels to comply with the California Electrical Code and the BICSI TDMM.

8. Terminal Cabinets shall be securely fastened to the mounting surface by at least four points.
9. Unused openings in cabinets shall be effectively closed.
10. Cabinets shall be grounded as specified in Article 250 of the California Electrical Code.
11. Conduits shall be installed so as to prevent moisture or water from entering and accumulating within the enclosure.
12. Maintain the required bending radius of cable and conductors inside the cabinet.
13. Clean the cabinets of foreign material such as cement, plaster, metal filings, and paint.
14. Remove debris from terminal cabinet interior.

C. Telephone Systems:

1. The telephone wiring system consists of distribution and feeder cables that permit connection of telephone handsets or other interfacing devices, through cross connecting panels, back to connecting blocks associated with an Owner-furnished, Owner installed PBX System. The installation of the PBX system and related powering systems is outside the scope of this specification.
2. The quantity of Telephone System cabling shall be designed based upon the size and scope of the project, or in accordance with drawings furnished by a designer. Telephone cables installed between the Main Distributing Frame (MDF) or PBX system location and respective Intermediate Distribution Frames shall be the sum of current telephone requirements plus a 40 percent growth factor of spare cable pairs.
3. Equipment specifications for the Project site shall be as indicated on Drawings, the scope of work, and as specified herein.

D. Underground service entrances are required for connections to:

1. Telephone Service Provider.
2. Community Antenna Television (CATV) Access Provider.

1.06 QUALITY ASSURANCE

- A. In addition to the following requirements, review and comply with Section 27 0126 - Test and Acceptance Requirements for Structured Cabling.

- B. Use adequate numbers of skilled personnel who are manufacturer certified, trained and experienced on the necessary crafts, and familiar with the specified requirements and methods needed for the proper performance of the work.
- C. The work of this section shall conform to California Code of Regulations, Part 3, and other applicable codes and standards.
- D. Permits and Inspections: Obtain and pay for required permits and inspections; deliver certificates of inspection to the Inspector.
- E. Only a qualified Installer holding licenses required by legally constituted authorities having jurisdiction over the work, shall do the work.
 - 1. Contractor shall have completed at least five projects of equal scope to systems described herein and shall have been in the business of supplying and installing specified type of systems for at least five years.
 - 2. Include in the Product Data list submission, copies of current manufacturer certificates indicating that the Contractor is an authorized distributor of the manufacturer's products, has been trained in the installation of those products, and has a service organization capable of responding within 24 hours of receipt of written notification and resolution within one day for MDF equipment and five days for equipment located either in the classrooms, IDF's, or LDF's.
- F. Material or work damaged during the planning, installation, testing, and clean-up of this project must be replaced or repaired, at no expense to the Owner, to meet current Owner specifications before final acceptance of work. Examination of, or failure to examine, work by the Owner shall not relieve Contractor from these obligations.
- G. Installation shall be performed in accordance with applicable building codes, industry standards, and best trade practices.
- H. Include in the Material List Submission copies of the manufacturers' certifications that the Contractor is a current authorized distributor of the submitted manufacturers' products and Contractor's staff has been adequately trained and certified in the installation of those products. This requirement applies to structured cable components and cable described in this specification.
- I. Coordinate cable runs and rack equipment locations with the Owner's Authorized Representative prior to the start of construction. Contractor and Owner's Authorized Representative must agree as to the final location of devices and the cable plant design.

1.07 WARRANTY

- A. Warranty that work executed and materials furnished shall be free from defects in materials, fabrication and execution for a minimum period of three years from date of

installation acceptance, excluding specific items of work that require a warranty of a greater period that may be set forth in this Specification. In the event a manufacturer's warranty is longer than three years, the manufacturer's warranty shall be the warranty period. Immediately upon receipt of written notice from the District, repair or replace at no expense to the District, any defective material or work that may be discovered before final acceptance of work or within the warranty period; any material or work damaged thereby; and adjacent material or work that may be displaced in repair or replacement. Examination of or failure to examine work by the District shall not relieve Contractor from these obligations.

- B. Provide a performance warranty for the installed data cabling system and components for a minimum of fifteen years after system is turned over to the Owner. Components of the optical data backbone cable system including cables, distribution shelves, LIUs and connectors must carry a fifteen year single manufacturer's applications warranty at speeds of one Gbit/second.

PART 2 - PRODUCTS

2.01 EQUIPMENT STANDARDS - APPLIES TO ALL SYSTEMS

- A. Where required by Specifications, components installed under this Contract shall be listed by UL or another Nationally Recognized Testing Labs (NRTL).
- B. Equipment Requirements.
 - 1. Various manufacturers' equipment may meet the standards of quality set by the Owner. Provide equipment specification sheets for items included in the submitted bid.
 - 2. The Owner's Quality Control representative or designated agent will establish equivalency and compliance of product or components offered for use under this Contract.

2.02 LOCAL AREA NETWORK CABLING

- A. Multi-Mode Optical Fiber.
 - 1. The optical fiber shall be multimode, graded-index optical fiber waveguide with nominal 62.5/125 micron core/cladding diameters. The optical fiber shall comply with ANSI/EIA/TIA-492AAAA.
 - 2. The mechanical and environmental specifications for multi-mode fiber distribution cables shall be indoor/outdoor, riser rated, tight-buffered type cables. The cable shall meet the requirements of the California Electrical Code (CEC) section 770 and the requirements of TIA-455-82B water ingress test. Confirm that the cable is listed for the specified application.

3. Cabled optical fiber shall meet the graded-index attenuation performance specifications of ANSI/TIA 568-C including current sub sections and addendum. Attenuation shall be measured in accordance with ANSI/EIA/TIA-455-46, -53, or -61. Information transmission capacity shall be measured in accordance with ANSI/EIA/TIA-455-51 or -30. The cable shall be measured at 23 degrees C $\pm$ 5 degrees C.
4. Multi-mode optical fiber shall meet the following minimum performance requirements:
 - a. Attenuation: The maximum attenuation of the multi-mode laser optimized fiber shall be 3.5db/km or less at 850nm and 1.5db/km or less at 1300nm.
 - b. Utilize GbE Gigabit Enhanced 62.5/125 multi-mode fiber to exceed standard bandwidth and distance limitations. Cable manufacturer shall guarantee that the multi-mode optical cable will support Gigabit Ethernet transmission up to 550 meters using SX optics.

B. Single-Mode Optical Fiber.

1. Single-mode optical fibers shall be Class IVa Dispersion-Unshifted Single-mode Optical Fibers and shall comply with ANSI/EIA/TIA-492BAAA. Fiber conductors shall have a nominal core diameter of 8.7 microns. Cable shall have transmission window centered at 1310 and 1550 nanometer wavelengths.
2. The mechanical and environmental specifications for single-mode fiber distribution cables shall be indoor/outdoor, riser rated, tight-buffered type cables. The cable shall meet the requirements of the National Electrical Code (NEC) section 770 and the requirements of TIA-455-82B water ingress test. The Installer shall confirm the cable is listed for the specified application.
3. Cabled optical fiber shall meet the attenuation performance specifications of ANSI/TIA-568-C. Attenuation shall be measured in accordance with ANSI/EIA/TIA – 455-78ASP-3-3644-RV2 or 61. The cable shall be measured at 23 °C $\pm$ 5 °C.

C. Fiber Optic Connectors. Fiber optic connectors shall be Duplex SC type, MM or SM connector.

D. Fiber Optic Light Interconnection Units (LIUs). Rack mounted with the capacity to handle a minimum of 18 terminated fibers. Complete kit to include panels' bulkheads and supporting hardware.

1. LIU for Local Distribution Frames and other locations requiring 18 optical fiber strands or less shall not exceed one EIA rack unit in height.

- E. Fiber Optic Distribution Shelves. 72 port rack mountable, with SC-compatible bulkheads and built-in cable management.
- F. Multimedia patch panels for LDC and LDF cross connections: Rack mounted field configurable panels for mixed media installations. The panel shall have a variety of modular inserts which support as a minimum Category 5E and duplex SC connectors.
 - 1. Patch panels for LDF cabinets shall support a minimum of three duplex SC optical fiber connectors and Category 5E connections as required by the number of drops supported at that distribution point.
- G. Fiber Optic Jumper Cables.
 - 1. Multi-mode or Single-mode duplex cable, OFN rated. Length: three meters, at a minimum, pre-manufactured with SC-SC connectors with same transmission characteristics as the terminated fibers as defined in Article 2.02.
 - 2. Fiber optic patch cables shall be supplied in sufficient quantity to connect each active fiber pair at intermediate cross-connect locations identified in the construction documents. Patch cables are not required for spare fibers. Intermediate cross connect locations include the following:
 - a. MDF – cross connect between the MDF and MPOE and MPOP.
 - b. IDF – cross connect between primary backbone and secondary backbone or horizontal fiber.
 - 3. Fiber optic patch cables shall be OFN type, jacketed with polyvinyl chloride with yellow indicating a single-mode patch cable and orange indicating a 62.5/125 multi-mode patch cable. The cable shall meet requirements of TIA/EIA-568 except for the more stringent requirements on bandwidth and attenuation identified in this Specification.
- H. Fiber Optic Innerduct. Materials: one-inch and/or one and one half inch, orange corrugated with pull rope, rated as required by code.
- I. Category 5E data Cable. Horizontal enhanced Category 5 cabling shall be 24 AWG, four-pair UTP, UL/NEC rated, with appropriately rated PVC (riser) or FEP (plenum) jacket as appropriate to the installation environment and N.E.C. Individual conductors shall be FEP or polyethylene insulated as appropriate to the installation environment. Cables installed in cable trays or on “J”-hooks shall carry a CMP rating regardless of the installation environment. Cable shall meet ANSI/TIA/EIA minimum requirements for return loss, propagation delay, delay skew, NEXT loss, PSNEXT loss, FEXT loss, ELFEXT, and PSELFEXT for four-pair Category 5E cabling as detailed in ANSI/TIA-568-C.2. Category 5E data cabling and patch cables shall be blue or green.

- J. Flooded Category 5E cable for underground applications: Enhanced category 5 cabling shall be 24 AWG, four-pair UTP, UL/NEC rated, with appropriately rated polyethylene jacket with water blocking flooded core. Individual conductors shall be polyethylene insulated. Cable shall meet ANSI/TIA minimum requirements for return loss, propagation delay, delay skew, NEXT loss, PSNEXT loss, FEXT loss, ELFEXT, and PSELFEXT for four-pair Category 5E cabling as detailed in ANSI/TIA-568-C.2.
- K. Category 5E Inserts. Category 5E data inserts shall be wired to the T568B wiring pattern. Category 5E data inserts shall meet ANSI/TIA/EIA minimum requirements for return loss, propagation delay, delay skew, NEXT loss, PSNEXT loss, FEXT loss, ELFEXT, and PSELFEXT for Category 5E connecting hardware as detailed in ANSI/TIA/EIA-568. Category 5E data inserts shall be blue or green in color as consistent with the cable jackets for this system.
- L. Exterior Category 5E data drops shall be embedded in an environmentally sealed enclosure with an IEC NEMA 6 rating for Protection from live or moving parts, dust, and protection from immersion in water) and with an ADC 110 punchdown contacts for field termination of horizontal backbone cable of specified length. The connector shall combine existing RJ-45 connector technology with weatherproof housing assemblies and shall be compatible with standard Category 5E RJ-45 connectors. The exterior Category 5E connector shall interlock with exterior patch cord as described in paragraph 2.02.N of this Specification, and provide a seal with a NEMA 6 rating. Category 5E data inserts shall be wired to the T568B wiring pattern. Category 5E data inserts shall meet ANSI/TIA minimum requirements for return loss, propagation delay, delay skew, NEXT loss, PSNEXT loss, FEXT loss, ELFEXT, and PSELFEXT for Category 5E connecting hardware as detailed in ANSI/TIA-568-C.2.
- M. Category 5E Patch Cords. Patch cords shall be Category 5E rated, 24 AWG, four pair assemblies. Patch cords shall be factory assembled by the manufacturer of the cabling system. LAN Patch cords shall be the same color, blue, or green as the cabling system. Provide and install Category 5E patch cords as follows:
 - 1. One two-meter Category 5E patch cord for each work area outlet installed.
 - 2. In the wiring closets, Category 5E patch cords shall be provided in a like manner (one per user port). Patch cords shall be provided in varying lengths to accommodate a patch that can be neatly loomed into the cable management system. In wiring closets and passive patch locations, patch cords shall be installed and shall cross connect structured cabling to LAN equipment ports.
 - a. In LDF locations in cabinets with less than 26 inches of rack space, Patch cables shall be provided in the following distribution of lengths – 30 percent one foot; 40 percent two feet; 30 percent three feet.
 - b. In MDF, IDF, and LDF locations in stand-alone cabinets with between 26 inches and 56 inches of rack space, patch cords shall be provided in

the following distribution of lengths – 60 percent one meter; 40 percent two meters.

- c. In MDF and IDF locations in cabinets with more than 56 inches of rack space, or ganged cabinets, patch cords shall be provided in the following distribution of lengths – 20 percent one meter; 40 percent two meters; 40 percent three meters.
- N. Category 5E patch cords for exterior locations. The patch cord shall combine existing Category 5E RJ-45 plug technology with weatherproof assemblies and shall be compatible with standard Category 5E RJ-45 connectors. One end of the ten foot patch cord shall be a Category 5E RJ-45 plug embedded in a housing that creates an environmental seal, a strain relief, and a locking mechanism when mated to exterior Category 5E connector, and an ingress protection of NEMA 6. See paragraph 2.02 L of this Specification. The other end of the patch cord shall be a standard Category 5E RJ-45 plug connector.
- O. Category 5E Patch Panels. Patch Panels shall be provided in 24 or 48 port compliments with modular jack ports wired to T568B. Patch panels consisting of 48 ports or less shall not exceed one EIA rack unit in height. Patch panels shall be augmented with cable support bars in rear to properly dress cable. Patch panels shall meet ANSI/TIA/EIA minimum requirements for return loss, propagation delay, delay skew, NEXT loss, PSNEXT loss, FEXT loss, ELFEXT, and PSELFEXT for Category 5E connecting hardware as detailed in ANSI/TIA/EIA-568. Quantity and size of patch panels must be selected to provide 20 percent expansion capacity. One EIA rack unit of horizontal wire management shall be provided adjacent to each patch panel both above and below.
- P. Outlet Gang Boxes. As a minimum, the telecommunications outlet box shall be capable of housing four Category 5E terminations or two terminated optical fibers. The outlet box shall have the ability to secure the optical fiber cable and provide for a minimum fiber bend radius of one inch. Typically, the telecommunications outlet/connector box shall consist of a four inch by four-inch electrical box or surface mount box.
- Q. Weatherproof single gang outlet box shall be NEMA 3R rated, either flush mount or surface mount as shown on the Drawings. The weatherproof single gang outlet box shall be used for mounting exterior Ethernet outlets (See paragraph 2.02.L of this Specification). This outlet box shall be mounted inside a terminal cabinet for exterior Ethernet outlet.
- R. Faceplates. Faceplates shall be constructed of ABS molding compound and have the ability to accommodate one insert.
- S. Exterior faceplate shall be a single gang, two ports, and stainless steel plate. The faceplate shall be pre-punched for mounting use with weatherproof housing assemblies (paragraph 2.02 L.). The faceplate shall be gasketed and have an NEMA 12 rating.

- T. Fiber Faceplates. Fiber faceplates shall be constructed of ABS molding compound and have the ability to accommodate a minimum of two angled duplex multi mode or single mode SC connectors.
- U. Horizontal Cable Management panels shall be 19-inch rack mount with a minimum of four-management rings one-rack unit (1.75 inches) in height. Rings shall not exceed more that 1.75 inches in depth unless otherwise noted in the construction documents.
- V. Floor Standing Cabinet. Floor-standing equipment cabinet for MDF or IDF installation use as required. Cabinet shall provide at least 84 inches (48 EIA/TIA rack units) of total mounting space for 19-inch panels and 36 inches of usable interior depth. If two cabinets are required in an MDF, structured cabling components shall terminate within the same rack with the Backbone Switch. Cabinet shall be constructed of steel with 14-gage carbon steel front and rear adjustable mounting rails tapped for #10-32 screws on EIA spacing front and rear. Cabinet shall be tested and certified to the seismic specifications set forth by NEBS Telcordia Technologies GR-63-CORE. Cabinet shall be provided with a thermostatically controlled heat dissipation fan; textured antique finish; matching side panels and louvered top panel; a hinged, key locking, bronze-tinted acrylic window door in front keyed to Corbin Cat 90; and a full length, hinged, key-locking rear door keyed to Corbin Cat 90. Cooling fan thermostat shall be set at 78 degrees Fahrenheit. When installed, both doors shall be able to swing fully open. Cabinets shall be UL listed.
- W. Wall-Mounted Cabinet. Wall-mounted equipment rack for IDF and LDF locations. IDF cabinet shall provide at least 45 inches of mounting space for 19-inch panels (26 EIA/TIA rack units), a 22-inch main body and a minimum of 24 inches of usable interior depth. LDF cabinet shall provide at least 24 inches of mounting space for 19-inch panels (13 EIA/TIA Rack Units), a 22-inch main body and 24 inches of usable interior depth. Cabinet bodies shall be 14 gage or better, welded steel construction with 14-gage carbon steel front and rear adjustable mounting rails, tapped for #10-32 screws on EIA spacing, fully adjustable front-rear. Allowable deflection of an open cabinet when loaded to its maximum weight capacity, shall not exceed .75 inches (3/4 inches) Wall mount IDF and LDF cabinets shall be configured to have a minimum of 18 inches from front to rear rack-mounting rails. Cabinet shall have factory made top or side ventilation capability and a thermostatically controlled heat dissipation fan rated at no more than 32dBA, a Plexiglas front door, and flush mounted locks on both front and rear sections. The front lock shall be keyed to Corbin CAT 90 and the rear lock shall be keyed to Corbin CAT 90. Cooling fan thermostat shall be set at 78 degrees Fahrenheit. Cabinets shall be provided with white powder coat finish. Cabinets shall be UL listed.

2.03 SIGNAL TERMINAL CABINETS

- A. Cabinets shall be code gage galvanized steel or blue steel; fronts, doors, and trim shall be code gage furniture steel. Cabinets shall be furnished with at least six-inch high gutters at top and bottom where feeder cable size exceeds four gage or where feeder

cable passes through cabinet vertically. Cabinets shall be furnished with top and bottom gutters sized as required by inspection department having jurisdiction, but never less than six inches where more than one feeder enters top or bottom of cabinets. Side gutters shall not be less than four inches wide. Width of cabinets shall be 20 inches, unless otherwise indicated on Drawings.

- B. Doors shall be cut true, shall accurately fit opening, and finished smooth across joints. Rabbets shall be inside. Door shall be sized as required to permit removal of devices intact. Gutters shall be provided at sides and top of compartment. Hinges shall be entirely concealed except for barrels and pins. Hinge flanges shall be welded to door and trim. Doors shall be equipped with flush type, spring-latching, Corbin locks for metal doors keyed to Corbin No. 90 keys.
- C. Outdoor cabinets shall be NEMA Type 3R. Construction shall be formed from code gage galvanized steel with ANSI No. 61 gray enamel finish. Provide heavy-duty, three-point latching, vault type door handles with padlocking provisions. Provide stainless steel butt hinges on doors. Padlocks shall be furnished, keyed to Corbin No. 90 keys. Outdoor terminal cabinets shall be used only if approved by the Owner.

2.04 TELEPHONE SYSTEMS

A. Wiring

1. Telephone Trunk Cables. Cables shall be rated for inside installation, PVC insulated 22 AWG solid conductor cables unless otherwise specified by access provider. Cables shall be available in standard increments of 25, 50, 100, 200, 600, 800, 1,000 and 1,200 pairs. Any cable that exits the building must be rated for exposed environments and graded as outside plant cable.
2. Installed telephone cable terminations, on 110-type terminating blocks, shall be installed in signal terminal cabinets, on $\frac{3}{4}$ inch plywood backboards, painted using fire-retardant paint. Cables shall be dressed in orderly fashion on entrance to the cabinets, properly secured with cable D-Rings that preclude snagging or inadvertent movement of the cables.
3. Telephone Trunk Cables shall be terminated at the MDF locations using 110 type blocks that meet Category 5E data specifications (i.e., Siemens, or equivalent). Cross connects in the MDF at these blocks will then distribute to interior PVC-jacketed, Riser grade, or outside Plant Grade cables that connect to individual IDF locations, depending on whether IDFs are located in the same building, a different floor, or in a different building.
4. Category 5E Cable, when used to connect voice telephones to the nearest IDF location shall carry the same rating and specifications as listed in the Local Area Data Networking (Article 2.02). Category 5E telephone wiring systems shall use yellow or red-jacketed cable.

5. Flooded Category 5E cable for underground applications. Category 5E Cable, when used to connect voice telephones to the nearest IDF location shall carry the same rating and specifications as listed in the Local Area Data Networking (Article 2.02).
6. Category 5E Inserts. Category 5E data inserts shall be wired to the T568B wiring pattern. Category 5E data inserts shall meet ANSI/TIA/EIA minimum requirements for return loss, propagation delay, delay skew, NEXT loss, PSNEXT loss, FEXT loss, ELFEXT, and PSELFEXT for Category 5E connecting hardware as detailed in ANSI/TIA/EIA-568. Inserts shall be yellow or red in color as consistent with cable color for the system.
7. Category 5E Patch Cords. Patch cords shall be Category 5E rated, 24 AWG, four pair assemblies. Patch cords shall be factory assembled by the manufacturer of the cabling system. Telephone system patch cords shall be the same color (yellow or red) as the telephone cabling system.
8. Category 5E Patch Panels. Patch Panels shall be provided in 12, 24 or 48 port compliments with modular jack ports wired to T568B. Patch panels shall be augmented with cable support bars in rear to properly dress cable. Patch panels shall meet ANSI/TIA/EIA minimum requirements for return loss, propagation delay, delay skew, NEXT loss, PSNEXT loss, FEXT loss, ELFEXT, and PSELFEXT for Category 5E connecting hardware as detailed in ANSI/TIA/EIA-568. Quantity and size of patch panels must be selected to provide 20 percent expansion capacity. One EIA rack unit of horizontal wire management shall be provided adjacent to each patch panel both above and below.
9. Telephone Modular Jacks. Contractor Furnished, Contractor Installed (CFCI):
 - a. Provide modular jacks, eight-position, TIA-568, Category 5E, using T568B wiring pattern. Jacks shall be UL verified and listed, Category 5E with 110 contacts and blue or red in color – whichever is consistent with the system cable sheath color. Provide duplex faceplate mounting straps, where required. Provide wall and floor outlet plates as indicated in Section 26 0513: Basic Electrical Materials and Methods.

B. Telecommunications Related Equipment:

1. Telephone Type T7. Contractor Furnished, Contractor Installed (CFCI).
2. Type T7 shall be a modular telephone jack - type RJ-11 - on an independent line, separate from the telecommunications system. Provide independent line modular jacks at Administration fax machines to each elevator room, pay telephones (typically at multipurpose room, gymnasium, and auditorium lobbies), and/or as indicated on Drawings. Each independent line will be terminated at the backboard in the MPOE. Termination of Category 5E cable to

an RJ-11 jack shall use the green and green/white conductors for typical tip and ring connections. The green conductor shall be terminated at the jack on the tip side.

PART 3 - EXECUTION

3.01 PREMISE WIRING INSTALLATION

Site Conditions. Examine the areas and conditions under which the work of this Section will be performed. Unsatisfactory conditions shall be reported to Owner before the contractor begins work.

A. Conduit Subsystem:

1. Excavation:

- a. Call the Owner's Authorized Representative at least 48 hours prior to excavation.
- b. Locate and protect existing construction, plant life, and utilities. Before excavation, contact the "Underground Service Alert of Southern California" (USASC) for information on buried utilities and pipelines.

2. Inter-building Conduits:

- a. Provide and install two inner ducts of 1 ½-inch and one inner duct of 1 inch with indexed pull cords.
- b. Ductbanks shall have a continuous slope downward toward ground vaults and away from buildings with a pitch of not less than 4 inches in 100 feet.
- c. Inter-building exterior and underground conduit runs shall not exceed 200 feet and shall not contain more than two bends of 90-degrees or less between pullboxes or vaults. Distances of up to 600 feet between underground pull boxes may be allowed if the conduit run between pull boxes has no bends, and is indicated on Drawings.
- d. Stagger joints of the conduit by rows and layers so as to provide a duct line having maximum strength.
- e. During and after construction, protect partially completed duct lines from the entrance of debris such as mud, sand, and dirt by means of suitable conduit plugs. As each section of a duct line is completed from ground vault to ground vault, draw a stiff bristle brush of the proper diameter through each duct until the conduit is clear of particles of earth, sand, and gravel then immediately re-install conduit plugs.

f. Conduit fill shall not exceed 40 percent.

3. Intra-building Conduits:

- a. Interior conduits for multiple cables to communication outlets are to be a minimum of 1 ¼-inch and dedicated conduits shall serve outlet boxes.
- b. No more than six feet of flexible conduit shall be used in any conduit run.
 - 1) Flexible conduit shall not be used in concealed or inaccessible areas such as interstitial wall spaces or hard lid ceilings.
 - 2) Where flexible conduit is used, the conduit fill shall be derated by one trade size.

4. Entrance/Access Provider Conduits:

- a. Entrance Conduit for Telecommunications:
 - 1) Telecommunications entrance conduits for small and medium size sites less than 100 classrooms shall consist of one, 4-inch trade size) conduit plus one spare of equal size.
 - 2) Telecommunications entrance conduits for large secondary school sites of 100 classrooms or more shall consist of two four inch trade size conduits plus one spare of equal size.
 - 3) Each installed conduit shall be equipped with a 5/16 inch polypropylene pull rope.
 - 4) The primary entrance conduit shall be provisioned with two 1-1/2 inch and one one-inch inner ducts each installed with indexed pull cords, unless AP representative indicates other requirements.
- b. Entrance conduits for CATV Access Provider
 - 1) CATV entrance conduit shall be one three inch trade size conduit.
 - 2) Each installed conduit shall be equipped with a 5/16 inch polypropylene pull rope.
- c. Construction of underground duct banks:
 - 1) Construct underground ductbanks of individual conduits encased in concrete. The concrete encasement surrounding the

bank shall be rectangular in cross-section and shall provide at least 3 inches of concrete cover for ducts.

- 2) Separate conduits by a minimum concrete thickness of three inches. Provide plastic duct spacers between ducts, at a maximum five feet on center.
- 3) The top of the concrete envelope shall not be less than 24 inches below grade.
- 4) Duct lines shall have a continuous slope downward toward ground vaults and away from buildings with a pitch of not less than four inches in 100 feet.
- 5) Manufactured bends shall have a minimum radius of 36 inches.
- 6) Stagger joints of the conduit by rows and layers so as to provide a duct line having maximum strength.
- 7) During and after construction, protect partially completed duct lines from the entrance of debris such as mud, sand, and dirt by means of suitable conduit plugs. As each section of a duct line is completed from ground vault to ground vault or ground vault to building, draw a brush through having the diameter of the duct, and having stiff bristles until the conduit is clear of particles of earth, sand, and gravel then immediately install conduit plugs.
- 8) No underground conduit run, without a pull box, is to be longer than 200 feet and shall contain no more than two bends of 90-degrees or less.
- 9) Pull boxes or ground vaults shall not be used in place of conduit bends.
- 10) Conduit types shall be limited to rigid metal conduit and schedule 40 PVC. Flexible metallic conduit and EMT shall not be used in entrance systems.
- 11) Conduit shall be reamed to eliminate sharp edges and terminated with an insulated bushing.
- 12) Joint trench methods shall not be used in entrance facility duct banks.

d. Ground Vaults and Pull Boxes:

- 1) Ground Vaults and pull boxes shall be installed in paved areas wherever possible. Top of box shall align with finish surface of paving. Wherever possible, install boxes where runoff water will not drain to the box. If vaults or boxes must be installed in an unpaved area subject to runoff, top of box shall be raised to allow no less than one inch of clearance from grade to top of box. In all cases, the top of vault or box shall be at or above the highest point in the runoff area.
 - 2) Provide pulling irons on opposite walls and below horizontal centerlines of ducts and cemented openings, and in bottom. Install pulling irons with each end hooked around a reinforcing bar.
 - 3) Install a floor drain into sump containing two cubic yards of crushed rock, minimum size 48 inches deep and 36 inches diameter. Provide a 36-inch length of 6-inch diameter perforated tile pipe extending down into sump and fill with gravel. Cover sump with grille.
 - 4) Install ground rod in each concrete pull box. Locate near a wall with six-inch projection above floor for ground clamps. Permanently ground metal equipment cases, cable racks, etc. in pull boxes. Ground conductors shall be #4-0 bare stranded copper.
- e. Above grade exterior and interior conduit systems:
- 1) Conduits placed and mounted to exterior and interior portions of a building to extend conduit pathways from the ground vaults to the site's MPOP shall be Rigid Metallic Conduit (RMC).
 - 2) Conduits shall be bonded and grounded.
 - 3) Securely fasten entrance conduits to the building so they can withstand a typical placing operation performed by the AP.
 - 4) Pull boxes, if needed, must be accessible. Do not place pull boxes above fixed ceilings, HVAC ducts, or piping.
 - 5) No interior conduit is to be longer than 100 feet between pull boxes, and shall contain no more than two bends of 90-degrees or less.
 - 6) Pull boxes shall not be used in place of conduit bends unless site conditions do not allow the use of conduits with data sweeps.

- 7) Where not required elsewhere in District Specification or Code, pull boxes shall be sized per the BICSI TDMM current edition.
- 8) An UL-approved fire stop applicable to the installation must be used when penetrating fire rated walls or floors.

f. Conduit termination in MPOP:

- 1) For conduits entering telecommunications room from below grade point, conduits shall extend four inches above the finished floor.
- 2) For conduits entering from ceiling height conduits shall terminate four inches below the finished ceiling.
- 3) Keep the area around an entrance conduit free of any construction, storage, mechanical apparatus, etc.
- 4) Seal the inside-the-building end of a conduit to prevent rodents, water, or gases from entering the building. Use rubber conduit plugs, a water plug, or duct sealer, depending upon the conditions.

B. Local Area Network MDFs/IDFs/LDFs:

1. If backboards are necessary for MDFs, IDFs, and LDFs they are to be ¾-inch fire-retarding ACX plywood with the A side out and painted with two coats of flat light colored fire-retarding paint on all sides. The size of the backboards will be determined by the size of the building and space provided.
2. Provide an MDF, IDFs, and LDFs at each campus. The MDF shall be co-located, or located as close to the MPOE as practical. IDFs shall be located within the campus buildings and in sufficient quantity to maintain compliance with the horizontal cable running distance limitations as specified in TIA/EIA 568. IDFs will distribute network connections to the classrooms. LDFs will provide connection for the workstations within offices, student nutritional service areas, multi-purpose rooms, computer labs, and libraries.
3. Provide an LDF in each student nutritional service area, multi-purpose room, computer laboratory, and library. LDFs shall consist of a wall-mounted cabinet containing the data switches, Category 5E patch panels, patch cords, connectors, and wire management required to distribute each Category 5E data drop to the workstations located within the room. However, if the LDF is within compliant distance from an otherwise adjacent MDF or IDF cabinet, the LDF may be physically co-located within that MDF/IDF cabinet.

4. MDF cabinets shall normally be installed in a LAN or Information Services room and may be used for support to some local data drops. Provide receptacles, cabling, and pathways to those local drops.
5. MDF/IDF/LDF Category 5E Termination Installation:
 - a. Category 5E patch panels shall be installed in 24 or 48 port complements. Provide and install necessary patch cords, both copper and fiber optic, for internal cabinet interconnections.
 - b. One EIA rack unit of horizontal wire management shall be provided adjacent to each patch panel both above and below.
 - c. Cables shall be dressed and terminated in accordance with TIA/EIA-568, manufacturer recommendations, and this Specification.
 - d. Pair untwist at the termination shall not exceed one half inch for Category 5E connecting hardware.
 - e. Bend radius of the cable in the termination area shall not be less than four times the outside diameter of the cable.
 - f. Cables shall be neatly bundled, not overly tight, and dressed to their respective panels or blocks. Cable wraps shall not be tight enough to disturb the internal cable pair twists and positioning.
 - g. The cable jacket shall be maintained as close as possible to the termination point.
 - h. Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support ties.
 - i. Patch cords used at the rack or cabinet shall include single-mode and multi-mode duplex fiber, and Category 5E, 24 AWG, four-pair assemblies, as required.
6. MDF/IDF/LDF Fiber Termination Hardware Installation:
 - a. Stripped fiber slack shall be neatly coiled within the fiber termination panel. No stripped slack loops shall be allowed external to the fiber panels. Fiber loops must not be smaller than minimum bend radius of the cable.
 - b. Cables shall be individually attached to the respective termination panels by mechanical means.

- c. Each fiber cable shall be stripped upon entering termination panels and the individual fibers routed neatly into termination panels.
- d. Each cable shall be clearly labeled at the entrance to the termination panel.
- e. Dust caps shall be installed on unused connectors and couplings.

7. Backbone Cabling:

- a. Proper bending radius and pulling strength requirements of cables shall be followed during handling and installation. Cables, splice cases, punch-down frames, LIUs, patch panels, and supporting hardware shall be installed in accordance with manufacturer recommendations.
- b. Outside plant fiber shall be installed in 1 ½-inch or one inch corrugated inner duct installed within the backbone conduit.
- c. Interior innerduct and cable shall be plenum or riser rated, as required by applicable code regulation or standard. Riser rated innerduct as a minimum shall be installed on floor-to-floor fiber optic cabling.
- d. Interior fiber not installed in cable tray, conduit or raceways shall be installed in innerduct. Innerduct installations shall be properly strapped and supported every four feet in concealed spaces only. Innerduct shall be rated for indoor or outdoor use as applicable by code.
- e. Cables in panels, cabinets, trays, and racks shall be neatly grouped and strapped using hook and loop cable straps. Cables shall be placed in a manner that allows equipment installation without rerouting. Full rack rail travel adjustments shall not be impeded by cable installation. Cables and panels shall be clearly identified at both ends with a unique cable numbering system and in compliance with ANSI/TIA 606. Refer to Section 27 0536 for Cable Tray requirements.
- f. When cable runs are being installed, provide additional slack at both ends to accommodate future cabling system changes. The minimum amount of allowable slack at the:

- 1) MDF shall be ten feet.
- 2) IDF and LDF shall be three feet.

Include the slack in length calculations to ensure that the cable does not exceed maximum allowable lengths as defined herein. Do not store slack in bundled loops. Store cable slack in an extended loop or in a figure eight configuration to alleviate stress.

- g. The backbone fiber optic cable shall be installed in configurations based upon the physical topology and logical connections required as follows:
 - 1) If the MDF-to-IDF cabling distance is 450 meters or less:
 - a) The installed cable from MDF-to-IDF shall be a minimum of 12 strands multi-mode and six strands single-mode.
 - b) The multi-mode fiber optic strands shall be installed in multiples of six including a minimum of 10 percent spare multi-mode fiber strands after required fiber optic links are connected.
 - 2) If the MDF-to-IDF cabling distance is greater than 450 meters:
 - a) The installed cable from MDF-to-IDF shall be a minimum of 12 strands multi-mode and 12 strands single-mode.
 - b) The single-mode and multi-mode fiber optic strands shall both be installed in multiples of six with a minimum of 10 percent spare single-mode and multi-mode fiber strands after required fiber optic links are connected.
- h. Fiber optic strands shall be terminated and no fiber cable shall be spliced.
- i. Cable shall be installed in accordance with manufacturers' recommendations and best industry practices.
- j. Cable raceways shall not be filled greater than the NEC maximum fill for the particular raceway type.
- k. Cables shall be installed in continuous lengths from origin to destination with no splices.
- l. The cable's minimum bend radius and maximum pulling tension shall not be exceeded.
- m. Replace any cable damaged or subjected to installation practices outside of those specified within this document.
- 8. Secondary Backbone Cable:
 - a. Fiber distribution cable for data circuits from IDFs to LDFs shall be four or six strands of fiber optic cable, CMP or CMR rated as required. Secondary Backbone cables shall not exceed 90 meters in length.

- 1) If the MDF-to-IDF cabling distance is 450 meters or less, the installed horizontal fiber cable for the computer labs, libraries, classrooms, and other LDF locations shall be a minimum of four strands multi-mode fiber including 10 percent spare capacity rounded up to an even number of strands, terminating on duplex SC network drops. Network drops shall be collocated within the LDF installation - described in this Specification.
- 2) If the MDF-to-IDF cabling distance is greater than 450 meters, the installed horizontal fiber cable for the computer labs, libraries and other LDF locations shall be a minimum of four strands single-mode fiber including 10 percent spare capacity rounded up to an even number of strands, terminating on duplex SC network drops. Network drops shall be collocated within the LDF installation - described in this Specification.
- 3) Fiber cable shall be installed in conduit, cable tray, raceways, or in innerducts when installed in J-hooks. No cable shall be installed laying on ceiling tile. Cable supports shall be installed to independently carry the cable without pinching or crimping the cable in any way. Vary the spacing of supports to prevent frequency dependent aberrations. Fiber hung on J-Hooks shall be installed in innerduct, with proper supports every four feet.
- 4) Cable shall be installed in accordance with manufacturers' recommendations and best industry practices.
- 5) Cable raceways shall not be filled greater than the NEC maximum fill for the particular raceway type.
- 6) Cables shall be installed in continuous lengths from origin to destination with no splices.
- 7) When cable runs are being installed, provide additional slack at both ends to accommodate future cabling system changes. The minimum amount of allowable slack at the:
 - a) MDF shall be ten feet.
 - b) IDF and LDF shall be three feet.
 - c) Include the slack in length calculations to ensure that the cable does not exceed maximum allowable lengths as defined herein. Do not store slack in bundled loops. Store cable slack in an extended loop or in a Figure 8 configuration to alleviate stress.

- 8) The cable's minimum bend radius and maximum pulling tension shall not be exceeded.
- 9) J-Hook or trapeze system shall be used only if shown on drawings to support cables in dropped ceiling spaces. J-Hooks shall not be used to distribute optical fiber cables within classrooms. Horizontal optical fiber cables distributed using J-hooks shall be placed in innerduct. Horizontal cables shall be supported at a maximum of three-foot intervals and shall be in full compliance with the Codes and Standards as listed in Article 1.04 of this Specification.
 - a) Cable(s) shall not rest on or attach to acoustic ceiling grids or panels.
 - b) Cable shall be installed above fire-sprinkler and other mechanical systems and shall not be attached to the system or any ancillary equipment or hardware.
 - c) Cables shall not be attached to ceiling grid or lighting support wires.
- 10) Replace any cable damaged or subjected to installation practices outside of those specified within this document and the Codes and Standards listed in Article 1.04 of this Specification.

9. Horizontal Cabling:

- a. Optical fiber distribution cable for horizontal data circuits from IDFs to classrooms, libraries, and other instructional areas shall be four strands of multi-mode fiber optic cable, CMP or CMR rated as required. Fiber optic horizontal cables shall not exceed 90 meters in length. Horizontal Fiber terminations will be made as follows:
 - 1) If an LDF is specified – Each four or six strand fiber optic cable shall be terminated on a modular rack mount patch panel which combines connectivity for both the fiber, using duplex SC connectors, and Category 5E, using RJ-45 connectors.
 - 2) When wall jacks are specified - Each four-strand fiber optic cable shall be terminated on a dual SC, duplex outlet with angled connectors at the work area. Associated faceplates shall accommodate both duplex, SC connector outlets.
- b. Copper Horizontal distribution cable shall be TIA/EIA-568, Category 5E, four-pair unshielded twisted pair, and CMP or CMR rated cable, as required. Each Category 5E cable shall be terminated on an eight-

position, eight-conductor Category 5E jack (at the workstation locations) or patch panel (in the MDF/IDF/LDF). Terminations shall be wired in accordance with T568B. Associated faceplates shall accommodate four jacks. Quantities of cables to each outlet shall be in accordance with the location type and project document.

- 1) Cable shall be installed in accordance with manufacturers' recommendations and best industry practices.
- 2) Copper horizontal cable shall not exceed 90 meters in length.
- 3) Cable raceways shall not be filled greater than the NEC maximum fill for the particular raceway type.
- 4) Cables shall be installed in continuous lengths from origin to destination (no splices or cross-connects are permitted).
- 5) The cable's minimum bend radius and maximum pulling tension shall not be exceeded.
- 6) Unshielded twisted pair cable shall be installed so that there are no bends less than four times the cable outside diameter.
- 7) When cable runs are being installed, provide additional slack at both ends to accommodate future cabling system changes. The minimum amount of allowable slack at the:
 - a) MDF, IDF or LDF will be three feet.
 - b) Work Area Outlets will be 12 inches.
- 8) J-Hook or trapeze system shall be used only if shown on drawings to support cables in dropped ceiling spaces. Horizontal optical fiber cables distributed using J-hooks shall be placed in innerduct. Horizontal cables shall be supported at a maximum of three-foot intervals and shall be in full compliance with the Codes and Standards as listed in Article 1.04 of this Specification.
 - a) Cable installed above fire-sprinkler systems shall not be attached to the system plumbing or any ancillary equipment or hardware.
 - b) Cables shall not be attached to ceiling grid or lighting support wires.

- 9) Pulling tension on four-pair UTP cables shall not exceed 25 pounds for a single cable or cable bundle.
- 10) Replace, before terminations are completed, cables damaged or subjected to installation practices outside of those specified within this document, at Installer's expense.

c. The following identifies the minimum number of Category 5E and fiber drops to be installed into each area identified. Additional areas and additional drops may be required and will be identified on the project documents. Cable and termination requirements are identified in Article 2.02 of this specification.

- 1) Standard office, workstation, or cubicle will receive three Category 5E drops in a single four-position faceplate. Two Category 5E drops will be marked for Data, the other for Voice. Empty openings on faceplates shall be effectively closed using factory made blank inserts.
- 2) Administrative office core areas shall receive three Category 5E drops in a single four-position faceplate per user or desk indicated on the drawings. Two Category 5E drops will be marked for Data, the other for Voice. Empty openings on faceplates shall be effectively closed using factory made blank inserts.
- 3) Conference rooms will receive up to eight Category 5E drops; four each at two separate locations in the room. Each group of four drops will terminate in a single faceplate with two Category 5E indicated for Voice and two for Data. Empty openings on faceplates shall be effectively closed using factory made blank inserts.
- 4) Classroom:
 - a) A minimum of one four-strand fiber drop to the teacher's drop in the classroom.
 - b) A minimum of five student Category 5E drops, one Category 5E drop for a printer, and one Category 5E drop at the teacher's location. Category 5E drops shall terminate on two-port faceplates. Empty openings on faceplates shall be effectively closed using factory made blank inserts.
 1. For High Schools provide an additional Category 5E student drop.

- 5) Library: A minimum of one four-strand fiber drop to the LDF in the library and a minimum of 12 Category 5E data drops distributed from the LDF. Larger libraries shall be provided with up to 20 drops. Category 5E drops must be grouped with two Category 5E jacks (and two blank jacks) per faceplate. Drops must be distributed within the room according to the Project documents. Empty openings on faceplates shall be effectively closed using factory made blank inserts.
- 6) Computer Laboratories: A minimum of one (1), six-strand fiber drop to the LDF in the computer laboratory and 40 Category 5E data drops distributed from the LDF. Category 5E drops shall be grouped with up to six Category 5E jacks per faceplate. Empty openings on faceplates shall be effectively closed using factory made blank inserts. Drops must be distributed within the room according to the Project documents.
- 7) Student Nutritional Support Areas: one, four-strand fiber drop to the LDF and up to 20 Category 5E data drops distributed from the LDF. Category 5E drops must be grouped with two Category 5E jacks and two blank jacks per faceplate. Empty openings on faceplates shall be effectively closed using factory made blank inserts. Drops must be distributed within the room according to the Project documents.
- 8) Student Nutritional Support Areas - Exterior Locations: Each location shall receive two Category 5E drops in an environmentally sealed enclosure as described in paragraph 1.02 B. 4 of this specification.
- 9) Multi-purpose rooms shall contain a total of: one, 4-strand fiber drop and 8 Category 5E data drops distributed from the closest LDF or IDF location. Category 5E drops must be grouped with two Category 5E jacks per faceplate. Empty openings on faceplates shall be effectively closed using factory made blank inserts. Drops must be distributed within the room according to the Project documents and consistent with the descriptions below.
 - a) In the stage area of a multipurpose room, there shall be two Category 5E drops and one, four-strand, multimode fiber optic drop located either at stage apron or the proscenium arch.

- b) On the other three walls of the multipurpose room, two Category 5E data drops shall be evenly distributed and installed.

- 10) Additional non-instructional and office work area horizontal fiber and Category 5E cabling requirements will be indicated on the Project documents.

10. Labeling and Marking:

- a. Provide complete cable location chart and as-built documentation in an envelope and attach to the inside rear doors of distribution frame cabinets in wiring spaces.
- b. Mark distribution panels, cables, and cover plates with computer-generated labels. Drops shall be labeled with the same identifier on the receptacle faceplate, inside each junction box, on the cable at the jack, on the cable at the patch panel, on the termination side of the patch panel, and on the patch side of the patch panel. Cable markers shall be located within two inches of the end of the cable jacket and shall be directly readable. Panel labels shall be computer-generated and printed using a laser printer. A disk with the label files shall be submitted as part of the project record documents.

C. Racks/Cabinets

- 1. Racks and cabinets shall be bolted to the floor or wall mounted, as required, and provided with tip bars and additional accessories required for a complete functional system. Racks and cabinets shall be seismically braced and attached to horizontal ladder racking or cable tray with $\frac{3}{4}$ inch threaded rod.
- 2. MDF/IDF cabinets shall be placed to accommodate 36-inch aisles in the front and rear. When wall mounted, cabinet placement shall allow a minimum of 31 inches clear on each side and 36 inches in front.
- 3. Provide CAT 90 keys and locks for cabinets and equipment enclosures. The manufacturer and part number shall be Corbin Russwin part number 5865-JVR or ILCO part number S1000V or equal. The locks and keys shall have a 53315 lock/key code.
- 4. Where backboards are used for mounting IDFs, and LDFs, they are to be $\frac{3}{4}$ inch plywood, ACX grade surface with the "A" side exposed and painted with two coats of flat light, colored fire-retarding paint on all sides. The size of the backboards will be determined by the size of the space provided. Cut edges of plywood shall be sanded smooth.
- 5. Unused openings in cabinets shall be effectively closed.

6. Cabinet doors shall close without striking installed components.
7. Cabling in cabinets shall be installed and loomed in a manner that allows full travel in rack rail adjustment. Cabling shall not infringe on space used for equipment mounting.
8. Cabinets shall be grounded as specified in Article 250 of the California Electrical Code.
9. Conduits shall be installed so as to prevent moisture or water from entering and accumulating within the enclosure.
10. Conductor lengths shall be maintained to a minimum within the wiring gutter space. Conductors shall be long enough to reach the terminal location in a manner that avoids strain on the connecting lugs.
11. Maintain the required bending radius of conductors inside the cabinet.
12. Clean the cabinets of foreign material such as cement plaster and paint.
13. Distribute and arrange conductors neatly in the wiring gutters.

D. Telephone Systems:

1. Terminals, Cabinets, and Racks: Telecommunications system and auxiliary cabinets/racks shall be installed and wall-mounted in accordance with CBC seismic requirements and shall not block any existing removable panels or swing-open doors required for normal system expansion or service.
 - a. Terminal Blocks: See appendix 3 for typical network diagram:
 - 1) Furnish terminal blocks in terminal cabinets/racks, and where indicated on Drawings, as required to provide a termination for conductors in communication cabinets/racks and backboards.
 - 2) Terminal blocks shall be 110 Series, solder-less, push-on type, solid, and 22 - 26 AWG. Terminals for connections to external circuits shall be properly labeled. Terminal blocks shall be installed on mounting legs and installed within cabinets/racks as required. Terminal blocks shall be installed on inside back of cabinets/racks only, not on side. Cross-connect and wire management shall meet or exceed TIA/EIA-568, Category 5E performance standards. Terminal blocks shall be pairs of 25 or 100 with mounting legs.
 - b. Terminal Cabinets/racks:

- 1) Lines and cables within cabinets/racks and on main terminal backboards shall be secured with cable straps. Cables shall be formed in rectilinear configuration. Insulation between conductors and ground shall be properly maintained. Cables shall be properly numbered in numerical order and shall maintain the same numbering system throughout the Project site.
 - 2) Conductors shall be color-coded per EIA/TIA 568 standards. Individual cables shall be run out and tagged with laser-printed cable markers. Cable index strips shall be typed and installed on terminal cabinet door. Index strips shall be covered with clear plastic adhesive covers. Terminal cabinet cable codes shall be typed on record drawings.
 - 3) Terminations and connections shall be on 110 Series blocks. Cables shall be identified as to buildings and rooms served and terminated in terminal cabinets/racks and backboards.
 - 4) Cables to PA system consoles and amplifier inputs shall terminate on 110 Series blocks where PA system is required.
 - 5) Cables from PA consoles and amplifier outputs shall terminate on 110 Series blocks.
 - 6) Cables to telecommunications switches, trunk inputs, shall terminate on 110 Series blocks.
 - 7) Cables from telecommunications switches (extensions, consoles, night bells, etc.) shall be terminated on 110 Series blocks. Provide blocks and cables for maximum possible system configuration.
 - 8) Cables to satellite terminal locations and classrooms shall be terminated on 110 Series blocks. Provide blocks as needed, plus two vertical rows for future expansion, at main cross-connect locations only.
2. Wiring: Wiring within communication cabinets/racks and backboards shall be installed to conform to ANSI/TIA-568-C, Category 5E performance standards, and shall be terminated on terminal strips for required external connections. Wiring shall be cabled, laced, and securely fastened in place so that weight is not imposed on equipment, controls, switches, or terminals. Input circuits and terminal strips shall be installed to provide separation necessary for proper operation. Wires shall be identified by number and chart, and 120VAC wiring shall be in a required conduit or raceway.

3. Cables: Discussion of cable terminations and location of blocks are subject to provisions of the Terminal Signal Cabinet section above.
 - a. Install conductors and cables to devices indicated on Drawings. Provide conductor terminations to devices for complete telecommunications system to function as specified and as indicated on Drawings.
 - b. Cable runs shall be continuous, no splicing shall be allowed. Terminations shall be in communication cabinets/racks or on telephone backboards. Connections from incoming to outgoing shall be provided with cross-connect wires. Cables shall not directly connect to other cables.
 - c. Conductors and cables shall be installed within conduits, cable trays, boxes, raceways, and cabinets/racks in a manner, which shall provide an enclosed installation, except where otherwise specified. Furnish and install conductors to connect incoming and outgoing circuits, including spare conductors, to terminal strips in the LAN or telephone equipment room, in accordance with TIA/EIA 569.
 - d. Cables and four-pair wires shall be behind 110 Series blocks in space created by stand-offs and shall be neatly laced and securely bundled.

3.02 RELATED SYSTEMS INSTALLATION

A. Telephone Systems:

1. Coordination of Installation of Telecommunication Systems:
 - a. Work, including installation or removal, will be coordinated with the OAR. The Contractor shall be responsible for floor plans for cutover, station reviews, and cut sheets. Installer will also provide a complete and detailed scope of work prior to commencement of any implementation.
 - b. If the scope of the Work includes the extension and replacement of an existing telephone system, the cutover and station review must be coordinated with the OAR prior to implementation and every effort must be made to minimize interruption of service during the cutover or at any other time.
 - c. Examination:
 - 1) The Inspector shall observe installation of main cable runs. Notify the Inspector not less than two days in advance of proposed time of installation.

3.03 CERTIFICATION AND TESTING

- A. Provide the Owner's Authorized Representative (OAR) with copies of factory calibration certificates for each test set used in the testing procedures. Test equipment used shall have been factory calibrated within the previous 12 month period. Operators of the test equipment shall have factory training in the use of the equipment and its software. Cables and termination hardware shall be 100 percent tested for defects in installation and to verify cable performance under installed conditions. Conductors of each installed cable shall be verified useable prior to system acceptance. Defect in the cabling system installation including, but not limited to, cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100 percent usable conductors in cables installed.
- B. Local Area Network:
1. Copper:
 - a. Each cable shall be tested for continuity on all pairs and conductors.
 - b. Enhanced Category 5E data cable shall be performance verified using an automated test set for Category 5E link configurations.
 - c. Test set shall be certified Level IIE. To ensure verifiable equipment calibration, the Owner shall require field calibration each time a new set of tests are performed. Test for the continuity parameters defined above, and provide results for the performed tests. This test set shall be capable of testing for the continuity and length parameters defined above, and provide results for the following tests:
 - 1) Attenuation.
 - 2) Wire Map.
 - 3) Attenuation to Crosstalk Ratio ACR.
 - 4) Pair-to-pair NEXT loss.
 - 5) PSNEXT loss.
 - 6) Return Loss.
 - 7) Pair-to-pair ELFEXT.
 - 8) PSELFEXT.
 - 9) Propagation delay.
 - 10) Delay skew.

11) Cable length.

- d. Cable length shall be tested using the cable manufacturers' published Nominal Velocity of Propagation (NVP) parameter. Owner's Quality Assurance Agent shall verify the NVP setting prior to commencement of the testing process. Generic settings not using the published NVP parameter will not be accepted.
- e. Test results shall be automatically evaluated by equipment, using the most up-to-date criteria from the ANSI/TIA-568-C standard and the results shown as pass/fail.
- f. Test results shall be printed directly from the test unit in native format, and both hard and soft copies in native format shall be provided to the Owner. The printed test results shall include tests performed, the expected test result, and the actual test result.

2. Fiber Optics:

- a. Terminate, test, and document multi-mode and single-mode fiber optic cables with approved connectors at the drop locations and on approved fiber optic patch panels at the MDF, IDFs, and LDFs. No fiber optic cables shall remain un-terminated.
- b. Fiber optic cables shall meet EIA/TIA performance standards and shall be tested in accordance with applicable standards. Light source and power meter tests shall be dual wavelength and shall be tested in both directions at each wavelength on each fiber strand. Optical time domain reflectometer (OTDR) tests shall be performed with an instrument suitable for testing campus cable plants. OTDR tests shall be conducted at both wavelengths from the MDF with sufficient launch cables installed at both ends of the fiber run to clearly identify the mated connectors. OTDR launch and landing cables shall not be less than 100 meters in length. The light pulse duration used shall not be greater than 50 nanoseconds. Sampling resolution shall not be less than five feet per 100 meters.
 - 1) Multi-mode fiber optic cable runs shall be tested in both directions at each frequency with a power meter and light source combination that can verify distance and attenuation. Wavelengths tested shall include 850nm and 1300nm.
 - 2) Single-mode fiber optic cable runs less than or equal to 200m shall be tested in both directions at each frequency with a power meter and light source combination that can verify distance and attenuation. Wavelengths tested shall include 1310nm and 1550nm.

- 3) Single-mode fiber optic cable runs greater than 200m shall be tested with a power meter and light source combination and with an OTDR. Wavelengths tested shall include 1310nm and 1550nm.
3. Completion: Work for the installation shall be considered complete after the following have been accomplished:
 - a. System testing has been completed. Certify that system is in working order. Cable Test Forms and equipment-specific test documentation, both electronic files and paper records, have been submitted to the Owner.
 - b. Ceiling panels previously removed have been put back in place.
 - c. System labels have been put in place.
 - d. Construction debris and scrap materials have been removed from project site.
 - e. Marked up, project record documents have been returned to the Owner.
 - f. Unused customer material has been returned to the Owner.
 - g. The Owner has successfully completed acceptance testing of the network wiring installation.
 - h. The Owner's Inspector has inspected and accepted the installation.
- C. Signal Terminal Cabinets:
 1. Cabinets will be securely bolted to the floor and the wall or ceiling as required by seismic requirements.
 2. Cabinet will be serviceable and lockable.
- D. Telephone Systems:
 1. Provide test and reception gear to test for specified performance.
 2. For multi-pair copper communications cable, test pairs within counts and binder groups to ensure that no less than 99 percent of the pairs of a multi-pair cable achieve continuity and operation in voice band tests. For Category 5E copper cable, test and certify 100 percent of drops for using test equipment certified for 10/100 validation and operation.
 3. For category 5E cabling, requirements of paragraph 3.03 B above.

4. Before Substantial Completion, submit test results and related documents to the Inspector.

3.04 PROJECT RECORD DOCUMENTS

A. As-Built Documentation

1. Block diagrams indicating items and their point-to-point connections in a manner following floor plan layout.

B. Operating and Servicing Manuals, Record Drawings:

1. Deliver three copies of operating, specification descriptions, and/or service manual. Each complete manual shall be bound in a three ring binder, and data shall be typewritten or drafted.
 - a. Manuals shall include a page with Project site and Project name, date of Substantial Completion, Contractor name, address, telephone, and fax numbers.
 - b. Manuals shall contain a letter, signed by an officer of the company indicating the beginning and ending date of any warranties described in Article 1.07 of this specification and shall describe the company's commitment to service the warranty during the terms specified.
 - c. Manuals shall include specifications and instructions necessary for proper operation and servicing of system.
 - d. Manuals shall include installation and coordination drawings specifically related to this section shall be included as follows:
 - 1) Size A (8 ½ by 11) and size B (11 by 17) shall be bound into the manual.
 - 2) Larger drawings shall be folded and inserted into transparent envelopes and bound into the manual.
2. Deliver two copies of Record drawings on labeled CDs (Compact Disks) representative of the work performed shall be presented at completion of work in the most recent Autodesk's AutoCAD format (.dwg), for Microsoft Windows.
 - a. The submittal shall contain systems wiring installed including telephone, LAN, and any other low voltage system Contractor-installed wiring.

- b. The submittal shall consist of two electronic copies on CD-ROM and three paper record copies on no less than "E" size drawings, presented prior to the acceptance inspection.
- c. Owner utilizes layers as a key tool in controlling visibility of drawing elements and to provide consistent information between drawings, yet provide control over what is seen on each sheet. Premise wiring shall be shown on a separate layer, labeled as "Premise Wiring" that uses both building floor plans and conduit supporting structure layers below. The use of any version control blocks or company logos shall be on a layer separate from the premise wiring as-built drawings.
- d. AutoCAD, electronic files supplied shall be multi-layer drawings with the following layers as a minimum:
 - 1) Layer 1 shall contain title blocks only.
 - 2) Layer 2 shall contain building or site plan backgrounds only.
 - 3) Layer 3 shall contain terminal cabinets, devices, cabling, and other system components.

C. Cable Numbering Records:

- 1. Owner requires both labeling and record documentation at the conclusion of each cable installation project. Labels and cable records allow the Owner to locate, identify, and diagnose cases of trouble more efficiently. They are required for each cable installation project regardless of size and scope.
 - a. Installation, provide a cable management spread sheet that shall include the following:
 - 1) Cable Schedule.
 - 2) Cable Test Forms.
 - 3) Cable Labels.
 - 4) Network planning chart.
 - b. Present the data in an Excel spreadsheet that will operate on Windows XP or Windows 7 platforms. Information shall be presented in paper and electronic forms in a format that will be provided by the Owner.
 - c. A paper copy of the cable schedule in a transparent plastic sleeve shall be affixed to the front door of each Intermediate and Local Distribution Frame (IDF and LDF). In the MDF cabinet, the cable schedule shall be affixed to the rear door of the cabinet.

2. The following information is provided to assist architects, engineers, and installation contractors in understanding and complying with the requirements of this specification. Owner's cable numbering is based on a defined format which readily identifies cable type, and allows maintenance technicians to determine originating and terminating locations by means of cable labels, as required in other sections of the specification.
3. Figure 3-1 below provides a diagram describing functional cabling and network connection elements that have been standardized by the Owner. This cable information is consistent with, but exceeds, the requirements as contained in EIA/TIA Specification 606. Terminating Points In (TPI) and Terminating Points Out (TPO) may be 110-Type blocks, 110-Type blocks, 24 or 48 density RJ-45 Patch Panels, or Fiber Optic Patch Panels. Termination point equipment is not part of cable records.

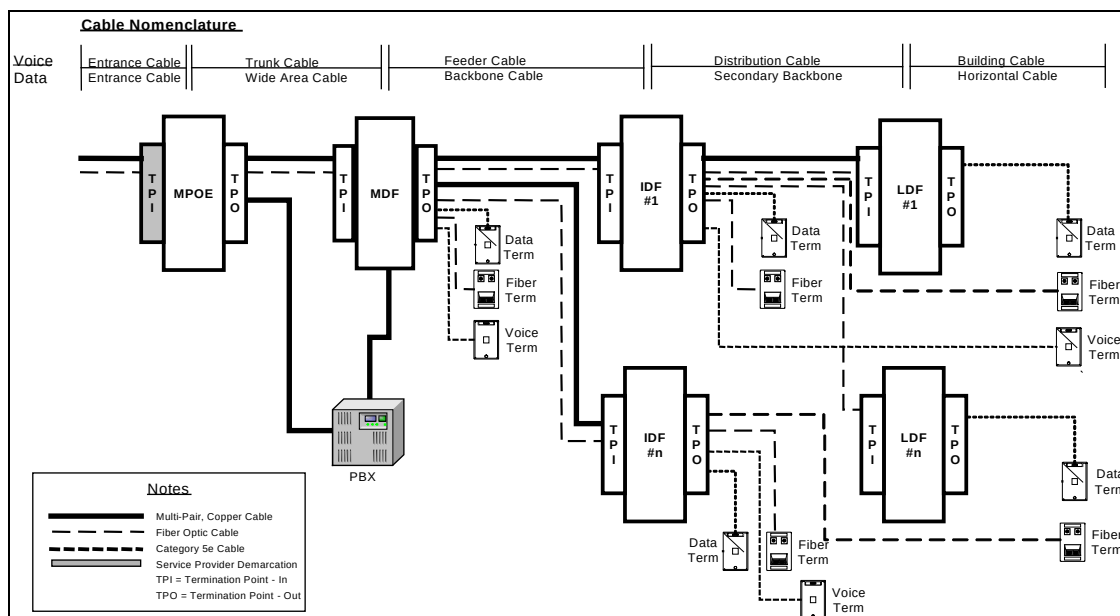


Figure 3-1 - Functional Cabling and Network Connection Elements

4. Each cable sheath shall be identified by laser-generated labels, and on the cabling record document (see attachment 3) by means of a nine-digit alpha/numeric number. In addition to the nine-digit sheath/cable number, provide three-digit, numeric pair/strand-numbering information specific to each cable/sheath number. The pair/strand number will be documented in the cable record document (attachment 3). The following provides the definition and use of each field.

Cable Number								Pair/Strand Number		
A	A	N	N	N	N	N	N	-	N	N

#1 - Cable Definition	#2 - Cable Type	#3 - Destination No.	#4 - Destination No.	#5 - Destination No.	#6 - Cable Number	#7 - Cable Number	#8 - Cable Number	#9 Reserved	#10 Pair/Strand Number	#11 Pair/Strand Number	#12 Pair/Strand Number
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A=alpha characters only; N=numeric character only

5. The following are the permissible characters that may be entered into each field.

a. Cable Definitions (Field #1):

T Trunk – Voice from MPOE to MDF
W Wide Area – Data from MPOE to MDF
F Feeder – Voice from MDF or PBX to IDF
B Backbone – Data from MDF to IDF
D Distribution – Voice IDF to LDF (see note below)
S Secondary Backbone – Data IDF to LDF
B Building cable drops – Voice IDF to User Jack
H Horizontal – Data IDF, or LDF to User Jack

b. Cable Types (Field #2):

C Multi-pair copper cable
F Multi-pair fiber optic cable

c. Destination Number (Fields #3-4):

Fields 3 -- 5 taken together will be a three-digit sequential number identifying the IDF, or LDF destination. The first digit of this destination number (field #3) will be structured to identify whether the destination is an IDF or LDF using the following convention:

- 1) IDFs are identified in field #3 by the numbers “0” through “1”.
- 2) LDFs are identified in field #3 by the numbers “2” through “3”.
- 3) The numbers “4” through “9” are reserved for future use.
- 4) For each situation, fields #4 and #5 will be a sequential number identifying unique, specific IDF or LDF locations.

By this convention, each IDF or LDF will be represented by a unique three digit number; IDFs will be numbered in the range 000—199 and LDFs will be numbered in the range 200—399.

d. Cable Number (Fields #6-8):

This will be a unique and sequential three digit number assigned to each cable sheath.

- e. Field #9 is reserved and will be represented using a dash “-”.
- f. Pair/Strand Number (Fields #10-12):
This will be a unique and sequential three digit number for each copper cable pair or fiber strand within a sheath.

Note: Code “D” in the Cable Definition Field is a non-standard cable configuration and normally not used. Owner serves voice jacks directly from IDFs. The Owner must approve, in advance of construction or installation, any installation that brings voice communications through an LDF.

3.05 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.06 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.07 OWNER ORIENTATION

- A. Completed shop drawings, as specified in Article 3.04 above shall serve as the Owner’s orientation.

END OF SECTION

APPENDIX 1 – ACRONYMS

ANSI	American National Standards Institute
BICSI	Building Industry Consulting Services, International
CESM	Compact Edge Switch-Managed
CLDF	Classroom Local Distribution Frame
EIA	Electronic Industries Alliance
ESM	Edge Switch-Managed
FEP	Fluorinated Ethylene Propylene
HVAC	Heating, Ventilation, and Air Conditioning
IDF	Intermediate Distribution Frame
IEC	International Electrotechnical Commission (IP Code)
IEEE	Institute of Electrical and Electronic Engineers
IP32	Degree of Ingress Protection Provided by Enclosures (IEC)
IP	Internet Protocol
IPX	Inter-network Packet Exchange
ISA	Industry Standard Architecture
ISDN	Integrated Services Digital Network
ISM	Intermediate Switch-Managed
ISP	Internet Service Provider
ITD	LAUSD, Information Technology Division
LAN	Local Area Network
LAUSD	Los Angeles Unified School District
LDF	Local Distribution Frame
LIU	Light Interconnection Unit
MDF	Main Distribution Frame
MDF-BBS	Main Distribution Frame Backbone Switch
MPOE	Minimum Point of Entry
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
OAR	Owner Authorized Representative
OFNR	Optical Fiber Non-Conductive Riser
OTDR	Optical Time Domain Reflectometer.
PA	Public Address
TIA	Telecommunications Industry Association
UL	Underwriters Laboratories Inc.
UTP	Unshielded Twisted Pair
WAN	Wide Area Network

END OF APPENDIX 1

APPENDIX 2 – DEFINITIONS

BBS	The Backbone Switch that serves as the central point of network termination, and provides network connectivity to IDFs, computer labs, student nutritional service areas, and libraries.
ISM	The Intermediate Switch–Managed serving as the network termination point for horizontal cabling to classrooms and other areas excluding computer labs and libraries.
ESM	The Edge Switch–Managed serving as the network termination point for horizontal cabling within computer labs, student nutritional service areas, and libraries.
CESM	The Compact Edge Switch-Managed and is a small form factor network access point within the classroom or other designated area for network connections.
MDF	The structure that serves as an entrance facility or main cross-connect, serving the building or campus.
IDF	Located between the MDF and the LDFs and provides a network access point for horizontal fiber cabling.
LDF	A wall-mounted cabinet that serves as the termination point for Category 5E cabling within the room/area in a computer lab, student nutritional service area, or library.

END OF APPENDIX 2

APPENDIX 3 – CABLE RECORD DOCUMENT

Cable Installation Record

Page: # of #

Project Name:

Date Work Completed:

Installation Contractor:

Inspected by:

Cable									Strand/Pair			Termination
#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12	Room Number
T	C	0	0	1	0	0	1	-	0	0	1	
								-	0	0	2	
								-	0	0	3	
								-	0	0	4	
								-	0	0	5	
								-	0	0	6	
								-	0	0	7	
								-	0	0	8	
								-	0	0	9	
								-	0	1	0	
								-	0	1	1	
								-	0	1	2	
								-	0	1	3	
								-	0	1	4	
								-	0	1	5	
								-	0	1	6	
								-	0	1	7	
								-	0	1	8	
								-	0	1	9	
								-	0	2	0	
								-	0	2	1	
								-	0	2	2	
								-	0	2	3	
								-	0	2	4	
								-	0	2	5	
T	C	0	0	1	0	0	2	-	0	0	1	
								-	0	0	2	
								-	0	0	3	
								-	0	0	4	
								-	0	0	5	
								-	0	0	6	
								-	0	0	7	
								-	0	0	8	
								-			•	
								-			•	
									SAMPLE ONLY			

LAUSD - Cable Record (Revision 1b - 06/01/06)

PROJECT NAME
SCHOOL NAME

10/01/2011
STRUCTURED CABLING (EXISTING SITES)
27 1013-50

END OF APPENDIX 3