

SDUSD GUIDE SPECIFICATIONS – 11/08/2010

**SECTION 27 15 23 – COMMUNICATIONS COPPER HORIZONTAL CABLING
INTERIOR**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01, 06, 07, 09, 26, 28 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Section 27 05 00 – Common Work Results for Communication Systems.
 - 2. Section 27 05 26 – Grounding and Bonding for Communication Systems.
 - 3. Section 27 11 16 – Communications Cabling, Racks, Frames, and Enclosures.
 - 4. Section 27 13 00 – Communications Backbone Cabling.
 - 5. Section 27 21 00 – Data Communications Equipment.
 - 6. Section 27 41 16 – Integrated Audio Video Systems.
 - 7. Section 27 41 33 – Master Antenna Television Systems.
 - 8. Section 27 51 16 – Public Address Systems.
 - 9. Section 27 51 24 – Assistive Listening Systems.
 - 10. Section 27 51 25 – Local Sound Reinforcement Systems.
 - 11. Section 27 53 13 – Clock and Bell Systems.

1.2 SUMMARY

- A. The work shall consist of labor and materials for the provision, termination, testing, and documentation of a complete and fully functional ANSI/EIA/TIA 568 B Category 6 copper horizontal cabling system.
- B. The instructions in this section are specific to communications copper horizontal cabling installations and should be read in conjunction with all other applicable divisions and sections of the contract documents. All Data pathways shall be constructed around ANSI/EIA/TIA 569 A (current revision) and BICSI standards and will use most of the recommended/suggested practices, including but not limited to service loops and cable bend radius.

1.3 CODES, STANDARDS, AND REFERENCES

- A. ANSI/EIA/TIA 568 B: Commercial Building Telecommunications Wiring Standard, current edition.
- B. ANSI/EIA/TIA 569 A: Commercial Building Standard for Telecommunications Pathways and Spaces, current edition.
- C. ANSI/EAI/TIA 606 A: The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings, current edition.

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- D. ANSI/EIA/TIA 607: Commercial Building Grounding and Bonding Requirements for Telecommunications, current edition.
- E. ANSI/EIA/TIA 758 A: Customer-Owned Outside Plant Telecommunications Cabling Standard, current edition.
- F. ANSI/ICEA P-61-694: Coding Guide for Copper Outside Plant and Riser Cable.
- G. Building Industry Consulting Service International (BICSI) publications:
 - 1. Telecommunications Distribution Manual, current edition.
 - 2. LAN and Internetworking Design Manual, current edition.
 - 3. Telecommunications Wiring Installation Manual, current edition.
 - 4. Customer Owned Outside Plant Design Manual, current edition.
- H. Cal OSHA: California Occupational Safety and Health Administration Regulations.
- I. CBC: California Building Code.
- J. CEC: National Electric Code with California Amendments.
- K. IEEE 802: A set of network standards developed by the IEEE.
- L. IEEE 802.3: Local Area Network (LAN) protocols. Ethernet Standard, defining the MAC layer for bus networks that use CSMA/CD.
- M. IEEE 802.11: Specifications developed by the IEEE for wireless LAN (WLAN) technology. Providing 1 or 2-Mbps transmission in the 2.4 GHz band using either frequency hopping spread spectrum (FHSS) or direct sequence spread spectrum (DSSS).
- N. IEEE 802.11a: Applies to wireless LANs and provides up to 54-Mbps transmission in the 5 GHz band.
- O. IEEE 802.11b: Applies to wireless LANs and provides 11 Mbps transmission (with a fallback to 5.5, 2, and 1-Mbps) in the 2.4 GHz band.
- P. IEEE C2 (NESC): National Electrical Safety Code.
- Q. NEC 770: Communications Technology. Applies to optical fiber cables.
- R. NEC 800: Communication Circuits.
- S. NFPA 70 (NEC): National Electric Code.
- T. NFPA 780: Lightning Protection Code.
- U. Underwriters Laboratories – UL 13: Power-Limited Circuit Cables.
- V. Underwriters Laboratories – UL 96: Standard for Safety Lightning Protection Components.
- W. Underwriters Laboratories – UL 96A: Standard for Safety Installation Requirements for Lightning Protection Systems.

- X. Underwriters Laboratories – UL 444: Standards for Communications Cables.
- Y. Underwriters Laboratories – UL 1479: Standard for Safety Fire Tests of Through-Penetration Firestops.
- Z. Underwriters Laboratories – UL 1863: Standard for Communications-Circuit Accessories.

1.4 DEFINITIONS

- A. The following definitions apply to the scope of this project:
 - 1. Backbone Cables: Cables linking the Main Distribution Frame (MDF) to each Intermediate Distribution Frames (IDF)
 - 2. Horizontal Cables: Cables linking from the Intermediate Distribution Frame (IDF) to each workstation outlet.
 - 3. Station Cables: Cables linking the workstation outlet to active equipment.
 - 4. Main Distribution Frame (MDF): Main cross-connect located in the equipment room, from which the Inter-building (campus) horizontal cabling emanates. The primary function of the MDF is to connect entrance cables, building horizontal cables and equipment cables.
 - 5. Intermediate Distribution Frame (IDF): The intermediate cross-connect onto which the building horizontal cables terminate and at which connections to the Main Distribution Frame (MDF) are made. The primary function of the IDF is to connect the MDF and the Intermediate Distribution Frame (IDF).
 - 6. Intermediate Distribution Frame (IDF): The cross-connect frame where the horizontal cabling in the respective classroom terminates to other cabling, e.g., building horizontal cabling.
 - 7. Main Distribution Frame/Intermediate Distribution Frame (MDF/IDF): The cross-connect that functions both as MDF and IDF.
- B. Acronyms:
 - 1. PBX: Private Branch Exchange.
 - 2. RTU: Remote Terminal Unit.
 - 3. TDR: Time-domain Reflectometer.
 - 4. RCDD: Registered Communication Distribution Designer.
 - 5. ELFEXT: Equal Level Far-End Crosstalk.
 - 6. NEXT: Near-End Crosstalk.
 - 7. PSELFEXT: Power Sum Equal Level Near-End Crosswalk.
 - 8. PSNEXT: Power Sum Near-End Crosswalk.
 - 9. CMP/CMR: UTP Network Cable Ratings (P-Plenum; R-Riser).
 - 10. UTP: Unshielded Twisted Pair.

1.5 SCOPE OF WORK

- A. The Work shall include labor and materials that consist of provisions, installing, terminating, testing, and documenting a complete and fully functional communications copper horizontal cabling system. The work shall include, but not limited to the following.
- B. Conduct underground detection survey to ensure constructability of outside plant pathway routing.

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- C. Provide indoor optical fiber and copper cabling.
- D. Furnish and install modular patch panels for termination of UTP and copper horizontal cables within the MDF/IDF. Use copper patch panels for all copper horizontal cable terminations located in the MDF and IDF.
- E. Furnish and install telephone punch blocks at PBX location using multi-pair cable for interconnection between PBX and MDF, as required. Furnish and install intrusion punch blocks at RTU location using multi-pair cable for interconnection between RTU and MDF.
- F. Furnish and install connectors (terminate cable) and wall and/or faceplates as specified.
- G. Furnish and install all high impact plastic cover wall and/or faceplates and connector housings for all communication systems outlet locations.
- H. Furnish and install connectors (terminate cable) and wall and/or faceplates as specified.
- I. Furnish and install equipment racks, with zone 4-rated seismic bracing and associated accessories in telecommunications spaces where required.
- J. Furnish and install full labeling of the entire installation in compliance with ANSI/EIA/TIA 606, prior to testing.
- K. Testing of each copper horizontal cable and connector with Power Meters and TDR.
- L. Furnish the documentation of the installation, including test results, cable management records, and as-built documents on paper and in electronic format on CD-ROM (AutoCAD and MS Visio for drawings, MS Excel for schedule).
- M. Provide and install associated and incidental items that may not be specifically indicated but belong to the Work described and which are required for a complete system.

1.6 WORK NOT INCLUDED

- A. The work detailed in this section shall not include the following:
 - 1. Installation of active networking equipment and computer terminals.
 - 2. Installation of telephone equipment and associated services.
 - 3. Installation of wireless access point devices.

1.7 SUBMITTALS

- A. Refer to Division 01, Article 9.1 for general submittal guidelines, and submit, for approval, all submittals specified herein, within thirty (30) days of Notice to Proceed.
- B. Format: Submittals for the copper horizontal cabling system shall be arranged in accordance with the sequence of sub-section headings in this specifications section. All submittals shall be signed by an RCDD for the work defined under this section.
- C. References: Provided three (3) project references as required in Paragraph 1.2 A, of this Section with bid proposal. All project references shall be within sixty-mile radius of this project and be accessible for the District to visit upon request.

- D. **Personnel Qualifications:** Technical certifications of the installation team as defined in 1.8, B of this section. The submittal shall reflect appropriate manpower required to complete this project as consistent with the overall project timelines and milestones.
- E. **Single Line Diagrams:**
1. A complete shop drawing, which shall be based on all drawings included in the Construction Documents. It shall be updated to show quantities, part numbers, and descriptions for all components including copper patch panels, cables, conduits, cable trays, and all other associated components.
 2. Telecommunications grounding and bonding implementation that comply with ANSI/EIA/TIA 607A standards.
 3. Customer-owned outside plant pathway routing and spaces that comply with ANSI/EIA/TIA 758 A standards.
 4. Telecommunication administration and documentation implementation that comply with ANSI/EIA/TIA 606 A standards: It shall include all components of the communications infrastructure system including telecommunications pathways and spaces, bonding and grounding, horizontal and horizontal cabling cross-connects, patch cables, station cables, and all other associated components.
- F. **Test Equipment:** Details of each item of test equipment to be used to test the copper components. Include patch cords and all other associated specialized components.
- G. **Product Literature/Data Sheets:** Manufacturer's product data sheets for each component to be provided by the Contractor to make up the complete copper horizontal cabling system. The product literature/data sheets shall be arranged in the sequence of items as listed in Part 2 of this section. Certify that the data sheets depict the components as described in this section of the Specifications.
- H. **Component Samples and Mock-ups:**
1. Ten (10) working days after approval of product literature/data sheets submitted, provide for approval, one installation sample mock-up of each of the following components, to be fully labeled in accordance with this section of Specifications.
 2. All sample mock-ups are intended to represent the components that are to be installed as part of this project; therefore, they are to be provided with all associated components and labeling necessary to make up a complete mock-up. Installation shall not proceed until all samples have been approved. The Consultant will retain all samples.
 3. **Copper Cable Samples:** Provide a 24" length of each type of copper cable being used as a part of this installation. The outer jacket shall be stripped back 6" from one end of the sample to allow the individual pairs to be inspected for all cables. Label each cable as detailed in this specification. The sample shall show all cable markings, including part numbers, Manufacturer, and lengths.
 4. **Patch Panels:** Category 6 patch panel samples, one each. This shall consist of the respective specified patch panel, fully loaded; complete with all associated components. The patch panel shall be fully loaded with the maximum number of cables dressed into the patch panel and terminated as described in this specification. All strain relief shall be provided as part of the sample. The unit shall be fully labeled in compliance with ANS/EIA/TIA 606 A standard.
 5. **Outlet Samples:**

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- a. Provide a mock-up of each communications outlet, as listed below. The sample is intended to represent a typical communications outlet and shall include all associated parts to make a complete sample. Provide bushings and strain relief for the distribution cable jacket, demonstrating how the cable shall be secured. Label the outlet and each connector as detailed in this specification.
 - b. Provide samples of the following outlet configurations:
 - 1) Wall-mounted outlet - provided the communications outlet and all terminations, the electrical backbox, a 12" length of raceway and a 36" length of the relevant cable(s). Labeling shall also be provided.
 - 2) Wall-mounted phone outlet - provided faceplate and jack insert only.
 - 3) Furniture outlet – provided faceplate, bezel, outlets, cable and labeling only.
6. Upon approval, the samples will be used as the standards by which the quality of work on the project by the Contractor shall be judged. Any installation that does not meet this standard shall be replaced or re-worked by the Contractor as approved by the District, at no additional cost to the project.

I. Record Documentation:

1. Ten (10) working days following completion of the installation, submit the following record drawings, documentation and testing for approval and inclusion into the Operations and Maintenance Manual.
2. Operations and Maintenance Manual: Manual shall be in matching three ring binders, clearly and neatly identified, including the project name, address, discipline and date. Submit five (5) copies.
3. Provide a complete Table of Contents without required detailed material for review and acceptance prior to preparing final manuals.
4. Base final manuals on comments received from this review:
 - a. Submit one final manual with all information for review and acceptance.
 - b. Submit final required total number of copies after this review.
5. Table of Contents:
 - a. Original design criteria, Section 27 15 23 – Communications Copper Horizontal Backbone Cabling Specifications.
 - b. Record Design Record Drawings. Submit Table of Contents and include all design drawings prepared by communication designers, including drawing number, original issue date, and list of all revision numbers and dates of issue.
6. Design team shall update drawings and reflect the latest Scope of Work. Drawings are not intended to represent the detailed actual installed conditions, but rather to reflect the contractual status of the scope of the design work.
 - a. It is the construction Contractor's responsibility to obtain the latest design drawings as part of this section of the manuals.
 - b. Stamp clearly "RECORD DESIGN" on each drawing.
 - c. Provide two complete sets of reproducible drawings separately from the manual book, to the District, IT Department of the District and the Physical Plant Operations Department of the District.

7. Record Drawings: Provide five (5) sets of Record (As-built) Drawings showing locations of telephone, tele/data and data outlets, horizontal, link and external cable routes, data rack locations and telephone termination board locations.
8. Final Test Results: Test results for each cable indicating tests performed, results obtained and values measured. Test results shall be provided in electronic format with the associated application (if required) for viewing.
9. All documentation and drawings shall be provided in an electronic format (AutloCAD and MS Visio for drawings, MS Excel for schedule, etc.) and supplied on CD-ROM.

1.8 QUALITY ASSURANCE

- A. Qualifications: Contractor-employed persons or organizations performing work under this section shall have a minimum of three (3) years full-time experience executing work of similar scope and complexity. The Contractor shall have completed and have been the primary responsible Contractor for at least three previous installations of comparable size, complexity, and work force within the last three years. Each installation shall utilize components, installation practices and testing procedures as specified in this document.
- B. Certifications: Installers shall be certified by the Manufacturer of the equipment and components being furnished and be authorized by the Manufacturer to install and convey the product warranty and performance guarantee to the District upon completion of contract. The Contractor shall employ a Registered Communications Distribution Designer (RCDD) or pre-approved equivalent to serve as an onsite Project Manager. The Project Manager is responsible for the entire project and will serve as the single point of contact until the completion of the Work. The RCDD shall be in good standing with Building Industry Consulting Services International (BICSI) and shall have a current registration. Installation and testing crew assigned to this project shall be BICSI Registered Technicians who have held a certification for a minimum of six (6) months at the time of installation, for copper and fiber cabling installation by the Manufacturer whose components are to be installed. The Registered Technicians shall be in good standing with Building Industry Consulting Services International (BICSI) and have a current registration.
- C. Regulatory Requirements: The Contractor shall certify that all products to be installed meet or exceed every performance parameter specified in all applicable standards published or ratified by American National Standards Institute/Telecommunications Industry Association/Electronic Industry Association (ANSI/EIA/TIA) and/or Institute of Electrical and Electronic Engineers (IEEE) within thirty (30) days prior to commencement of the work.
- D. Licensing: The Contractor shall hold a valid C-7 Contractor's license in the State of California, and be insured and bonded throughout the duration of the project. The Contractor is responsible for obtaining and paying for all permits and inspections required by all legal authorities and agencies having jurisdiction to perform the work, without additional cost to this project.
- E. Letter of Compliance: Letter of Compliance, Attachment "A", shall be completed and signed by the Contractor and the Subcontractor(s) and provided with proposal documents.
- F. Mock-Ups and Component Samples: Construct full-size installation mock-ups of all the components listed in Part 2 of this specification for review and District's approval. Submit mock-ups within ten (10) days after approval of product literature/data sheets. Approved mock-ups shall serve to establish standards by which the Work will be judged. Remove mock-ups only after Work is substantially complete and with District's approval.

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1.9 PROJECT CONDITIONS

- A. To ensure a constructible copper horizontal cabling system, the Contractor shall examine all drawings and specifications to familiarize themselves with the type of construction materials to be used, and the nature and extent of work provided in other sections of the construction documents. Any clarifications needed shall be requested no later than ten (10) working days before bid opening. Upon contract award, Contractor shall assume full responsibility for any cost incurred due to changes as required to complete the work as defined in this section.
- B. Coordinate copper horizontal cabling with Division 27 Contractor installing conduit/raceways, electrical boxes, hand holes, pull boxes, and power receptables. This coordination shall occur prior to start of construction to insure proper alignment of components and equipment.
- C. Verify dimensions and the correct location of hardware before proceeding with the installation of hardware, cabling, and/or connections.
- D. All existing utilities (voice, data, intrusion, safety systems, etc.) serving facilities occupied by District or others shall not be interrupted unless permitted under the following conditions and then only after arranging temporary utility services according to requirements indicated:
 - 1. Notify the Construction Manager no less than five (5) working days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without the Construction Manager's written permission.
 - 3. Contractor shall furnish and provide an alternative communications path and/or equipments for these utilities during interruptions, without additional cost to the District.
 - 4. Ensure that existing equipment and furniture are returned as found in original locations.

1.10 WARRANTY

- A. The Contractor shall furnish Manufacturer extended Component Product Warranty and Complete ANSI/TIA/EIA-Compliant System Performance Guarantee for no less than twenty five (25) years, with additional performance criteria specified in this section.

1.11 MANUFACTURERS

- A. The component Manufacturer part numbers specified in this document are not intended to limit or restrict submission of proposals for products by other Manufacturers but to set a baseline of performance, operational functions and product accuracy that all proposals must meet.
- B. In conjunction with Division 01, Article 10.2, it is acceptable for Bidders to submit any proposal for substitution of Manufacturers not less than ten (10) working days before bid opening. Proposed components shall be listed in an index page with exact sequence of components listed in this specification, and be accompanied by samples, shop drawings of individual components with comparison of detail dimensions in comparison to those specified, neutral third party verification, test results, certifications, and all pertinent technical data.
- C. No substitution of components in this section shall be considered after thirty five (35) days of Notice to Proceed.

1.12 ADMINISTRATION STANDARD FOR TELECOMMUNICATIONS INFRASTRUCTURE

- A. The Contractor shall provide all labeling materials. The Contractor shall provide the communications administration scheme in compliance with ANSI/EIA/TIA 606 standard, for approval. This labeling scheme will implement building numbers, room numbers (where applicable), work area outlets, and all other components that make up the Copper horizontal cabling system.

1.13 SYSTEM PERFORMANCE

- A. The copper horizontal cabling system shall support data network protocols/services at data transmission speed of 1000 Mb/s (Gigabit Ethernet) as defined in IEEE 802.3 standards.
- B. The following performance criteria shall also be met for worst-case EIA/TIA 568-B.2-1, 4-connector, 100-meter horizontal channels.
 - 1. Exceed EIA/TIA Category 6 channel specifications for NEXT, PSNEXT, ELFEXT, PSELFEXT and Return Loss by a minimum of 17.3 dB @ 250 MHz in any EIA/TIA compliant channel configuration up to a 4 connector channel.
 - 2. Channel performance guarantees shall be verified in the field with a Manufacturer approved hand-held tester.
 - 3. Free from bit errors caused by the structured cabling system for, horizontal and peer-to-peer channels.
 - 4. Comprised of solid conductor (CMP/CMR) UTP, and stranded patch cordage from the same cable Manufacturer.
 - 5. Verified by neutral third party testing laboratory for EIA/TIA Category 6 channel performance to 250 MHz or higher, the verification is representative of 2, 3 and 4-connector CMP and CMR 100-meter channels.
 - 6. Free from bit errors caused by the structured cabling system for 100Base-TX, 1000Base-T, 1000Base-SX, and 1000Base-LX as verified by a neutral third party testing laboratory.
 - 7. Verified by a neutral third party testing laboratory for 100Base-TX/1000Base-T, 1000BaseSX/LX peer-to-peer testing at worst-case 4-connector 100-meter horizontal UTP channels through worst-case 2-level multimode optical horizontals at a minimum of 600-meters (1000BaseSX).
 - 8. 5 Gb/s (CAT-6) channel capacity guarantee for horizontal structured cabling system at 250 MHz.

PART 2 - PRODUCTS

2.1 COMPONENTS

- A. This specification section is built around a copper cable based ANSI/TIA/EIA 568-B compliant wiring infrastructure. All terminations shall conform to T568B wiring standard. Vendors are to supply systems that meet or exceed the functional requirements herein. The base for this design includes all hardware components and cabling a complete copper horizontal cabling system.
- B. Following attributes will be implemented in all future copper horizontal cabling design:
 - 1. Classroom Wall Mount (Typical MDF/IDF) configuration) 6 voice/data drops consisting of 1 triplex wall plate with 3 drops on the teacher's wall, 1 duplex with 2 drops, and one

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- drop, biscuit block or wall-mounted above the drop ceiling near the exterior wall. The classroom wall mount configuration is associated with MDF/IDF structured cable plants.
2. To IDF from Classroom Wall mount:
 - a. Data Cabling – Provide 6 Category 6 cables from Classroom Wall and ceiling mounts to IDF modular patch panel locations in the IDF.
 - C. In the MDF Room (Main Distribution Frame): Provide and install minimum of one Primary Rack and two Secondary Racks. Provide and install within the Secondary Rack, Category 6 UTP patch panels, and wire management for termination of Category 6 copper horizontal cable in the MDF. The remaining Primary Rack space will be used for data communications hardware (not supplied under this contract).
 - D. In MDF and IDF Rooms: The following configuration shall be adhered to, for rack component placement (top position going down):
 1. PoE Switch – 1U.
 2. 24 port patch panel – 1U.
 3. Wire management panel – 1U.
 - E. In the MDF and IDF Rooms: Group classroom cables in the following fashion on patch panels:
 1. Classroom A Voice/Data Drops (first classroom of two per patch panel): Five (5) wall-mounted drops in one contiguous group using positions 1-5 on patch panel.
 2. Classroom B Voice/Data Drops (second classroom of two per patch panel): Five (5) wall-mounted drops in one contiguous group using positions 13-17 on patch panel.
 3. Classroom A LWAP and Spare Drops: One (1) LWAP designated drop shall occupy position 12 with 5-11 spare.
 4. Classroom B LWAP and Spare Drops: One (1) LWAP designated drop shall occupy position 24 with 17-23 spare.
 5. The above represent preferred grouping arrangement of classroom cables on patch panels. In the event, existing configuration requiring a different grouping arrangement is encountered, the cable grouping arrangement on patch panels shall be configured with prior consultation and approval of the District's IT Department.
 - F. Category 6 Data/Voice Cable:
 1. Provide blue, plenum-rated, Category 6, characterized to 500 MHz with a minimum guaranteed PSACR of 3.5 dB and minimum guaranteed Return Loss of 17.3 dB @ 250 MHz, unshielded twisted pair (UTP) four pair cable for locations as noted herein. Do not exceed a total footage of two hundred ninety five feet for any single run. Termination of all plenum-rated, data, Category 6, UTP cable will be according to T568-B termination scheme.
 2. UTP, plenum-rated, Category 6 cable shall be LANmark-6, 10136233, by Berk-Tek or District pre-approved equal.
 3. Provide Quantity of: As required.
 - G. MDF/IDF Data Patch Panels:
 1. Terminate all Category 6 cabling in the MDF on EIA/ITA Category 6 compliant rack mounted patch panels located in the data rack(s). Provide sufficient patch points for each

Category 6 cable terminated in the MDF room plus spares as needed. With each patch panel, provide a closed or open cover wire management panel with dimensions sufficient for wiring management that is mounted on a standard EIA 19" compatible mounting panel. Rack mounted patch panels shall be OR-PSD66U48 by Ortronics or District pre-approved equal.

2. With each patch panel, provide a metal, five ring horizontal wire management panel with dimensions sufficient for wiring management that is mounted on a standard EIA 19" mounting panel. Horizontal wire management shall be OR-60400131 (1RU), by Ortronics or District pre-approved equal.
3. With each patch panel provide 1 Rack Unit of open space to accommodate the Data Communications Switch.
4. Provide Quantity of: As required.

H. Wall Plates and Connectors:

1. The Contractor will be responsible for providing all plates for communication boxes whether they exist for interconnection to Video, Voice, or Data systems. The Contractor will also be responsible for providing a connector housing for every communication box in the facility whether that box contains active or inactive ports.
2. Faceplates: Provide single-or dual-gang high impact front and rear loading compatible plastic faceplates, fog white in color for all communication box locations as shown on the contract drawings. Faceplates shall be TracJack OR-40300548 and OR-40300547 by Ortronics or District pre-approved equal.
3. Housing: Provide a 4-port field configurable housing from the surface raceway Manufacturer matching the raceway in material or color for all communication boxes brackets located on the raceway. Raceway device bracket base-plate shall be OR-40800019-99 by Ortronics. For all housing, provide blanks for connector positions that are not utilized. Blank modules shall be OR-42100002-99 by Ortronics or District pre-approved equal.
4. Data Outlets: Terminate all outlets with one orange Category 6 snap-in module. Utilize the EIA/TIA T568-B termination method. Provide blank modules as necessary to fill all unused positions of the outlet. Category 6 module shall be OR-TJ600-23 by Ortronics or District pre-approved equal. Blank module shall be OR-42100002 by Ortronics or District pre-approved equal.

2.2 TEST EQUIPMENT

A. Draft Category 6 Test Equipment:

1. Microtest Omni-Scanner, Fluke DSP-4100, or District pre-approved equal Level III tester to be used for Category 6 tests.
2. Provide test leads for the specific cabling system Manufacturer as specified in this document.
3. Power Meter: Fluke DSP-4100/DSP-FTA10S or District pre-approved shall be used for copper horizontal testing.

PART 3 - EXECUTION

3.1 EXECUTION

- A. Through examination and coordination shall be conducted by the Contractor prior to installation, to ensure that the following conditions are met:
1. All works furnished under other trades, such as cable trays installations, pathway provisions, etc., that have impact on the structured cabling systems are in compliance with this specification and the construction documents.
 2. Upon delivery to project site, the Contractor shall ensure all components to be installed are free from defects and workmanship.
 3. Prior to installation, the Contractor shall verify that all related work, furnished under other trades, are in compliance with all requirements for the execution of the work under this section.
- B. Do not start the work of this section until all deficiencies have been corrected. Commencement of work constitutes acceptance of total and absolute responsibility including but not limited to bearing all cost to redo the work of this section and work furnished under other sections as well.

3.2 INSTALLATION

- A. Horizontal Distribution Cabling: As specified in the construction drawings and this specification, place plenum-rated distribution cables, no longer than 290 feet each including service slack, running from each communications connector to the patch panels located in the MDF or IDF serving each outlet:
1. Maintain minimum bend radius of 1" for copper cables.
 2. Do not exceed maximum pull force of 110 N (25 lbf) per cable. To ensure that there is no excessive tension and deforming of the cable, use a 25 lb. breakaway swivel attached between the pull rope and the cable for all horizontal distribution cables.
 3. All cables shall be secured in Category 6 compliant "rings" and Velcro® straps cable ties as appropriate.
 4. No tie wraps shall be used on this project.
 5. When within the 290-foot distance limit, the service slack in the Telecommunications Room shall be the total length of the distance to reach the farthest corners, plus the distance from floor to ladder rack.
 6. The length of services slack at the work area shall be 2 ft. long for all cables.
 7. Pull ropes must be reinstated for future cabling.
 8. Each cable label shall be a unique identifier that is clearly visible on both ends of the cable in accordance with EIA/TIA 606.
 9. Cable information detailing the origin and destination of each cable at both ends shall be documented.
- B. Horizontal and Link Cabling: As specified in the construction drawings and this specification, place the horizontal cabling connecting the telecommunications spaces, i.e., MDF/IDF, and entrance facilities:
1. During pulling from top down in vertical pathway, use a reel dolly to place the cable. A reel brake shall be used to help control the descent of the cable as it is pulled off the cable

reel. Pulleys will be used to handle the cable from the reel to the point where it will be dropped down to lower floors.

2. During pulling from bottom up, use swivels, tuggers, and pulleys.
3. All horizontal copper cables shall be placed in cable trays.
4. At each floor, all cables shall be secured using channel with straps.
5. When the vertical pathway enters a wiring closet, make a sweep of the cable toward the termination point and secure the cable onto vertical cable tray, with Velcro® straps within cable trays or ladder racks. Cable ties (zip-ties) are not acceptable.
6. The service slack shall be the total length of the distance to reach the farthest corner, plus the distance from floor to ceiling and another additional ten (10) feet.
7. All cables shall be secured with Velcro® straps and other appropriate devices to the backboard, tray, or rack.
8. Document the cable information, showing clearly what kind of cables installed, which conduit used, and the purpose of the installed cables.

C. Communications Outlets:

1. Administrative Work Areas, and Offices within Classrooms.
 - a. Unless otherwise specified, each workstation shall have one (1) 2-port faceplate configured with two (2) 8P8C Category 6 connectors for data and/or voice applications.
 - b. Provide two (2) Category 6 distribution cables running from each outlet back to the MDF/IDF.
 - c. Terminate all distribution cables onto the Category 6 patch panels in the MDF/IDF as appropriate.
 - d. Terminate each Category 6 distribution cable at each end using the EIA/TIA T568B wiring scheme.
2. Teacher's wall within Classrooms.
 - a. Unless otherwise specified, each workstation shall have one (1) 3-port faceplate configured with two (3) 8P8C Category 6 connectors for data and/or voice applications.
 - b. Provide two (3) Category 6 distribution cables running from each outlet back to the MDF/IDF.
 - c. Terminate all distribution cables onto the Category 6 patch panels in the MDF/IDF as appropriate.
 - d. Terminate each Category 6 distribution cable at each end using the EIA/TIA T568B wiring scheme.
3. Standard Communications Outlet in Rear of Classrooms (Refer to Construction Drawings):
 - a. Unless otherwise specified, each workstation shall have one (1) 2-port faceplate configured with two (2) 8P8C Category 6 connectors for data and/or voice applications.
 - b. Provide two (2) Category 6 distribution cables running from each outlet back to the MDF/IDF.
 - c. Terminate all distribution cables onto the Category 6 patch panels in the MDF/IDF or wall mounted as appropriate.

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- d. Terminate each Category 6 distribution cable at each end using the EIA/TIA T568B wiring scheme.
 4. Standard communications outlet in ceiling for Wireless Access Points (WAP):
 - a. Unless otherwise specified, each WAP shall have one (1) 1-port faceplate configured with two (1) 8P8C Category 6 connectors for WAP applications.
 - b. Provide one (1) Category 6 distribution cables running from each outlet back to the MDF/IDF.
 - c. Terminate all distribution cables onto the Category 6 patch panels in the MDF/IDF as appropriate.
 - d. Terminate each Category 6 distribution cable at each end using the EIA/TIA T568B wiring scheme.
- D. Required Installation Practice:
 1. Provide bushings, grommets, and strain-relief for cables terminating in equipment cabinets to ensure durable and robust connections. The bushings and grommets are intended to protect the cables from any sharp edges that present a risk to the cables. Ensure that all sharp edges are covered to protect the cables from damage.
 2. No cables shall be installed in a fashion that contravenes either the minimum installed or the minimum under-load bend radius of the cable.
 3. No cable is to be pulled through a conduit "L-bend" (condulets).
 4. Install all cables in complete runs from outlet or patch panel to patch panel. In-line joints, splices, distribution points or other intermediate connections are not permitted.
 5. At no point shall the communications cables be tied to power cables or other building services or their supports, or run in the same ducts, raceways, conduits or connection boxes as per power cabling.
 6. Use plenum-rated Velcro® straps in all ceiling voids.
 7. Where conduits are not provided in ceiling void or access space, install Category 6-compliant "rings" at intervals of every four (4) feet.
 8. Reinstall all pull-wires in conduits and ducts after use to facilitate future addition of cables.
 9. Cables shall not be held so tightly with Velcro® straps so as to bend or warp the cables.
 10. Individually and properly ground all relay racks, ladder racks, and equipment cabinets.
 11. Ensure that all waste materials are disposed of in a safe manner. Pay particular attention to waste materials produced during the termination of copper horizontal cabling. Ensure that all used components and copper cut-offs are collected in purpose-made containers and disposed of properly.
 12. Replace all moisture and fire barrier material in ducts, conduits, and other penetrations disturbed during installation of structured cabling. Install barrier material in all fire-rated penetrations that have cabling running through them. The barrier material shall be installed so the final penetration has the same fire rating as the original wall/floor.
 13. Provide expansion plugs in all ducts/conduits entering the building. Seal all unused ducts/conduits with plugs that allow the pull-string to be tied off on the inside.
 14. Use purpose-built pulling grips during cable installation. Do not pull cables by attaching pull wires to cable jackets, elements or reinforcement. Use strain gauges or equivalent measures to ensure that the maximum tensile load rating of the cables is not exceeded during installation.

15. The number of cables in each conduit shall be controlled to allow for future cable installation and to remain within the Manufacturer's maximum allowable cable pulling tension. Conduit fill ratios shall not exceed the current requirements of the CEC.
 16. The maximum run length of each distribution cable shall not exceed the 290-foot limit. Notify the District immediately if, due to on-site conditions or other factors, the length of a distribution cable exceeds this distance.
 17. Provide Velcro® (hook and loop) ties to secure cabling running in the telecommunications spaces. Provide straps at 3' intervals. Upon completion of installation, neatly run and re-tie all cable bundles.
- E. Unused Complementary Parts of Components: Any unused complementary parts included in any component purchased in accordance with these specifications shall be documented and submitted to the District upon complete of the project.
- F. Testing:
1. General Instructions:
 - a. The testing is to demonstrate beyond reasonable doubt that there are no errors, damaged or incorrectly installed components, that the installation is correctly labeled and that all the installed components meet or exceed the criteria detailed in this section of the specification. Any test that does not demonstrate that a component is satisfactorily installed, as per these specifications, shall be repeated. If a test procedure requires modification to satisfactorily test some components, the modification shall be submitted for approval to the District before the tests are conducted
 - b. Following copper horizontal cable installation, including labeling and termination at both ends, undertake and record tests to ensure that the cabling system will perform satisfactorily in service. In addition to the tests detailed in this specification, the Contractor shall perform any additional tests that are deemed necessary to ensure the satisfactory operation of the systems. The Contractor shall incur the costs of these additional tests.
 - c. All outlets, cables, patch panels and associated components shall be fully assembled and labeled prior to testing. Any testing performed on incomplete systems shall be redone upon completion of the work.
 - d. All testing shall be performed in presence of the Districts representative. The Contractor shall demonstrate that the test procedures appropriately identify the fault conditions being tested for.
 - e. Complete all of the tests identified in these specifications.
 - f. Notify the District at least ten (10) working days before the date of commencement of the cable tests. Provide details in writing, on the advance date of proposed tests including the test schedule, equipment to be used, the test certification and calibration, and the names and qualifications of test personnel.
 - g. The District or a designated representative shall be present during each type of test conducted. Contractor shall develop a reasonable, mutually agreeable schedule for the District to observe all tests. First instance tests shall be scheduled in such a fashion which will allow the District adequate time and opportunity for full participation.
 - h. In the event of multiple tests being conducted by the Contractor prior to this first inspection, the District reserves the right to reject these tests as non-compliant and to require them to be repeated at the Contractor's cost.

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- i. Personnel shall be competent in and qualified by experience or training for comprehensive TDR operation and troubleshooting, for both copper and optical fiber testing.
 - j. Include the cost of obtaining, calibrating and maintaining test equipment and the cost of carrying out and recording the tests detailed in this specification, including labor costs, in the bid sum. No extra costs will be entertained.
 - k. Ensure that all test equipment is in calibration before deliver to site and throughout the testing period. The Contractor shall be responsible for ensuring that any necessary tests and rework needed to maintain equipment's calibration status is carried out. Any tests performed on test equipment without calibration shall be repeated at the Contractor's cost.
 - l. The test documentation shall be available for inspection by the District during the installation period and copies shall be provided to the District within five (5) working days of completion of tests on cables in each area. The Contractor shall retain a copy to aid preparation of as-built information.
 - m. District reserves the right for District to observe and verify all re-tests. If the District wishes to exercise this right, Contractor will provide a mutually agreeable, reasonable re-test schedule.
 - n. Failures detected during the testing shall be noted on the test results schedule, rectified and re-tested. On the fault being rectified, this shall also be noted. These notes shall not be deleted or obliterated.
 - o. Rectification of all damaged cables shall include replacing damaged cables with new cables in complete runs, replacing damaged connectors or remaking poor terminations. In-line cable joints, splices or distribution points will not be acceptable except where specified in this document. All damaged cables shall be removed from site.
 - p. If, upon submittal of the construction record documentation, there are any missing test results or incorrectly named files, the test shall be repeated at the Contractor's expense.
2. Category 6 Cabling: Test each Category 6 cable and associated connectors. Carry out the following tests on every pair of every Category 6 cable.
- a. Conductor Continuity.
 - b. Conductor Separation.
 - c. Conductor Polarity.
 - d. Pair Mapping.
 - e. NEXT, ELFEXT, ACR and Attenuation.
 - f. Power Sum NEXT, Power Sum ACR and Power Sum ELFEXT.
 - g. Structural Return Loss and Delay Skew.
 - h. Cable length.
3. Work Area Faceplates:
- a. Carry out a visual inspection of the faceplates and blanking plates. Replace all damaged components.
 - b. Ensure that all faceplate labels are installed correctly, leveled and plumb.

END OF SECTION 27 15 23

SEE ATTACHMENT "A" – LETTER OF COMPLIANCE

COMMUNICATIONS COPPER HORIZONTAL CABLING INTERIOR
27 15 23 - 16

ATTACHMENT “A” – LETTER OF COMPLIANCE

TO: San Diego Unified School District

Reference bid opening, dated _____, for:

School Name(s):

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Dear Sirs,

The Subcontractor, _____ (Subcontractor Name),
is certified by _____ (Manufacturer(s) name) to install
and convey product warranty and performance guarantee to San Diego Unified School District upon
completion of installation for the above name(ed) school(s) structured cabling system. The products and
components furnished conform to Section 27 15 23. Attach copy of Manufacturers certificate.

General Contractor _____

Address _____

Phone Number _____

Fax Number _____

Email Address _____

General Contractor Printed Name

General Contractors Signature

Date

Subcontractor Name _____

Address _____

Phone Number _____

Fax Number _____

Email Address _____

Subcontractor Printed Name

Subcontractors Signature

Date