SECTION 271000 - STRUCTURED CABLING

PART 1 - GENERAL

1.1 WORK INCLUDES

A. Contractor shall provide:

1. Category 6 cabling.
2. Category 6 patch panels.
3. Category 6 patch cords.

4. Category 6A cabling.
5. Category 6A patch panels.

6. Multipair copper trunk cable.

7. Fiber optic cabling.
8. Fiber optic termination cabinet with adapter panels.
9. Fiber optic patch cords.

10. 110IDC Termination Blocks for Analog and Telephone (Voice) cabling.
11. Building Entrance Terminal (with electronic modules).

12. Water-resistant ("weatherproof") coverplate.

13. Identification and Labeling for Wireless Access Points.
14. Connectors and Terminations.

15. Floor-mounted Open Frame Reay Rack.
16. Wall-mounted Open Frame Relay Rack.

17. Testing and labeling of all cabling.
18. 20-year minimum Cabling System Warranty.

1.2 RELATED SECTIONS

A. Section 260533 – Conduit.

B. Section 260534 – Boxes.

C. Section 262726 – Wiring Devices.

D. Section 260553 – Electrical Identification.

E. Section 271000 – Communication Raceway System.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions

apply to this Section.

B. Design Criteria: The structured wiring system shall be comprised of horizontal copper and backbone fiber optic cables routed throughout the building. This system shall provide transmission media for voice and data signals. The contractor shall provide structured wiring transmission media, components, and testing as specified herein at locations shown on the plans and in conformance with manufacturers' recommendations.

1.4 SUMMARY

A. This Section includes the following types of control and signal transmission media:

1. UTP Copper, 4-Pair CAT 6.
2. STP/FTP Copper, 4-Pait CAT-6A.
3. Multipair CAT-5e.

4. Singlemode fiber optic cabling (OS2).
5. Multimode fiber optic cabling, 50um (OM3).
6. Multimode fiber optic cabling, 62.5um (OM1).

B. This Section includes the patch panels, connectors, patch cords, outlets, terminal blocks, etc. as required to provide a complete structured system. Documentation is critical to the successful installation of the structured wiring system. Unless agreed to in writing the systems shall be documented as specified herein or shown on the drawings.

C. Installation shall conform to the 2011 edition of NFPA 70 (National Electric Code, NEC), Telecommunications Industry Association and Electronic Industry Alliance (TIA/EIA), Building Industry Consulting Services International (BICSI), Telecommunications Distribution Methods Manual (TDMM), and local codes and ordinances, as applicable.

D. In addition, Installation shall conform to the latest edition of the following Codes and Standards:

1. ANSI/TIA 568-C.1 Commercial Building Telecommunications Cabling Standard.
2. ANSI/TIA 568-C.2, Balanced Twisted-Pair Cabling and Components.
3. ANSI/TIA 569-C, Commercial Building Standards For Telecommunications Pathways And Spaces
4. ANSI/TIA 606-B The Administration Standard For The Telecommunications Infrastructure Of Commercial Building
5. ANSI/TIA 607-B, Commercial Building Grounding And Bonding Requirements.
6. ANSI/TIA 862-A, Building Automation Systems Cabling Standard.
7. ASTM D 4566-05, Standard Test Methods for Electrical Performance Properties of Insulations and Jackets for Telecommunications Wire and Cable, 2005
8. BICSI Telecommunications Distribution Methods Manual (TDMM) 13th Edition
9. BICSI Information Transport Installation Manual (ITSM)
10. ISO/IEC 11801 – Information Technology – Generic Cabling for Customer Premise
11. IEEE 802.3 Standard for Information technology -Telecommunications and information exchange between systems - Local and metropolitan area networks – Specific requirements Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications
12. IEC 61156-1, Multicore and Symmetrical Pair/Quad Cables for Digital Communications – Part 1: Generic Specification, 2005

13. Federal Communications Commission Part 15 and Part 68
14. UL 444 – Standard for Safety of Communications Cable
15. UL 1666 – Standard for Safety of Flame Propagation Height
16. NFPA 70 – National Electrical Code, 2011 edition.
17. NFPA 262 – Flame Travel and Smoke of Wires and Cables
18. Local Authority Having Jurisdiction

1.5 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract.

1. Product data for structured wiring transmission media and components.

B. Qualification data for firms and persons specified in "Quality Assurance" article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of engineers and Owners, and other information specified.

C. Test plan, Test Procedure, and Test Reports: Indicate testing methods, testing device calibration and interpretations of test results for Field Acceptance Tests. Progress payments shall depend on the successful completion of testing and documentation. Provide for review and approval of the engineer a test plan for media testing. Deliver the test plan at least 14 days prior to the scheduled start of the first test. The test plan shall detail the objectives of all tests. The tests shall clearly demonstrate that the media and its components fully comply with the requirements specified herein.

1. Cabling System shall be capable of exhibiting the following minimum electrical characteristics when tested as a 4 connector Channel, using a Level III or Level IV tester:
2. Insertion Loss (IL) / 33 dB
3. Near End Crosstalk (NEXT) / 38 dB
4. PowerSum NEXT (PSNEXT) / 37 dB
5. Attenuation Crosstalk Ratio – (ACR) / 7 dB
6. PowerSum ACR (PSACR) / 6 dB
7. Attenuation Crosstalk Ratio Far End – (ACR-F) / 20 dB
8. Power Sum Attenuation Crosstalk Ratio Far End – (PSACR-F) / 18 dB
9. Return Loss (RL) / 12 dB

D. The test procedures shall contain at a minimum the following elements:

1. Test results for all Category 6 copper cables shall be provided on CD in a Level III or Level IV tester's native format.
2. All Permanent Link tests shall have a "PASS" result for all required parameters from the frequency of 1 to 250 MHZ.
3. One hard copy and one soft copy in the tester's native format of all test results shall be provided to the Owner upon substantial completion. Test reports shall include SSD labeling format identified in part 3 of these specifications.
4. All test results shall show electrical performance of the cabling system from 1 – 250 MHz when testing for Insertion Loss, Near End Crosstalk, Power Sum Near End Crosstalk, Attenuation to Crosstalk Ratio Far End, Power Sum Attenuation to Crosstalk Ratio Far End and Return Loss.

E. Testing and documentation as specified in Part 3.

F. Maintenance data for cables to include in Division 1 specifications.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer to install Category 6 cabling and connectivity. The installer shall be a member of BICSI and hold a valid RCDD certification. The installer shall also be certified by the proposed cabling supplier.

B. Installing contractor shall have a minimum of 5 years documented experience in the communications structured cabling business.

C. Testing Firm Qualifications: The testing firm shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907, or shall be a full member company of the International Electrical Testing Association.

D. Testing Firm's Field Supervisor Qualifications: A person currently certified by the International Electrical Testing Association or National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

E. Comply with NFPA 70 "National Electrical Code" (NEC) for components and installation.

F. Comply with all Codes and Standards (see section 1.3D for listing) for components and installation.

G. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms "Listed and Labeled": As defined in the "National Electrical Code," Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

H. Single-Source Responsibility: All cable and components of each kind shall be the product of a single manufacturer. Cable and connecting hardware do not need to be manufactured by the same company. All components of, and the entire horizontal copper cabling channel, shall exceed all requirements for ANSI/TIA/EIA-568-C.

1.7 CABLING SYSTEM WARRANTY

A. Provide a <u>20-year minimum</u> Cabling System Warranty. The warranty shall guarantee:

1. That each registered permanent link will meet or exceed the performance requirements of the designated permanent link defined in the ANSI/EIA/TIA Commercial Building Telecommunications Cabling Standards listed on the warranty certificate.
2. That each registered permanent link will support all current and all future network applications designed to run on the designated link defined in the Commercial Building Telecommunications Cabling Standards listed on the certificate, including Gigabit Ethernet (1000BaseT) protocols.
3. That all connectivity hardware and cable used in the structured cabling system will be free of defects in material and workmanship under normal handling and use.
4. The School District shall be instructed and trained to make Moves/Adds/Changes without voiding the cabling system warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS PRODUCTS

A. CAT-6 cabling (UTP)
   1. Commscope (Uniprise) UltraMedia.
   2. Berk-Tek LANMark-1000.
   3. General Cable GenSPEED 6000 Enhanced.
   4. Belden 3600 series.
   5. Mohawk AdvanceNet.
   6. Superior Essex DataGain.

B. CAT-6A cabling (STP/FTP)
   1. Commscope (Uniprise) Ultra10.
   2. Berk-Tek LANMark-10G2.
   3. General Cable GenSPEED 10k.
   4. Belden 2183.
   5. Superior Essex 10GainXP.

C. Optical Fiber
   1. Commscope.
   2. Berk-Tek.
   3. General Cable.
   4. Belden.
   5. Mohawk.
   6. Corning.

D. Terminating Equipment: Patch panels, wall jacks and cover plates.
   1. Commscope.
   2. Leviton.
   3. Panduit.
   4. Belden.
   5. Hubbell.
   6. Cabling partner with any of the cabling manufacturers.

E. Patch Cords

   1. Same manufacturer as cabling or terminating equipment.

F. Racks:

   1. Panduit.
   2. Chatsworth (CPI).
   3. Hubbell.
   4. Great Lakes.
   5. Lowell.

2.2 APPLICATION

A. All media shall be listed for the application, marked and protected as per the NEC. Articles 645, 725, 760, 770, 800 and 820 shall define the power source limitations, installation guidelines,

insulation properties, applications and allowable cable substitution schedules. Solid conductor materials shall be substituted for the specified 7-strand conductor materials as required by the NEC. All media substitutions shall conform to the NEC and be approved by the engineer.

2.3 TELEPHONE TERMINATIONS

A. All telephone terminations in electrical closets shall be 110 IDC type. Provide terminations in quantities required to terminate all cables at telephone terminal board (TTB), as well as all cross-connects to Utility equipment. Provide all ancillary frames, clips, etc. required for complete installation.

2.4 OPTICAL FIBER

A. General: The optical fiber cable construction shall consist of singlemode (nominal 9/125µm, OS1) or multimode (50/125um or 62.5/125um). These groups and individual fibers shall be identifiable in accordance with ANSI/EIA/TIA-606. These groups are assembled to form a single compact core, which is covered by a protective sheath. The sheath consists of an overall jacket and may contain one or more layers of dielectric material applied over the core.

B. Characteristics:

1. Each cabled optical fiber shall meet the graded performance specifications. Attenuation shall be measured in accordance with ANSI/TIA-455-46, -53, or B61. Information transmission capacity shall be measured in accordance with ANSI//TIA-455-51 or B30. The cable shall be measured at 23 deg C - 51deg. C.
2. The mechanical and environmental specifications for riser all-dielectric outside optical fiber cable shall be in accordance with ANSI/TIA-472CAAA and for all-dielectric outside optical fiber cable shall be in accordance with ANSI/TIA-472DAAA. The specifications for other constructed indoor optical fiber cable shall be in accordance with ANSI/ICEA S-83-596 and for other constructed outdoor optical fiber cable shall be in accordance with ANSI/ICEA S-83-640.
3. Each cabled optical fiber shall meet the attenuation performance specifications listed in the TIA 568B. Attenuation shall be measured in accordance with ANSI/TIA-455-78A or B61. The cable shall be measured at 23 deg C -51deg. C.

C. Rating:

1. UL-listed Communications Cable Type shall be rated CMP for plenum installation and CMR (riser-rated) where installed at the interior of a rated raceway (e.g. conduit). For outdoor cabling, cabling shall be rated for outside plant (OSP).

D. Cable Jacket:

1. The jacket shall be continuous, free from pinholes, splits, blisters, or other imperfections. The jacket shall have a consistent, uniform thickness; jackets extruded under high pressure are not acceptable. The jacket shall be smooth, as is consistent with the best commercial practice. The jacket shall provide the cable with a tough, flexible, protective coating, able to withstand the stresses expected in normal installation and service.
2. For cables with more than two fibers, the cable jacket shall be designed for easy removal without damage to the optical fibers by incorporating a ripcord under each cable jacket.
3. The nominal thickness of the cable outer jacket shall be sufficient to provide adequate cable

protection while meeting the mechanical, flammability, and environmental test requirements of this document over the life of the cable.

E. Identification:

1. The individual fibers shall be color coded for identification. The optical fiber color coding shall be in accordance with TIA-606. The coloring material shall be stable over the temperature range of the cable, shall not be susceptible to migration, and shall not affect the transmission characteristics of the optical fibers. Color coded buffered fibers shall not adhere to one another. When fibers are grouped into individual units, each unit shall be numbered on the unit jacket for identification. The number shall be repeated at regular intervals.
2. Jacket Printing: The outer jacket shall be marked with the manufacturer's name or UL file number, date of manufacture, fiber type, flame rating, NRTL symbol, and sequential length markings every two feet (e.g. "COMPANY-01/97-62.5/125 MICRON-Type OFN - (UL) 00001 FEET"). The print color shall be black. The printing shall be permanent and legible for the life of the cable.

F. Cable Specifications

1. Temperature Range: The storage temperature range for the cable on the original shipping reel shall be -40 to +70 degrees C. The installation/operating temperature range shall be 0 to +70 degrees C. Testing shall be in accordance with FOTP-3.
2. Crush Resistance: The cable shall withstand a minimum compressive load of 89 N/cm (50 lbf/in) applied uniformly over the length of the compression plate. The cable shall be tested in accordance with FOTP-41; "Compressive Loading Resistance of Fiber Optic Cable". While under compressive load, the fibers shall not experience attenuation greater than 0.6 dB at 1300 nm (multimode). After the compressive load is removed, the fibers shall not experience an attenuation change greater than 0.4 dB at 1300 nm (multimode).
3. Impact Resistance: The cable shall withstand a minimum of 20 impact cycles. The cable shall be tested in accordance with FOTP-25, "Repeated Impact Testing of Fiber Optic Cables and Cable Assemblies" The fibers shall not experience an attenuation change greater than 0.4 dB at 1300 nm (multimode).
4. Cycle Flexing: The cable shall withstand 25 mechanical flexing cycles at a rate of 30 +/- 1 cycles per minute. The cable shall be tested in accordance with FOTP-104, "Fiber Optic Cable Cyclic Flexing Test" The fibers shall not experience an attenuation change greater than 0.4 dB at 1300 nm (multimode).
5. Flammability: All cables shall comply with the requirements of the 2002 NEC, Article 770. Plenum cables (OFNP) shall pass UL-910.

2.5 CONNECTORS:

A. CAT 6 or 6A Connectors

1. All outlets and connectors shall be certified to Category 6 or 6A standards, component rated.
2. All locations shall utilize a RJ-45 type, 8-position, 8-conductor EIA/TIA T568B data jacks in quantities as required and detailed on drawings.
3. <u>Connectors for Wireless Access Points shall be RJ45 male – all other outlets shall be female, unless specifically noted otherwise on the drawings.</u>
4. Jacks shall be modular.
5. Color:

a. All Jacks: Blue for voice/data, Green for wireless access points.
b. Faceplates: to match wiring devices – see specification section 262726 for color/material.

6. Flush mount faceplates and boxes shall be provided at all locations unless otherwise noted. Exceptions to the specifications which request surface mounting in lieu of flush must be submitted and obtain approval prior to installation.
7. Provide wall jacks at 48" A.F.F., intended for wall mounted phones ("W" designation on drawings) with mounting hardware to support telephone devices.

B. Fiber Optic Connectors

1. Connectors shall be 'SC' duplex type at all communication closets (IDFs).
2. Optical fiber cable connectors shall be capable of terminating optical fiber glass cables with outside diameters ranging from 125 through 900 microns. Fabricate connectors with optical fiber, self-centering, axial alignment mechanisms.
3. The maximum optical attenuation per each mated field-installed connector pair shall not exceed 0.75dB. The total optical attenuation through the cross connect from any terminated optical fiber to any other terminated optical fiber shall not exceed 1.5dB. These measurements shall be performed at 5°C-23°C.
4. Connectors shall sustain a minimum of 500 mating cycles per ANSI/EIA/TIA-455-21 without violating specifications. These measurements shall be performed at 5°C-23°C.
5. The connector shall have an optical axial pull strength of 2.2N (0.5lbf) at a 0 degree angle and an optical off axial pull strength of 2.2N (0.5lbf) at a 90 degree angle, with a maximum 0.5dB increase in attenuation for both tests when tested in accordance with ANSI/TIA/EIA-455-6B.

2.6 PATCH PANELS

A. Patch panels for data runs designated in the structured wiring cables shall be CAT 6 rated, T568B preloaded with 110 connection blocks on the rear and 8 position modular jacks on the front. Each jack shall be terminated providing terminations for 22-26 AWG solid cable. Each jack shall be provided with designation strips or labels on the front and rear for labeling each circuit. Panels shall be rack-mounted.

A. FIBER: Rack-mounted fiber termination cabinets shall include retractable splice trays and adapter panels preloaded with "SC" duplex type adapters to properly connect to the identified fiber optic cables. Cabinets shall be lockable and labeled.

2.7 PATCH CORDS

A. Provide one (1) pre-manufactured 1-meter (3 ft.) CAT-6 patch cord for one-half of the terminated copper patch panel ports, and one 2m (6 ft.) for the other half. Provide one (1) pre-manufactured 1 meter (3 ft.) fiber optic cord for one-half of the terminated adapter panel ports.

B. Provide one (1) pre-manufactured 2-meter (6 ft.) CAT-6 patch cord for one-half of the terminated work area outlet, and one 3m (9 ft.) for the other half. Provide one (1) pre-manufactured 2 meter (6 ft.) fiber optic cord for one-half of the terminated adapter panel ports.

C. When testing system (see Part III of this section), cabling shall be tested both without patch cords (initial connection to adapter) to test the permanent link and with patch cords to test the

channel.

D. Patch Cords, shall be pre-manufactured by the same manufacturer of the terminating equipment and meet all conventions and specifications conforming to the structured wiring arrangement described above, except constructed using stranded wire. Patch cords made in the field are not acceptable.

2.8 OPEN FRAME RELAY RACKS

A. Size: Fully adjustable nineteen-inch (19”) mounting verticals. Overall height shall be 84” with a minimum of 79” of usable height 38U, unless noted otherwise.

B. Construction: The frame shall be made of extruded aluminum. Adjustable vertical mounting rails shall be universal EIA channel 1.265” x 3”, drilled and tapped on both sides with 12-24 mounting holes at universal EIA spacing.

C. Power Strip: Each rack shall contain a vertical mounted, non-protected power strip containing a minimum of six (6) simplex outlets (NEMA 5-15R) mounted on the interior sidewall of the rack so as not to interfere with cable routing. Provide bonding straps between all racks and frames.

D. Mounting: All racks shall be floor mounted and permanently fixed to the floor with bolt-down kits. Reference Section "Seismic Requirements" for additional information on securing floor- mounted equipment.

E. Cable Management: Provide **horizontal** cable management on front of rack and **vertical** cable management on both front and rear of rack. Horizontal managers shall be placed above and below each patch panel; minimum size of manager shall be 1.75” (1RU) high. Horizontal managers shall have plastic routing clips for uniform distribution of cables inserted into patch panels. Provide three (3) additional horizontal managers per rack location for routing of patch cords into owner provided hubs and switches.

2.9 OPEN FRAME, WALL-MOUNTED RACK

A. Size: Fully adjustable 19-inch mounting verticals. Overall height shall be 84” with a minimum of 79” of usable height, equivalent of 38U.

B. Construction: The frame shall be made of extruded aluminum. Adjustable vertical mounting rails shall be universal EIA channel 1.265” x 3”, drilled and tapped on both sides with 12-24 mounting holes at universal EIA spacing.

C. Power Strip: Each rack shall contain a vertical mounted, non-protected power strip containing ten (6) simplex outlets (NEMA 5-15R) mounted on the interior side wall of the rack so as not to interfere with cable routing. Provide bonding straps between all racks and frames.

D. Mounting: All racks shall be floor mounted and permanently fixed to the floor with bolt-down kits. Reference Section "Seismic Requirements" for additional information on securing floor-mounted equipment.

E. Cable Management: **Horizontal** managers shall have plastic routing clips for uniform distribution of cables inserted into patch panels. 1RU managers shall be installed between individual patch

panels, with a 2RU manager below the last copper patch panel at the rack. Provide (1) 1RU and (1) 2RU additional horizontal manager at each rack for routing of patch cords into owner provided hubs and switches. **Vertical** managers shall be standard 6" wide nonmetallic assemblies with hinged door at front of manager – provide one at outboards of each rack, and an intermediate one between two racks (i.e. three total for a two rack system).

2.10 WATER-RESISTANT (WEATHERPROOF) COVERPLATE

A. Where identified on the drawings, Electrical Contractor shall provide water-resistant coverplates over the indicated communications outlets.

B. Coverplate shall be manufactured by same firm responsible for the connectivity equipment (connectors, etc.) and shall be warrantied in a similar fashion.

C. Coverplate shall include base, cover (hinged, tamper-resistant), and top/bottom and back-seal gaskets.

D. Electrical Contractor shall provide water-resistant coverplates at outlets within 6’-0” of all lavatories, sinks or other plumbing fixtures.

2.11 EMERGENCY TELEPHONE

A. Construction: stainless steel or brushed aluminum with (2) vandal-resistant pushbuttons for HELP and INFO. Unit shall include handsfree communication.

B. Power: self-powered through telephone system.

C. Telephone shall meet all ADA requirements and shall be capable of activating a light (LED) to indicate call connection (for the hearing impaired).

D. Telephone shall be able to transmit and receive live voice or prerecorded audio. Telephone shall be able to dial up to four emergency numbers or extensions, and up to two help numbers or extensions, and shall include the capability to cycle between the both on busy or no answer.

E. Telephone shall also be capable of auto-hangup on silence, busy signal, dial tone or timeout conditions.

F. Unit shall be remotely programmable to capable of auto-answering incoming calls.

G. Provide backbox for station, as well as connection to telephone system at backbox (and not exposed to the general public).

H. Basis of Design is model #E-1600-20A by Viking Electronics.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine raceways and other elements to receive cable for compliance with installation tolerances and other adverse conditions. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install all cable according to manufacturer's written instructions.

1. Install transmission media without damaging conductors, shield, or jacket.
2. Do not bend cable, in handling or installation, to smaller radii than minimum recommended by manufacturer.

B. Pull cables without exceeding cable manufacturer's recommended pulling tensions.

1. Pull cables simultaneously where more than one is being installed in same raceway.
2. Use pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation.
3. Use pulling means including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage media or raceway.

C. All exposed cabling (at areas or rooms without a finished ceiling or through walls) shall be installed in conduit. Cabling shall be painted to match adjacent surfaces.

D. Install exposed conduit parallel and perpendicular to surfaces or exposed structural members, and follow surface contours where possible.

E. Connect components to wiring system and to ground as indicated and instructed by manufacturer and according to ANSI/TIA/EIA 607 Standard. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.

F. Provide cable maintenance loops of 10' length at work area outlets – maintenance loop shall be above the nearest accessible ceiling as loop at box is typically impractical.

G. Maintain ½" or less jacket removal at terminations.

H. Maintain ¼" or less un-twist at terminations.

I. Maintain 1" minimum bending radius at all bends.

J. All 4 pair cabling shall be terminated on a single jack or patch panel port, pair splitting is not acceptable.

3.3 DOCUMENTATION

A. As-built drawings must be provided showing the location and identification number of all voice and data outlets. In addition, as-built drawings must detail the copper patch panels in each rack. Documentation must show a cable identifier on each patch panel port. Drawings must be supplied on 30"x42" paper, as well as on CD, using AutoCAD version 2009 or later.

3.4 IDENTIFICATION

A. Cable Identification: All installed cables shall be labeled using a pre-printed stick-on self-adhering labeling system. The label must be applied on both ends of the cable, and shall remain

clearly visible after completion of the installation. The labels must utilize the complete cable identifier developed with the cable matrix specified herein.

B. Format: labeling scheme shall be FLOOR-CLOSET-RACK-POSITION.

C. Copper Data Cables: As part of the as-built documentation, a separate voice/data cable matrix must be supplied. This will consist of a typed listing that identifies each data cable by wiring closet, patch panel location, and device location.

D. Each data cable must be identified on the patch panels with the identification number developed with the cable matrix specified herein. Each fiber optic cable must be identified at every fiber optic patch panels with the identification number developed with the cable matrix specified herein.

E. Termination Identification: Provide a printed label for each terminated port on patch panels. Conform to Owner or their representative's labeling standard.

3.5 FIELD QUALITY CONTROL – CAT-6

A. Testing: Upon installation of cable and before energizing, demonstrate product capability and compliance with requirements. All CAT 6 cabling shall be tested using a CAT 6, Level III compliant tester. Typed or printed documentation must be provided listing all runs by location. The documentation must include the original instrument printouts detailing the results of all the tests. The documentation must also detail the date each cable was tested and the tester's name.

B. Calibration: Test equipment used shall have been certified to the manufacturer's specifications.

C. CAT 6 Cable: Shall be tested in permanent link configuration. Testing shall be accomplished with a Level III test set with a minimum spectral frequency range of 1 to 250MHz. The test specifications for all installed cables must meet or exceed the specifications for CAT 6 cabling that are documented within the TIA/EIA- 568-B.2. Correct malfunctioning cables and retest to demonstrate compliance; otherwise remove and replace with new and retest. All cables shall meet or exceed the specifications in the table listed below:

Parameter	100MHz (dB)	200MHz (dB)	250MHz (dB)	300MHz (dB)
Insertion Loss	19.0 dB	27.4 dB	30.9 dB	34.1 dB
NEXT Loss	43.9 dB	39.3 dB	37.8 dB	36.6 dB
PS NEXT Loss	41.9 dB	37.3 dB	35.8 dB	34.6 dB
ACR	24.9 dB	11.9 dB	6.9 dB	2.5 dB
PS ACR	22.9 dB	9.9 dB	4.9 dB	0.5 dB
ELFEXT	26.3 dB	20.3 dB	18.3 dB	16.8 dB

PS ELFEXT	23.4 dB	17.3 dB	15.4 dB	13.8 dB
Return Loss	14.7 dB	11.7 dB	10.7 dB	9.9 dB
Propagation Delay	528 ns	527 ns	526 ns	526 ns
Delay Skew	40 ns	40 ns	40 ns	40 ns

Cables results of FAIL* (marginally fail) are not acceptable.
Cable results of PASS* (marginally pass) are only acceptable if confirmed by A/E.
Correct any links that do not PASS, and re-certify the link.

3.6 GROUNDING & BONDING

A. Provide a #6 BTC insulated conductor from each rack to ground bar located in room.

3.7 CLEANING

A. Upon completion of system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

3.8 DEMONSTRATION

A. Train Using Agency's maintenance personnel on procedures and schedules for start-up and shutdown, troubleshooting, servicing, and preventive maintenance. Include training on fiber optic splicing and connector attachment techniques.

B. Review data in operating and maintenance manuals. Refer to Division One Section "Operating and Maintenance Data."

C. Schedule training with Using Agency, through the Architect/Engineer, with at least seven days' advanced notice.

D. Training for maintenance shall incorporate concerns regarding the 20-year warranty stated in Paragraph 1.6 of this section. The District's personnel shall be able to maintain this system and necessary training or certification shall be provided to avoid warranty issues.

3.9 ACCEPTANCE

A. Acceptance will be withheld until the following have been completed successfully:

1. Acceptance of all submittals.
2. Delivery of final documentation.
3. Successful testing.
4. Successful demonstration, including operation of systems using the cables, training and manual review.

END OF SECTION 271000