

# Exhibit 6

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## MONTEREY COUNTY TELECOMMUNICATIONS CABLING AND PATHWAY SYSTEMS

### PART 1-GENERAL

#### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specifications Sections, apply to Work of this Section.
- B. The general conditions for contracts of construction, referred to in the contract documents as the General Conditions, together with the following articles of the Telecommunications Cable and Pathways Specification, that amend, modify and supplement various articles and provisions of the General Conditions, are made part of the Contract and shall apply to all work under the Contract.
- C. All articles or parts of articles of the General Conditions not so amended, modified or supplemented by this Telecommunications Cabling Specification shall remain in full force and effect. Should any discrepancy become apparent between the General Conditions and the Telecommunications Cable and Pathways Specification, the Contractor shall notify the Architect, in writing, and the Architect shall interpret and decide such matters in accordance with the provisions of the General Conditions.

#### 1.02 SPECIAL CONDITIONS

- A. Standards, materials specifications, related drawings, cable schedules, industry guidelines, and codes referred to herein shall be considered part of these specifications and shall apply to the Work described or implied, herein.
- B. All local fees, permits and services of inspection authorities shall be obtained and paid for by the Contractor, The Contractor shall cooperate fully with local utility companies with respect to their services.
- C. It is the intent of these specifications for the Contractor to provide a complete, functional, standards-based cabling infrastructure for the County's use, utilizing Category 6 and Category 6A cabling to support high speed data applications up to and in excess of 1000 Mb/s horizontally and 10 Gigabit Ethernet in the wireless and backbone network systems.



- D. Any item not specifically shown on the drawings or called for in the specifications, but normally required to conform to the system design intent as presented, is to be considered as part of the Contract and required to be furnished and installed by the Contractor.
- E. Any given item of equipment or material shall be the product of one manufacturer solution throughout the facility. Multiple manufacturers of any one item will not be permitted, unless specifically noted otherwise or approved in writing by the Designer prior to purchase and use.
- F. This specification is an equipment and performance specification. Actual installation shall be as indicated on the Telecommunications Drawings and in the Specifications governing the Work. Any discrepancies found between the Specifications and the Drawings shall be immediately brought to the attention of the Architect for interpretation.
- G. Contract Documents and Drawings depict equipment installation and wiring in a diagrammatic fashion and indicate the general arrangement of equipment and wiring. The most direct routing for conduits and telecommunications pathways is not assured. Exact requirements shall be governed by architectural, structural and mechanical condition/features of the job. Consult all other drawings and specifications.

#### 1.03 PRICING

- A. Provide total cost and unit pricing as per the General Conditions and Bid instructions.

#### 1.04 CONTRACTOR EXPERIENCE

- A. The selected Contractor shall be fully capable and experienced in the telecommunications distribution system specified. To ensure the system has continued support, the County will contract only with Contractors having a successful history of sales, installation, service, and support.
- B. During the bid evaluation process, the Customer may, with full cooperation of the Contractor, visit the Contractor's places of business, observe operations, and inspect records. The Contractor must have a minimum of five (5) years of continuous experience in the network cabling installation field and possess a C7 or C10 license in the State of California.
- C. Contractor must be an approved Leviton Certified Installer in the Leviton Certified Network Installer program before, during, and through completion of the



system installation. Supporting documentation will be required as part of the submittal.

- D. The Contractor must have a Registered Communications Distribution Designer (RCDD) on staff that will be ultimately responsible for this project in the Project Manager role. The RCDD must have sufficient experience in this type project as to be able to lend adequate technical support to the field forces during installation, during the warranty period, and during any extended warranty periods or maintenance contracts. A resume of the responsible RCDD must be attached to the Contractor's response for evaluation by the County. Should the RCDD assigned to this project change during the installation, the new RCDD assigned must also submit a resume for review by the County. If, in the opinion of the County, the RCDD does not possess adequate qualifications to support the project, the County reserves the right to require the Contractor to assign an RCDD who, in the County's opinion, possesses the necessary skills and experience required of this project.

#### 1.05 WORK INCLUDED

- A. The work covered by this Contract includes the construction described and implied, all labor required to perform and complete such construction, all materials required to perform and complete such construction, all services, facilities, tools and equipment required to perform and complete such construction, and coordination with the General Contractor and all other trades.
- B. The scope of this work includes, but is not limited to:
1. Provision, installation, termination, identification, and testing of optical fiber backbone cables and high pair count UTP copper cables between the Equipment Rooms (ERs) and all Telecom Rooms (TRs).
  2. Provision, installation, termination, identification, and testing of inside plant UTP workstation cables between the TRs/ERs and the workstations located in the building. This includes all termination components to complete the horizontal links to each workstation outlet.
  3. Provision, installation and grounding of all telecommunications racks, cabinets, cables (as required), and all cable pathways requiring grounding under TIA standards and BICSI guidelines.
  4. Provision of labeling and documentation of all cables, racks, grounding buss-bars, pathways and spaces, faceplates, patch panels and termination blocks installed under this Work.
  5. Provision and installation of wire management components, ladder-type cable runway, any surface-mount raceways and miscellaneous "nuts & bolts" type components to provide a complete and working cable system.



6. Fire stopping of floor and rated wall penetrations specifically provided for the distribution of telecommunications cables. Required floor and wall ratings shall be maintained.
7. Preparation and submission of shop drawings, termination schedules, test results, as-built drawings, warranty application, and component documentations described within this Specification.

#### 1.06 RELATED WORK NOT INCLUDED IN THIS SECTION AND SPECIFIED ELSEWHERE, UNLESS OTHERWISE NOTED

- A. Installation of conduits, pull-boxes and floor-boxes (provided under electrical Work).
- B. Installation of workstation devices, computers, terminals and similar equipment (installed by County representatives and their additional representatives).
- C. Installation, provisioning or supply of active data and telephone switch equipment is not included in this scope of work.
- D. Provision and installation of AC grade or better plywood on the ER and TRs walls, as indicated in the drawings. Plywood shall be at least  $\frac{3}{4}$ " thick and treated on all sides with at least two coats of fire-resistant paint, white color. Fire rated stamping should be kept visible but rest of board to be painted white color. Each board shall have it's own stamp.

#### 1.07 SITE VISIT & FIELD CONDITIONS

- A. Prior to submitting bids for the project, and where practicable, contractor shall visit the work site to become aware of any conditions that may affect the cost of the project.
- B. For work performed on an existing structure, the Contractor shall visit and examine the site of the proposed work to determine the existing conditions that may affect the work. The Contractor shall be held responsible for any assumptions in regard thereto.
- C. Contractor shall obtain a complete set of Project Drawings and Specifications for coordination and to determine the full scope of work.
- D. The Contractor shall verify all dimensions and distances in the field and document the cable lengths and materials to be furnished and installed. The provision and installation of non-specified miscellaneous components and hardware, i.e. drag lines, nuts, bolts and tie wraps shall also be the Contractor's responsibility.
- E. Existing site conditions, Contract Documents and the overall construction schedule must be carefully reviewed to determine all required interfacing and timing of the work. All such documents shall be available through the General



Contractor or Construction Management.

1.08 PERMITS

- A. Contractor shall obtain all permits and required inspections for the installation of this work and pay all charges associated.
- B. Deliver to the Owner all certificates, permits and inspection reports issued by authorities having jurisdiction (AHJ).

1.09 ADHERENCE, ABBREVIATIONS AND DEFINITIONS



- A. The Work specified herein shall conform to the following codes, regulations, standards, and guidelines:
- B. FCC:
  - 1. Part 15: Unlicensed Radio Frequency Devices
  - 2. Part 68: Terminal Equipment Certification Requirements
- C. NEC 2017 or latest edition utilized by AHJ.
- D. NESC 2008 or latest edition utilized by AHJ.
- E. NFPA codes (latest edition utilized by AHJ).
- F. State and Local Municipal Construction-Related Codes
- G. Underwriters Laboratory (UL)
- H. IEEE:
  - 1. IEEE 802.3: 10Base-T Ethernet Standard
  - 2. IEEE 802.12: 100Base-TX Ethernet Standard
  - 3. IEEE 802.3ab: 1000Base-T Ethernet Standard
  - 4. IEEE 802.3ae: 10Gb/s Ethernet Standard
  - 5. IEEE 802.3af: Power Over Ethernet Standard
  - 6. IEEE 802.3at: Power Over Ethernet (PoE+) Standard
  - 7. IEEE 802.3bt: Power Over Ethernet (PoE+) Standard, Type 3 & 4
  - 8. IEEE 802.3ba: 40 and 100 Gigabit Ethernet Standard
  - 9. IEEE 802.11ac: All Wireless Ethernet Standard(s)
- I. BICSI:
  - 1. TDMM: 14<sup>th</sup> Edition or later
  - 2. ITSIMM: 7<sup>th</sup> Edition
  - 3. OSPDRM: 6<sup>th</sup> Edition
  - 4. ANSI/BICSI 007-2019: Data Center Design and Implementation Best Practices
  - 5. ANSI/BICSI 007-2017: ICT Design and for Intelligent Buildings and Premises
  - 6. ANSI/BICSI 008-2018: WLAN Systems Design and Implementation Best Practices
  - 7. ANSI/BICSI N1-2019: Installation of ICT Cabling to Support Remote Power
  - 8. ANSI/BICSI N3-20: Bonding and Grounding of ICT Systems and Infrastructure Building  
Telecommunications Cabling
- J. ANSI/TIA: (includes all related addenda to each standard)





1. TIA-310-D: Racks, Panels and Associated Equipment
2. TIA-455-13-A: Visual and Mechanical Inspection of Optical Fibers, Cables, Connectors and other Optical Devices.



3. TIA-455-57-B: Optical Fiber End Preparation and Examination.
- 4.
5. TIA-455-78-C: Measurement Methods and Test Procedures - Attenuation with an OTDR.
6. TIA-455-95-B: Absolute Optical Power Test for Optical Fibers and Cables.
7. TIA-4720000-A: Generic Specification for Fiber Optic Cable.
8. TIA.472C000-B: Standard for Optical Fiber Premises Distribution Cable.
  
9. TIA-492AAAD: Detail Specification for 850-nm Laser- Optimized, 50- $\mu$ m Core Diameter/125- $\mu$ m Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers Suitable for Manufacturing OM4 Cabled Optical Fiber.
10. TIA-492CAAB: Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers with Low Water Peak.
11. TIA-526-7: Optical Power Loss Measurement of Installed Single Mode Fiber Cable Plant.
12. TIA-526-14: Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant.
13. TIA-568.0-E: Generic Telecommunications Cabling for Customer Premises.
14. TIA-568.1-E: Commercial Building Telecommunications Cabling Standard.
15. TIA-568-2.D: Balanced Twisted-Pair Telecommunications Cabling and Components Standard.
16. TIA-568-3.D: Optical Fiber Cabling and Components Standard.
17. TIA-569-E: Telecommunications Pathways and Spaces
  
18. TIA-598-D: Optical Fiber Cable Color Coding.
19. TIA-606-C: Administration Standard for the Commercial Telecommunications Infrastructure
20. TIA-607-D: Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
21. TIA-758-B: Customer-owned Outside-Plant Telecommunications Infrastructure Standard.
22. TIA-862-B-1: Structured Cabling Infrastructure Standard for Intelligent Building Systems
23. TIA-942-B: Telecommunications Infrastructure Standard For Data Centers
24. TIA-1152-A: Requirements for Field Test Instruments and
25. Measurements for Balanced Twisted Pair Cabling TIA-5017  
Telecommunications Physical Network Security Standard
26. TIA-5018: Distributed Antenna Systems (DAS)



- 27. TIA TSB-162-A  
Access Points
- 28. TIA TSB-184-A
- K. ANSI/ICEA:

Telecommunications Cabling Guidelines for Wireless  
Power Delivery (4-pair)



1. ICEA S-83-596: Indoor Optical Fiber Cable Technical Requirements. (2016)
  2. ICEA S-90-661: Standard for Individually UTP Indoor Cables for Use in General Purpose and LAN Communication Wiring Systems Technical Requirements (2012).
- L. The installation shall comply fully with all National, State, and Local government authorities, laws and ordinances, as well as, all regulations, codes, and industry guidelines governing the work or interpreted to govern the work by the authority having jurisdiction (AHJ) at the site. This includes all Owner-specific standards and guidelines related to the Work.
- M. Should any change in the current plans or specifications be required to comply with any Code, Regulation or Standard noted above, the Contractor shall notify the Designer and Architect in writing at the time of submitting the construction schedule.
- N. All equipment and installation methods shall be equal to or exceed the minimum requirements of NEMA, IEEE, ASME, ANSI, TIA BICSI, and Underwriters' Laboratories, where applicable.
- O. CONFLICTS:
1. Drawings and specifications are to be used in conjunction with one another and to supplement one another. In general, the specifications determine the nature and quality of the materials and tests and give characteristics of performance that should be adhered to in the installation of the communications system components, the drawings establish the quantities and details of installation.
  2. If there is an apparent conflict between the drawings and specifications, or between specification sections, the items with the greater quantity or quality shall be estimated and installed.
  3. Clarification with the Owner and/or Owner's Representative about these items shall be made prior to ordering and installation of components.

#### 1.10 SUBMITTALS

- A. Provide submittals in accordance with schedule and general requirements defined in the General Conditions.
- B. Product Data:
1. Provide, as part of the bid, manufacturers' product data sheets for all material and equipment whose products are proposed. Only specified or accepted manufacturers or suppliers shall appear in the Product Data Submittal. Bid



shall not be considered without a complete Product Data Submittal.

2. Approved suppliers of the structured cabling system are Berk-Tek and Leviton, or Leviton Network Solutions . Approved supplier of the support infrastructure components is Chatsworth Products.
3. Provide, as part of the bid, manufacturer's product data sheets for all fire stopping materials proposed for use on the project.



4. Mark each copy to show applicable choices and options. Where product data includes information on several products, some of which are not required, mark copies to indicate the applicable information.
5. Requests for substitutions of equipment or materials must be made and approved prior to the bid submittal. Unapproved substitutions may constitute a non-compliant bid return.

C. Shop Drawings:

1. Provide, for Architect's action, shop drawings for the installation of the Work prior to beginning Work
2. Provide detailed plan views and elevations of all equipment racks, termination blocks, patch panels and cable paths, if the elevation and plan views are not identical to the T-series bid drawings.
3. Provide drawings to show evidence of coordination with other trades.
4. Acceptance of any submitted data or Shop Drawings for material, equipment apparatus, devices, arrangement and layout shall not relieve Contractor from responsibility of furnishing same of proper dimensions and weight, capacities, sizes, quantity, quality and installation details to perform efficiently the requirements and intent of the Contract. Such acceptance shall not relieve Contractor from responsibility for errors, omissions or inadequacies of any sort on submitted data or Shop Drawing.
5. All Shop Drawings shall be submitted sufficiently in advance of field requirements to allow ample time for review and re-submittal as may be required. All Submittals shall be complete and contain all required and detailed information.
6. All Shop Drawings shall contain job name/title and reference to the applicable Drawing and Specification article for reference by the reviewer.
7. Provide for County's documentation, a Finish Statement in form stipulated by the Architects, signed by the Contractor, stating that the Work was provided in compliance with the Contract Documents and that the installation was proper for the conditions of application and use.

D. Record Drawings – Submit for County's representative's documentation:



1. Provide Record Drawings annotated with the changes made during the installation of the Work so as to be a complete set of “as installed” plans. Drawings shall be in printed form and on compact disk in AutoCAD 2014 or earlier DWG format.
2. Provide County representative with two (2) sets of Operation and Maintenance Manuals including wiring diagrams, parts lists, shop drawings and manufacturers’ information on all equipment and cables provided under this Work. Provide manuals in a high quality, 3-ring binder, completely indexed. Provide manuals to the County representative not more than 1 week after project completion.

#### 1.10 QUALITY ASSURANCE

- A. Contractor is solely responsible for quality control of the Work. Comply with any Quality Control requirements specified in the General Conditions.
- B. All materials furnished shall be new and unused. All materials shall meet all applicable codes provided a standard has been established for the material in question.
- C. At a minimum, fifty percent (50%) of Contractor-provided field technicians at any time shall be factory-certified within 12 months by the manufacturer of the telecommunications system components to install the Contractor-selected and Owner-approved system components. Proof of certification shall be available on site for review at all times for each field technician.
- D. Contractor shall be in good standing with the selected manufacturer(s) of system components and be able to provide the Owner with the extended warranty for the installation offered by the manufacturer.
- E. All work performed by the Contractor shall be available for observation and approval by the Manufacturer, the Owner, and the system Designer in order to verify the systems integrity and increase the performance of the system under the installation and performance guidelines described in the Contract Documents.

#### 1.11 CODES, REGULATIONS & STANDARDS

- A. The installation shall comply fully with all government authorities, laws and ordinances, regulations and codes applicable to the installation.



- B. Should any change in plans or specifications be required to comply with governmental regulations, the Contractor shall notify the County representative and Architect at the time of submitting the construction schedule.
- C. Local electrical and building codes may differ with national codes. Follow the most stringent code or recommendations. Where there are instances of ambiguity refer to the Architect for interpretation.

#### 1.12 COORDINATION OF THE WORK

- A. Carefully check space requirements and the physical confines of the area of work to insure that all material can be installed in the spaces allotted thereto, including conduits and cable supports.
- B. Transmit to other trades in a timely manner all information required for work to be provided under the respective Sections in ample time for installation.
- C. Wherever work interconnects with or contacts the work of other trades, coordinate with other trades to insure that all trades have the information necessary so that they may properly install all the necessary connections and equipment.
- D. Due to the type of installation, a fixed sequence of operation is required to properly install the complete systems. Coordinate project and schedule work with the General Contractor in accordance with the construction sequence. Provide status of the installation to the General Contractor to allow them to update their project schedules.
- E. The Contractor shall, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades or for proper compliance with the design intent.

#### 1.13 DELIVERY, STORAGE AND HANDLING

- A. Procedure: In Accordance with Division One, General Requirements.
- B. Materials and equipment furnished shall be delivered in new condition and be of current production lots.
- C. Deliver materials (except bulk materials) in manufacturer's unopened container fully identified with the manufacturer's name, trade name, type, class, grade, size and color.
- D. Contractor shall ensure that material deliveries to work site shall be coordinated with construction manager responsible for materials distribution to all trades. Handle in accordance with Manufacturer's recommendations and instructions to avoid damaging equipment, installed devices and finish.





- E. Store materials suitably sheltered from the elements, but readily accessible for inspection until installed. Store all items subject to moisture damage in dry spaces and protected from vandalism. Provide space requirements for storage in submittals list. The General Contractor shall assign storage space.
- F. Contractor is responsible for all materials, tools and vehicles left on the job site.
- G. Inspect and report concealed damage to carrier within specified time.
- H. Contractor shall coordinate for the removal of all rubbish and packing materials produced by the Contractor's activities during the project.



#### 1.14 CERTIFICATION & WARRANTY

- A. All work and all items of equipment and materials shall be warranted by the Contractor for a minimum period of one year from the date of acceptance of the work. Where a manufacturer's warranty is longer than one year, the Contractor shall acquire and provide the extended warranty. The Contractor shall, upon notification of any defective items, repair or replace such items within 24 hours without cost to County, all to the satisfaction of the Architect.
- B. All cables, connectors, patch panels, and patch cords provided must be manufactured by the same Company to provide for a complete end-to-end solution. Mixed manufacturer solutions will not be accepted. High pair count copper requirements, if applicable, is separate from the end-to-end system requirement and may be a different manufacturer.
- C. The installed passive network cabling components of the Work described in the Contract Documents shall be covered under a manufacturer-supported Limited Lifetime Warranty related to installed materials, supported applications and the installation workmanship. The Contractor shall be responsible for submitting all necessary applications, test results, and closeout data to the Manufacturer in order to register this project with the Limited Lifetime Warranty. It is the responsibility of the contractor to provide all forms/documents necessary to obtain the system warranty. Evidence of such warranty will be provided by Contractor as part of their contractual obligation and final retainage payments are contingent upon delivery to Owner of Manufacturer's site warranty certificate. This guarantee and extended warranty shall be supported in writing by the manufacturer, mixed manufacturer solutions will not be accepted, and shall address and cover the following:
  - 1. All defects in wire, cable, components and/or other materials in the Voice and Data Communication System.
  - 2. All specification and performance parameters of system components as presented in the Construction Documents at the time of installation completion will be warranted/ guaranteed to provide performance margins as described in this document for all frequencies swept from 1 – 500 MHz (as appropriate) for the published ANSI/TIA-568-2 parameters for NEXT, PSNEXT, ACRF, PSACRF, and Return Loss performance standards as published in TIA/EIA.
  - 3. All installed components of the data backbone system shall support ten (10) Gigabits per second Ethernet applications that use 850 nm transceivers for serial transmission in LOMMF (OM4) at distances up to three hundred (300) meters.
  - 4. All workmanship associated with any warranty issues related to providing,



installing, certifying and documenting the Work described in the Construction Documents shall be covered by this warranty.

- F. Contractor shall respond to the Owners request and correct any problems, malfunctions, and warranty issues associated with the Work described in the Construction Documents without additional charge to the Owner within three (3) calendar days for the entire warranty period, as stated in the Warranty.
- G. Contractor warrants to the end-user that their installation practices and workmanship will adhere to all standards and Manufacturer's requirements. Contractor shall fix or repair any installation faults at their own cost. Should a defect or problem occur with any Manufacturers product the item(s) will be replaced by the certified contractor or a contractor approved by Manufacturer to perform warranty repair work.



F. The Owner considers the Voice Data Communications System components a whole, complete system with all cables, connectors, patch panels, and patch cords from the same manufacturer to provide for a complete end-to-end solution as described in the Construction Documents.

#### 1.15 PROJECT CLOSEOUT

- A. The installed Voice and Data Communications System will not be accepted until all work is complete and properly documented and all punch list items discovered are completed to the Designer and Owner's complete satisfaction.
- B. The warranty will not begin until after a thirty (30) day acceptance period (See below for Acceptance Period information) to judge the performance of the installed Voice and Data Communication System. If during this thirty (30) day period the installed system does not perform adequately, the Trade Contractor must repair the installation within two (2) days to the satisfaction of the Designer and Owner and/or the Contract Documents and the thirty (30) days will restart from the date of the resolution.
- C. The Trade Contractor's project manager must be available to answer questions about the installation and to attend site visits and meetings during the acceptance period.

### PART 2 – PRODUCTS

#### 2.01 DESCRIPTION

- A. Provide telecommunications cable and termination equipment with performance levels and capacities as noted herein.
- B. Any item not specifically shown on the drawings or called for in this section of the project specifications, but normally required to conform to the system design intent, are to be considered as part of the Contract and shall be included in the Contractor's scope of work.
- C. The Construction Documents define the minimum acceptable quality by designating a manufacturer's trade or brand name and part number, by describing attributes, performance, or other standards. It is the responsibility of the Contractor to verify that all Contractor-proposed products and system components meet or exceed the minimum acceptable performance requirements outlined below, even for those listed in the "material" section(s).



- D. All products designated as “or equal”, “or equivalent”, and “or acceptable substitute” indicate that an alternate product that equals or exceeds the product attributes may be substituted for that product so specified. The proposed alternate component(s) performance must be independently verified and documented. This independent verification documentation must be presented to the Owner or Designer for review and approval during the bid submittal process. The alternate product must be approved by the Designer and Owner prior to purchase, installation, and/or certification. Purchase and/or installation of any component without written approval of materials by the Designer and/or Owner is done at the Contractor’s own risk.
- E. Any part numbers provided in this Specification has been coordinated with the manufacturers’ latest available product literature. Part numbers are subject to change without notice by the manufacturers. Where a specific part number is invalid, provide product meeting component description.
- F. Contractor shall provide product submittals adequate to clearly demonstrate the conformance of the specific product to the attributes, performance, and standards set forth within the Construction Documents for all products prior to use after the bid submittal phase. Alternates proposed after the bid submittal phase are required to have written approval for use by the Designer.
- G. All cable shall be rated and installed for the specific construction environment, unless otherwise noted in the Construction Documents. It is the responsibility of the Contractor to verify the installation environment prior to bid.
- H. All products shall be new, unused, in perfect working condition, and in the original packaging containers upon arrival at the Project Site and also prior to installation. It shall be the Contractor’s responsibility to verify the status of the products and report, in writing to the Designer and Owner, any products that do not conform to the requirements described within the Construction Documents. Commencement of the Work described herein constitutes the Contractor’s acceptance of new, unused products as stated, being installed. Any products found to be non-conforming shall be replaced with conforming products by the Contractor at their expense immediately.

## 2.02 COMPONENT MANUFACTURERS

- A. Subject to compliance with technical requirements of this section and the bid requirements provided in General Conditions, provide cable and equipment from the manufacturers as indicated herein as a complete connectivity and distribution “solution”.



- B. Horizontal cables and terminations must be certified as a system. Manufacturers' specifications and guarantees of system compliance must be provided for acceptance.
- C. Approved suppliers of the structured cabling system are Berk-Tek ( a Leviton company) and Leviton Network Solutions only. Approved supplier of the support infrastructure components is ChatsworthProducts.

## 2.03 MATERIALS

- A. Where specific items are called out in the specification or indicated on the drawings for a specific application, use those products or materials, or approved substitutes. Where no specific call outs are made use premium products and materials.

## 2.04 SUBSTITUTIONS

- A. All products described by attributes and noted with the optional “or equal”, “or equivalent”, and “or acceptable substitute” indicate that an alternate product that equals or exceeds the specified product attributes may be substituted for that product so specified if approved by the Designer in writing prior to bid.
- B. The alternate or equal designated products must be submitted for review and judgment to the Owner and Designer prior to inclusion in a Contractor's bid. The Contractor-proposed alternate products or components that meet or exceed the specified attributes must be published and verified by two (2) independent sources within the past 6 months.
- C. The Contractor shall submit a written request for Designer and Owner approval of their use fourteen (14) elapsed days after the first pre-bid meeting date. This request shall include the two (2) independent sources, the original product's specification sheet, the proposed substitute product cut sheet, and a written request to review the substitute product that includes any cost impact (increase or decrease) associated with the request.

## 2.05 CABLE MEDIA

- A. CATEGORY 6A 4-PAIR CABLE UNSHIELDED TWISTED PAIR PLENUM:
  - 1. Category 6A cables made in the USA of solid annealed copper conductors insulated with FEP, 23AWG, with four individually twisted pairs with a central filler in a single round cable sheath. The cable core is surrounded by an insulated metallic isolation wrap and jacketed with a flame-retardant polymer alloy.



2. Characterized to 750 MHz, 250 MHz greater than the standard.



3. The Cat 6A plenum cable shall have a Universal Application Score (UA Score) of 8.6 verified to UL #B638581.
4. Cable shall have Flame Rating of Plenum-NFPA 70, CMP and ETL Listed as CMP-LP (0.7A).
5. The cable shall support up to 100 watts PoE with up to 720 cables in a bundle.
6. Outer diameter not to exceed 0.250" (6.35mm), CMP, typical
7. Colors as outlined in the T-series drawings.
8. Channel margin guarantees for TIA-568.2-D CAT6A and ISO/IEC 11801 ClassE<sub>A</sub> (margin vs. TIA-568-2 and margin guarantees are for a standard 2-connector channel).
  - a. Insertion Loss 3%
  - b. NEXT 3 dB
  - c. PSNEXT 4 dB
  - d. ACR-F (ELFEXT) 8 dB
  - e. PSACR-F (PSELFEXT) 8 dB
  - f. Return Loss 3 dB
  - g. ACR-N 4 dB
  - h. PSACR-N 5 dB
  - i. PSANEXT 4dB
  - j. PSAACR-F 5dB

Approved Products:

Berk-Tek BLUE LANmark-SST Category 6A CMP cable #11101842 (1000')

**B. CATEGORY 6 CABLE UNSHIELDED TWISTED PAIR PLENUM:**

1. Category 6 cables made in the USA of solid annealed copper conductors insulated with FEP and FRPP, 23AWG, with four individually twisted pairs with a cross-filler in a single round cable sheath.
2. 100 ohm nominal impedance, UL Listed and independently verified as TIA/EIA Category-6 performance.
3. Characterized to 550 MHz, 300 MHz greater than the standard
4. The Cat cable shall have a Universal Application Score (UA Score) of 7.3.
5. Cable shall have a Flame Rating of Plenum-NFPA 262, CMP and UL Listed.
6. The cable shall support up to 100 watts PoE with up to 312 cables in a bundle.





7. Outer diameter not to exceed 0.225" (5.72mm), CMP, typical
8. Colors as outlined in the T-series drawings.
9. Channel margin guarantees for TIA-568-2 CAT6 and ISO/IEC 11801 Class E (margin vs. TIA-568.2-D and margin guarantees are for a standard 2-connector channel).
  - a. Insertion Loss 5%
  - b. NEXT 6 dB
  - c. PSNEXT 6 dB
  - d. ACR-F (ELFEXT) 8 dB
  - e. PSACR-F (PSELFEXT) 9 dB



- f. Return Loss 3 dB
- g. ACR-N 8 dB
- h. PSACR-N 9 dB

Approved Products:

Berk-Tek BLUE LANmark 1000 Category 6 CMP cable #10032094 (1000')

C. MULTI PAIR VOICE RISER CABLE:

1. Physical Specifications: 100 twisted pair – 24 AWG, solid copper conductors, 100 ohm nominal impedance +/-15%.
2. Electrical characteristics: All pair counts must meet Category 3 transmission requirements.
3. Cable Construction: individually insulated conductors with standard UTP color code markings, a minimum of two twists per foot under a rated sheath.

Approved Products:

Berk-Tek # 10032111, 25-pr CMP, Gray.

Berk-Tek # 10032396, 25-pr CMR, Gray

Other multiples of 25 pairs are acceptable (50, 100, 200, 300pr as required)

D. MULTIMODE HORIZONTAL/BACKBONE FIBER:

1. Physical Specifications: Core Diameter 50  $\mu\text{m}$ , Cladding Diameter 125 $\mu\text{m}$  Laser-Optimized Multi-Mode Fiber, OM4.
2. Optical Characteristics: maximum fiber loss 3.0 dB/km @ 850 nm & 1.0 dB/km @ 1300 nm, minimum modal Bandwidth 4700 MHz @ 850 nm, 500 MHz @ 1300 nm. Must be able to support 1 Gb/s at distance up to 1,000 meters for 850 nm and 600 meters for 1300 nm, 10Gb/s up to 550 meters, and 40Gb/s or 100Gb/s up to 150 meters.
3. Armored Cable Construction: Cable shall be rated for use in plenum applications with fiber counts of 2 through 144 available. Cable shall consist of tight-buffered fibers with a dielectric strength member and be contained within an interlocking armor outer cover from end-to-end for protection.
4. Standard fiber Cable Construction: Cable shall be rated for use in plenum applications with fiber counts of 2 through 144 available. Cable shall consist



of tight-buffered fibers with a dielectric strength member and aramid yarn for protection.

5. Cable shall be indoor/outdoor when installed outside buildings, with a Dry-Gel system of water block. Indoor/Outdoor tight buffered fiber is not suitable for aerial lashing.

Approved Products:

Berk-Tek indoor Plenum OM4, # PDPxxxFB3010/F5

Berk-Tek Armored Plenum OM4, #

PDPKxxxFB3010/F5

Berk-Tek Indoor/Outdoor Plenum OM4, PDPxxxFB3010/F5-I/O-C4(AQU)

Berk-Tek Indoor/Outdoor Armored Plenum OM4, PDPKxxxFB3010/F5-I/O-C4C5(AQU)Where:

xxx = # of strands, 006 -024.

Replace xxx with 12Bxxx for strand counts greater than 24

(036, 048, 072, 096, 120, 144)

E. SINGLE MODE BACKBONE OPTICAL FIBER CABLE:

1. Physical Specifications: Core Diameter 8.3  $\mu\text{m}$ , Cladding Diameter 125  $\mu\text{m}$ . Low-Water Peak (OS2) singlemode fiber, complies with ITU-T G.652D.
2. Optical Characteristics: maximum fiber loss 0.70 dB/km @ 1310 nm & 0.70 dB/km @ 1550 nm.
3. Cable Construction: cable shall be rated for use in plenum applications with fiber counts from 2 to 144 available. Cable shall have a dielectric strength member for strength and be contained within a Plenum Tight Buffered Cable with Aluminum Interlock Armor from end-to-end for protection.

Approved Products:

Berk-Tek 24-fiber indoor Plenum Singlemode, # PDP024AB0707

Berk-Tek 24-fiber Indoor Armored Plenum Singlemode, PDPK024AB0707

Berk-Tek 24-fiber Indoor/Outdoor Plenum Singlemode, PDP024AB0707-I/O-C4(YEL)

Berk-Tek 24-fiber Indoor/Outdoor Armored Plenum Singlemode, PDPK024AB0707-I/O-C4C5(YEL)

Where:

xxx = # of strands, 006 -024.

Replace xxx with 12Bxxx for strand counts greater than 24

(036, 048, 072, 096, 120, 144)



#### A. COPPER TERMINATION BLOCKS

1. Provide termination blocks for Backbone Cabling Systems that support up to Category 5e applications and facilitate cross-connection using twisted pair wiring.
2. The connecting hardware block shall support the appropriate Category 3 to 5e voice (non-VOIP) applications and facilitate cross-connection and/or inter-connection using cross-connect wire.
3. The cross-connect shall be Category 5e 110-style wiring bases, mountable to wall or backboard to provide 110 termination capable of supporting voice, security, and Category 5e data applications, including high megabit and shared-sheath applications when used with Category 5e rated cabling.
4. The components shall be UL listed and TIA-568.2-D compliant. Bases shall support 50, 100 or 300 pair densities with provision for TIA-606 compliant labeling. Plastic bases and blocks shall be made of fire-retardant plastic rated UL 94V-0.
5. Cross-connect blocks shall be available in a variety of insulation displacement clips (IDC) with and without tails, and support wire sizes: Solid: Wire Ranges 22-26 AWG (0.64mm - 0.40mm).

#### Approved Products:

- Leviton 110 Connecting Block, 100-pair kit w/legs # 41AB2-1F4 (with C4)
- Leviton 110 Connecting Block, 100-pair kit w/legs # 41AB2-1F5 (with C5)
- Leviton Wire Manager w/legs, # 41A10-HCM

#### B. COPPER PATCH PANELS

1. Modular Insert Copper Termination Patch Panels shall exceed requirements for Category 6 and Category 6A described in TIA-568.2-D and Class E and E<sub>A</sub> requirements described in ISO/IEC 11801 in a standard-density (24 ports per Rack Unit) or High-Density (48 ports per Rack Unit) format.
2. All copper termination panels shall be modular metal, 19" frame, flat, 2RU 48-port or 1RU 24-port, made of 16-gauge steel and powder-coated black with white silkscreened lettering that accept modular "RJ45"-style 8P8C jack inserts of any category rating, or blank inserts from the same manufacturer.
3. 48-port single Rack Unit panels may be required in space-constrained situations only. Confer with Owner prior to installation.



4. Panels shall utilize the same universal jacks as are used in workstation area outlets, and not a special purpose “panel jack”.
5. Modular jack inserts shall correspond with the colors outlined in the T-series drawings. Wiring scheme shall be T568B.
6. IDF Patch panel modular jacks shall match the outlet jacks at each workstation location (color, performance, and labeling).

Approved Products:

Leviton QuickPort® 1RU 24-port Patch Panel, # 49255-H24

Leviton QuickPort® 2RU 48-port Patch Panel, # 49255-H48

Leviton QuickPort® 1RU 48-port Patch Panel, # 49255-Q48\*

\* Order rear management bar separately

C. MODULAR CONNECTORS/JACKS:

1. Provide modular type 8-position/ 8 conductor (8P8C, RJ45-style) connectors (jacks) for network (data, voice, wireless, video, etc.) information outlets using 22-26 AWG copper cable. Connectors shall be individual snap-in style, and exceed compliance with TIA-568.2-D specifications.
2. The connectors shall utilize a universal Keystone-style (QuickPort) insertion footprint. Jacks shall fit existing Leviton patch panels and faceplates to facilitate the County’s ongoing operations.
3. CAT6A Jacks shall comply with FCC Part 68; UL listed and CSA Certified. Verified to exceed all channel performance requirements in TIA-568.2-D from 1 MHz to 500MHz to support the IEEE 802.3 standard for 10 Gigabit Ethernet over UTP Cable
4. CAT6 Jacks shall comply with FCC Part 68; UL listed and CSA Certified. Verified to exceed all channel performance requirements in TIA-568.2-D from 1 MHz to 250MHz to support the IEEE 802.3 standard for 1 Gigabit Ethernet over UTP Cable
5. Every connector shall include polymer springs above the tines (“Retention Force Technology” or similar functionality) to promote return of tines to original position and protect against deformation due to stress of patch cords or inappropriate materials insertion.
6. Connector shall have Pair Separation Towers on IDC to facilitate quick, easy terminations without a complete untwist of each pair of conductors. Jacks shall employ 2 or more circuitry solutions for dampening of NEXT.
7. The connector shall be rear 110-type insulation displacement connectors (IDC) with solder-plated phosphor bronze contacts, configured in a 180° orientation such that the punch down field is in the back, allowing for rear termination.
8. All plastics used in construction of the connector bodies shall be fire-retardant



- with a UL flammability rating of 94V-0.
9. The connector shall provide a ledge directly adjacent to the 110-style termination against which the wires can be directly terminated and cut in one action by the installation craftsman.
  10. Connector wiring label shall provide installation color codes for both T568A and T568B wiring schemes on separate labels.
  11. Category 6A (CAT6A) connectors shall support 10G and will feature an injection molded Cone of Silence™ technology to eliminate alien crosstalk (AXT).
  12. Category 6A/6 connector module will exceed IEEE 802.3bt standard to support up to 0.5 amps per conductor (100 watts) continuously.

Approved Products:

- Leviton eXtreme CAT6A QuickPort Module # 6110G-R\*6
- Leviton eXtreme CAT6+ QuickPort Module # 61110-R\*6
- Leviton eXtreme CAT5e+ QuickPort Module # 5G110-R\*5

Where \* = one of 13 colors. White=W, Light Almond=T, Blue=L, Ivory=I, Yellow=Y, Orange=O, Crimson=C, Dark Red=R, Purple=P, Green=V, Gray=G, Black=E, Brown=B. See drawings or check with County for application.

D. FIELD-TERMINABLE MODULAR PLUGS

1. The plug shall BE universal IN DESIGN, and meet or exceed all performance requirements for Category 6A and below as described in ANSI/TIA-568.2-D, as well as Class E<sub>A</sub> requirements as described in ISO/IEC 11801-1.
2. The plug shall comply with all National Electrical Codes, be compliant with ANSI/TIA-1096-A, and be UL listed. The plug shall be compliant with UL 2043 for use in air handling spaces.
3. The plug shall meet all requirements of IEC 60603-7 (including IEC 60512-5-2) and IEC 60512-99-001(including IEC 60512-9-3) standards.
4. The plug shall be encased in a 360-degree die-cast housing to protect it from potential EMI/RFI.
5. The plug shall not require a specialized termination tool.
6. The plug wiring shall accommodate 26-22 AWG solid or stranded conductors and terminable in both T568A and T568B wiring schemes. T568B shall be used.
7. The plug may be used to terminate to horizontal cable when connecting to Ethernet devices placed in fixed locations as recognized in ANSI/TIA-



568.2-D Annex F- Modular Plug Terminated Link (MPTL), ANSI/TIA-



862-B Annex C- Direct Connections, and ISO 11801-6 Type B generic cabling.

8. The connector module shall support IEEE 802.3at, IEEE Draft 802.3bt POE standards, and Power over HDBaseT™ (POH) applications up to 100 watts

Approved Products:

Leviton Cat 6A Universal Tool-Free Plug, # 6APLG-S6A

E. Category 6A Field Installable Coupler with Terminated Patch Cord

1. The coupler patch cord assembly shall meet or exceed all requirements for Category 6A as described in ANSI/TIA-568.2-D.
2. The coupler patch cord assembly shall be compliant with ANSI/TIA-1096-A and NFPA-70 CMP rated for installation above a drop ceiling or in other air handling spaces.
3. The coupler patch cord assembly shall be constructed with a zinc alloy body designed for use in both UTP and shielded channels.
4. The coupler patch cord assembly shall not require a specialized termination tool.
5. The coupler patch cord assembly wiring shall function in either T568 A/B wiring schemes.
6. The coupler patch cord assembly shall accommodate 22-26 AWG solid or stranded conductors.
7. The coupler patch cord assembly shall comply with the following POE standards:
  - a. IEEE 802.3at (Type 1) Power over Ethernet (PoE) applications up to 15.4 watts
  - b. IEEE 802.3at (Type 2) Power over Ethernet (PoE+) applications up to 30 watts,
  - c. IEEE 802.3bt (Type 3) Power over Ethernet (PoE+) applications up to 60 watts
  - d. IEEE 802.3bt (Type 4) Power over Ethernet (PoE+) applications up to 90 watts
  - e. Cisco Universal Power Over Ethernet Plus (UPOE+) applications up to 90 watts
  - f. Power over HDBaseT™ (POH) applications up to 95 watts





8. The coupler patch cord assembly shall be 26 AWG stranded conductor cable with an outside diameter of 0.223” for the patch cord.
9. The coupler patch cord assembly shall be terminated with an 8-position modular plug on one end.
10. The coupler patch cord assembly shall have a standard cable length of 18-inches. Custom lengths and colors available upon request.
11. The coupler patch cord assembly shall be available in White, Blue, and Gray cable colors.

Approved Products:

Leviton VXC™ Plenum Assembly SBCPI-18\*

\* = Colors: White (W), Blue (L), Gray (S)

#### F. OUTLETS & WALLPLATES

1. Contractor shall provide and install single gang faceplate kits to allow up to six data or voice jacks as required for all work area outlets, workstation base feeds, and unused telecom backboxes and furniture openings.
2. Faceplates shall utilize a Quickport (“keystone”-style) footprint to match the approved connectivity manufacturer, and be made by the same manufacturer as the connectors.
3. Faceplates shall support any connectivity media type, including fiber and copper applications, and shall be available in single-gang and double-gang configurations.
4. Surface-Mount Blocks (SMBs) are used to protect terminated CAT6 and CAT6A cables at the endpoints where they are not contained within walls or furniture. Example locations may be Wireless Access Points (WAPs) or other network-enabled device locations.
5. SMB shall be Plenum-rated for use in Plenum environments.

Approved Products:

Leviton QuickPort Single-Gang with ID Windows, # 42080-#xS

Leviton QuickPort Double-Gang with ID Windows, # 42080-#xP

Leviton QuickPort Blank Inserts, pack of 10, # 41084-0Bx

Leviton QuickPort Surface-Mount Box, # 41089-#xP

Where:

# = number of ports: 1, 2, 3, 4, 6

x = color: White (W), Ivory (I), Light Almond (T), Gray (G), Black (E)

Match colors and materials of the power wiring device plates

#### G. CATEGORY-RATED PATCH CORDS:

1. Standard copper patch cords for CAT6 and CAT6A UTP locations shall be 26-



gauge stranded conductor construction (0.24" OD), with a standard 8-position modular (RJ45) plug on both ends.



- a. Maximum Outer Diameter of 0.24"
  - b. Power over Ethernet (PoE and PoE+) compatible
  - c. Support 1 Gigabit applications over 90-meter permanent links with up to 10 meters of cordage
  - d. Meets all applicable standards and listings: ANSI/TIA-1096-A (formerly FCC Part 68), RoHS compliant, IEEE 802.3, PoE: IEEE 802.3bt
2. High-flex copper patch cords for CAT6UTP cable systems used inside Telecom Enclosures, Rooms and racks may be 28-gauge stranded conductor construction (0.15" OD CAT 6), with a standard 8-position modular (RJ45) plug on both ends.
  3. High-flex copper patch cords for CAT 6A UTP cable systems used inside Telecom Enclosures, Rooms and racks may be 28-gauge stranded conductor construction (0.185" OD Cat 6A) with a shielded 8-position modular (RJ45) plug on both ends to be used in shielded and unshielded channels.
  4. Copper patch cords shall be Power over Ethernet (PoE and PoE+) compatible and certified to support 1 Gigabit (CAT6) or 10Gigabit (CAT6A) applications over 90-meter permanent links. Cords shall meet all applicable standards and listings, such as ANSI/TIA-1096-A (formerly FCC Part 68), RoHS, IEEE 802.3, and PoE: IEEE 802.3bt
  5. Copper patch cords used in Plenum spaces shall be Plenum-rated. Cat 6A Plenum patch cords shall be universal, can be used in both shielded and unshielded channels.
  6. Copper patch cords shall not have an overmolded rubber "boot" which covers the release tab.

Approved Products:

Leviton "Slimline" CAT6 Patch Cord, #6D460-xx\*

Leviton "Slimline" CAT6A Patch Cord, #6AS10-xx\*

Leviton High Flex 10G Cat 6A Patch Cords, #H6A10-xx\*

Leviton High Flex 1G HD6 Patch Cord, for CAT6 systems, # 6H460-xx\*

Leviton Plenum-Rated CAT6A Patch Cord, #6ASP0-xx\*

Where

xx = Length in Feet (01, 03, 05, 07, 10, 15, 20 standard)

\* = color, **W**hite, **Y**ellow, **R**ed, **B**lue, **G**reen, **S**late (Gray), **E** (Black)

H. FIBER TERMINATION ENCLOSURES:

1. Shall provide cross connect, inter connect, and splicing capabilities and contain cable management for supporting and routing the fiber cables/jumpers.
2. Fiber enclosure shall be available in 1, 2 and 4RU versions to accommodate termination and splicing of fiber as outlined in the T-series drawings.



3. Enclosure depth shall be 17” and shall fit into a standard 19” rack. The combination shelf shall be able to support the terminations associated with the fiber cables and connectors as well as any splice cases required



4. Enclosure shall feature a sliding tray which removes completely, front or rear, from enclosure to facilitate field terminations and splicing.
5. Rack-mount enclosure shall have removable transparent hinged doors and slide away covers allow easy access during install and visibility of interior after install.
6. Fiber Adapter Plates (bulkheads) shall accept SC and/or LC connectors, MTP® adapters, and plug-n-play MTP modules/cassettes.
7. Fiber cable management for routing, storage, and protection shall accept patch cords, tight-buffer fiber, and backbone cables. Rear fiber cable management rings shall be stackable and configurable in ¼, ½, or full ring arrangements. Enclosure shall be constructed of 16-gauge steel with a powder-coated black finish and an optional locking door feature shall be available.
8. Enclosure shall support the use of splice cassettes in a standard adapter plate footprint.

Approved Products:

Leviton Opt-X 2000i SDX Rack-Mount 1RU Enclosure, # 5R1UH-S03  
Leviton Opt-X 2000i SDX Rack-Mount 2RU Enclosure, # 5R2UH-S06  
Leviton Opt-X 2000i SDX Rack-Mount 4RU Enclosure, # 5R4UH-S12  
Leviton lock and key # 5L000-KAL  
Leviton armored cable ground kit, # DPGRD-KIT

I. FIBER TERMINATION PANELS AND MODULES:

1. The adapter plate shall be offered in LC, SC, and MTP styles in 6, 12, or 24 fiber configurations. The adapter plate shall be compliant to ANSI/TIA-568.3-D (for performance) and respective ANSI/TIA-604-X (for intermateability) standards, and shall be made in the United States of America.
2. Adapter plates shall use zirconia ceramic sleeves and be offered in standard fiber type colors pursuant to ANSI/TIA-568.3-D standards. The adapter and plates shall be precision molded to eliminate “rattle” and loose fit.
3. SDX Integrated Fiber pigtail fusion splice modules shall be offered in 12- or 24-fiber LC in OS2 (Singlemode) and OM4 fiber types. Construction of module shall be of 14-gauge aluminum for robustness and light weight.
4. SDX Splice Modules shall be pre-loaded and routed with respective 3-meter, color-coded pigtail assembly. Individual pigtails shall have maximum insertion loss of 0.4 dB and 0.35 dB for OM4 and OS2 fiber types, respectively. Return Loss



shall be greater than -25 dB (for OM4), and -55 dB (for OS2/UPC).

5. SDX Splice Modules shall contain individual compartments which provide slack storage and bend radius protection for incoming backbone fibers, 900µm tight- buffer fibers, and fusion-spliced fibers. Incoming 250µm backbone fibers shall be protected by a braided mesh sleeve. Heat shrink style splice sleeves, braided mesh sleeve, and tie wraps shall be included with splice module.
6. HDX pigtail fusion splice modules shall be offered in 12-fiber LC and 36-fiber MTP configurations in OS2 and OM4 fiber types. Pigtail shall be preconfigured to allow for termination to loose tube, tight buffered, or ribbon fiber cables without modification or replacement.
7. HDX splice module construction shall be polycarbonate for robustness and lightweight.
8. HDX splice module individual pigtails shall have maximum insertion loss of 0.15 dB (OM4) and 0.25 dB (OS2) for LC. For MTP a maximum insertion loss of 0.35 dB max on both OM4 and OS2.
9. HDX splice module shall provide slack storage and bend radius protection for incoming backbone fibers, 900 µm tight-buffer fibers, and fusion spliced fibers. Incoming 250 µm or ribbon backbone fibers shall be protected by a braided mesh sleeve. Heat-shrink style splice sleeves, a ribbon splice sleeve, a braided mesh sleeve, and tie wraps shall be included with module.

#### Approved Products:

Leviton 12-strand SDX Adapter Plate, LC, SM, #5F100-2LL  
Leviton 12-strand SDX Adapter Plate, SC, SM, #5F100-2LC  
Leviton 24-strand SDX Adapter Plate, OM3/4, #5F100-4QL  
Leviton Opt-X 12-Fiber SDX Splice Module, SM, # SPLCS-12L  
Leviton Opt-X 12-Fiber SDX Splice Module, SM, SC, #SPSCS-12L  
Leviton Opt-X 24-Fiber SDX Splice Module, OM4, # SPLCS-244  
Leviton HDX to SDX Adapter Bracket, #HDXAD-ACC  
Leviton HDX 12-Fiber OM4 LC Shuttered Aqua Splice Module, #SPLCH-12AQ  
Leviton HDX 12-Fiber OS2 LC Shuttered Blue Splice Module, #SPLCH-12BL  
Leviton HDX 36-Fiber (3x12 fibers) OM4 MTP, Male #SPMPH-MMPN  
Leviton HDX 36-Fiber (3x12 fibers) OS2 MTP, Male #SPMPH-SMPN

#### J. FIBER CONNECTORS

1. Pre-polished fiber optic connectors shall meet or exceed the requirements described in TIA-568.3-D and ANSI/TIA-604-5 (LC) Connector Intermateability Standards
2. Shall be pre polished and field installable to eliminate the need for hand polishing, bonding, or epoxy in the field.



3. Shall utilize a precision zirconia ceramic ferrule, and be re-terminable up to 3 times during testing without loss of performance.
4. Shall require the use of a cleaver with a guaranteed maximum cleaving angle of 2 degrees for multimode and 1 degree for singlemode fibers.
5. Shall be provided in LC, single-mode or multimode (laser optimized) configurations, terminated on 250 or 900  $\mu\text{m}$  buffered fiber and/or 2mm or 3 mm jacketed fiber.
6. Maximum connector insertion loss shall be no greater than 0.5 dB, with an average of 0.1 dB (MM) or 0.2dB (SM). Typical connector return loss shall be -25 dB (multimode) and -55 dB (single mode). All versions shall allow continuity to be verified by use of a visual fault locator (VFL).

Approved Products:

Leviton FastCAM LC Singlemode, # 49991-SLC

Leviton FastCAM LC OM3/OM4 Multimode, # 49991-LLC

Leviton / Lynx cleaver # 49886-LNX or equal



#### K. FIBER JUMPERS AND ARRAY CORDS

1. Fiber optic LC-LC patch cords shall be factory-manufactured, terminated and polished using Singlemode OS2 and Laser-Optimized OM4 Multimode optical fiber. Field terminations on fiber jumpers are not acceptable.
2. Shall utilize A-B polarity, and exhibit <math><0.35\text{ dB}</math> insertion loss for single-mode and 0.4 dB per mated for multimode. Multimode patch cords shall meet an optical return loss equal to or greater than 25 dB per mated pair, and single-mode equal to or greater than 50 db for UPC polish.

##### Approved Products:

Leviton Economy LC-LC SM duplex jumper, UPDLC-Sxx  
Leviton Economy LC-LC OM4 duplex jumper, 54DLC-Mxx  
(xx = Length in Meters, for example, 03 or 10) as required

#### L. 2-POST RELAY RACKS:

1. 19" EIA-310 standard universal telecommunications equipment rack. 7 ft. high
2. Suitable for mounting approved modular patch panels, wire management and active network equipment. Must be seismically restrained.
3. Use vertical cable raceways at ends of rows (6") and between each frame (10"), and horizontal cable management panels added as needed (if indicated in the T-series drawings).

##### Approved Products:

Chatsworth 55053-703, Aluminum Relay Rack, Black

#### M. ADJUSTABLE FOUR POST SERVER RACK:

1. 19" EIA-310 standard steel, 4-post adjustable equipment frame, 7 ft high x 29.5-35.4" deep,
2. Suitable for mounting approved modular patch panels, wire management and active network equipment. Must be seismically restrained.
3. Use vertical cable raceways at ends of rows (6") and between each frame (10"), and horizontal cable management panels added as needed (if indicated in the T-series drawings).
4. Square-punched mounting holes. Include (50) 12/24 square nuts and bolts.

##### Approved Products:

Chatsworth 15213-703, Adjustable Server Rack, Black  
Chatsworth 12639-007, square nuts and 12/24 hardware kit, packs of 25





N. WALL-MOUNT CABINET:



1. 19" EIA-310 standard steel, internal 4-post reinforced frame, 3 ft high, complete with vertical cable raceway channels and horizontal cable management panels (if indicated in the T-series drawings). Suitable for mounting approved modular patch panels, wire management and active network equipment.
2. Chatsworth Cube-IT Plus Cabinet

## 2.07 MANAGEMENT HARDWARE

### A. CABLE MANAGERS:

1. Rack mounted, Double sided Slotted MCS Master Cabling vertical cable manager.
2. Rack mount, Double sided 19" Horizontal Universal Wire Management Panel
3. Wall-mount Fiber Slack Storage Rings

#### Approved Products:

Chatsworth 30096-703, 10" Vertical Wire Manager, Black  
Chatsworth 30095-703, 6" Vertical Wire Manager, Black  
Chatsworth 30529-719, Horizontal 1U Wire Manager, Black  
Chatsworth 30530-719, Horizontal 2U Wire Manager, Black  
Leviton 12" Inside Plant Cable storage ring, 48900-IFR  
Leviton 24" Outside Plant/Armored Cable storage ring, 48900-OFR

## 2.08 CABLE PATHWAYS

- A. EMT Steel Conduit for horizontal cable. (Installed by Others). The horizontal cable system will be totally enclosed. The cable will run in conduit and through junction boxes. The conduit system will extend from the station outlet box to the telecommunications Rooms.
- B. Non-Continuous Cable Supports (Multi Tiered J Hook Assemblies) for cables not in conduit.
  1. Multi- tiered non-continuous cable support assemblies shall be used to support telecommunications cables in accessible ceiling areas. Assemblies may be factory assembled or assembled from pre-packaged kits. Assemblies shall consist of a steel angled hanger bracket holding up to six non-continuous cable supports, rated for indoor use in non-corrosive environments; UL Listed.



2. Provide all necessary hardware for installing multi-tiered support brackets in accessible ceiling spaces. These spaces may include T-bar ceiling, threaded rod spaces, and or direct mounting to concrete wall or ceiling.

#### Approved Products

BLINE BCH32-1D, 2 x 2" J-hangers on a support  
BLINE BCH64-1D, 2 x 4" J-hangers per support  
BLINE BCH32-2D, 2 x 2" J-hangers per support  
Other sizes or equivalent

#### C. Overhead and In-Box Brackets

1. Above-ceiling cable termination locations shall be either wall-mounted or suspended from structure above the drop ceiling. Cables or terminations shall not rest on ceiling grid or equipment above ceiling grid.
2. For Wireless access Points and other above-ceiling-mounted communications devices, cables shall land in an above-ceiling bracket which is affixed to dedicated cable support hardware. Above-ceiling bracket can hold 2 jacks, a 2-port Surface-Mount Box, or a 1U MOS SMB for multimedia applications.
3. For wall-mounted device locations (above or below ceiling), devices needing to be mounted directly to a backbox will utilize the in-wall mounting bracket to secure the jack inside the backbox.
4. One category-rated jack can be installed in each in-wall backbox jack mounting bracket. For devices requiring (2) category-rated jacks, (2) in-wall brackets must be used.

#### Approved Products:

Leviton QuickPort In-Ceiling Bracket, rod/wire hanger, 49223-CBC  
Leviton QuickPort In-Ceiling Bracket for beam and screw mounts, 49223-CB0  
Leviton QuickPort In-Wall Bracket, 49223-BA5 (pack of 5)

#### D. Cable Runway Support and Pathway System.

1. All industry standard cable runway shall be manufactured with tubular steel rails twelve inches (12"), fifteen inches (15"), eighteen inches (18") or twenty-four inches (24") in width configured with industry standard on and on-half inch (1.5") ladder cross bars positioned twelve inches (12") on center perpendicular to the rails, as indicated in the Project Drawings.



2. Cable runway system shall include structural engineered and approved components to provide and install the necessary zon-4 seismic support system including end caps, wall angle support brackets, bonding straps, butt splice kits, junction splice kits, and rack-to-runway mounting kits.
3. The cable runway system shall include a corner section at each intersection that creates a radius “L”, “X”, and/or “T” formed when two (2) or more pieces of cable runway are connected together with a junction splice assembly.
4. The cable runway system shall include all components indicated in the T-series drawings to complete the system. These components shall be available from the same manufacturer and shall include, but may not be limited to:
  - a. Cable runway bend radius drop assemblies (sized per runway section)
  - b. Cable runway movable cross member assemblies to support cable runway bend radius drop assemblies (sized per runway section).
  - c. Runway butt-splice kits
  - d. Runway junction splice kits
  - e. Cable runway corner brackets (sized per runway and site conditions)
  - f. Swivel splice kits
  - g. Rack-to-runway mounting plates (sized per runway section)
  - h. Cable elevation kits (sized per site conditions)
  - i. Wall angle support brackets (sized per runway section)
  - j. Runway foot kits
  - k. Threaded rod assemblies for attachment
  - l. Slotted Support brackets for runway attachment to threaded rod assemblies
  - m. Vertical wall brackets
  - n. Cable retaining posts (6” as required)
  - o. Runway grounding kits
  - p. Protective end caps
6. All cable runway components shall be black in color, unless otherwise noted in the Project Drawings.
6. Cable Runway System Manufacturer
  - a. Chatsworth Runway System and Components.

## 2.09 FIRESTOPPING



- A. Fire rated pathway devices shall be the preferred product and shall be installed in all locations where frequent cable moves, add-ons and changes will occur. Such devices shall:
1. Meet the hourly rating of the floor or wall penetrated.
  2. Permit the allowable cable load to range from 0% to 100% visual fill thereby eliminating the need to calculate allowable fill ratios.
  3. Permit multiple devices to be ganged together to increase overall cable capacity.
  4. Allow for retrofit to install around existing cables.
  5. Include an optional means to lengthen the device to facilitate installation in thicker barriers without degrading fire or smoke sealing properties or inhibiting ability of device to permit cable moves, add-ons, or changes
  6. Not require any additional action on the part of the installer to open or close the pathway device or activate the internal smoke and fire seal, such as, but not limited to:
    - a. Opening or closing of doors.
    - b. Twisting an inner liner.
    - c. Removal or replacement of any material such as sealant, caulk, putty, pillows, bags, foam plugs, foam blocks, or any other material.
  7. Where single cables (up to 0.27 in. (7 mm) diameter) penetrate gypsum board/stud wall assemblies, a fire-rated cable grommet may be substituted. Acceptable products shall be molded from plenum-grade polymer and conform to the outer diameter of the cable forming a tight seal for fire and smoke. Additionally, acceptable products shall lock into the barrier to secure cable penetration.
- Approved Products:  
Specified Technologies, Inc. EZ-PATH series 22, 33 and 44+ fire-rated pathway devices  
Specified Technologies, Inc. EZ-PATH GROMMET
- B. Where non-mechanical products are utilized, provide products that upon curing do no re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during or after construction.
1. Where it is not practical to use a mechanical device, openings within floors and walls designed to accommodate telecommunications and data cabling shall be provided with re-enterable products that do not cure or dry.



2. Utilize an EMT sleeve as a stub through a rated wall
3. Surround annular space between EMT sleeve and wall material with a hardening intumescent caulk.
4. Utilize re-enterable, non-hardening putty around cables inside a metal sleeve. Do not exceed 40% fill capacity of sleeve and follow all rated assembly requirements per Manufacturer, local codes, and AHJ.
5. Cable trays shall terminate at each barrier and resume on the opposite side such that cables pass independently through fire-rated pathway devices. Cable tray shall be rigidly supported independent from fire-rated pathway devices on each side of barrier.

Approved Products:

Specified Technologies, Inc. SSS Intumescent Caulk  
Specified Technologies, Inc. SSP Intumescent Putty

## 2.10 LABELS

### A. Labels:

1. Laser printed self-adhesive, smudge resistant self-laminating labels for cables and faceplates. Labels shall be appropriately sized for cable diameter. Labels shall be appropriately colored for faceplate color contrast.
  - a. Black text on clear tape for Stainless Steel and Ivory surfaces
  - b. Black text on white background for White surfaces and white label backgrounds
  - c. White text on black background for labeling on Black surfaces
2. Wrap-around cable labels shall be min. 1" wide, and of sufficient length to wrap around the entire cable with multiple lines of a repeating label, visible from any orientation.

Approved products:

Brother P-Touch TZe tapes, 3/8", 1/2" widths x 26.2' per cartridge (or as required)  
Brother P-Touch TZe Flexible-ID tapes, 1", and 1.5" widths x 26.2' per cartridge, for cable wraparound labeling  
Brother P-Touch TZe tapes, 1" or 1.5" Width, white text on black background, for rack labels and other high visibility equipment purposes



## PART 3 – EXECUTION

### 3.01 EXAMINATION

- A. Contractor shall examine the site conditions and telecommunications spaces associate with the work and the conditions under which the Work would be performed prior to beginning work. Contractor shall remedy conditions detrimental to the proper and timely completion of the Work. Do not proceed until unsatisfactory conditions have been corrected.

### 3.02 METHODS AND PROCEDURES

- A. Examine and compare the Telecommunications Drawings and Specifications with the Drawings and Specifications of the other trades. Report any discrepancies between them to the Architect, and obtain from them written instructions for changes necessary in the work. At time of bid, the most stringent requirements shall be included in the bid.
- B. Install and coordinate the telecommunications cabling Work in cooperation with other trades installing interrelated work. Before installation, make proper provisions to avoid interference in a manner accepted by the Architect. Any repairs or changes made necessary in the Contract Work, caused by the Contractor's neglect, shall be made by him at his own expense.
- C. The Contractor shall maintain a complete file of Shop Drawings and other submissions, including the Project specifications and the drawings, at the job site always. Shop Drawings and all other submissions shall be made available to the Architect and County representative at their request.
- D. The Contractor shall follow manufacturers' instructions for installing components and adjusting all equipment and telecommunications cables. Submit two (2) copies of such instructions to the Architect before installing any equipment. Provide a copy of such instructions at the equipment during any work on the equipment. Where no instructions are included with the equipment, follow accepted industry practices and workmanlike installation standards.
- E. Perform all tests required by local authorities in addition to test specified herein.
- F. Do not allow telecommunication cables to run parallel with electrical cables/conduits, unless they are separated by a minimum of 12 inches. Note: any telecommunications cables that must cross over electrical cables/conduits shall do so only at 90-degree angles.



- G. Ensure that all telecommunications cable supports (conduits, support grips, J hooks) are fully installed before proceeding with cable installation. At no times shall cables be installed and left unsupported. At no times shall cables be tie-wrapped to any other supporting structure in lieu of specified cable supports. Do not bundle or tie-wrap the cables even within the approved cable supports.
- H. For installation of Non-Continuous Cable supports (Multi-Tiered J Hook Assemblies), ensure cable is supported with J Hooks every 4 to 5 feet. No cable shall remain unsupported for more than 5 feet.
- I. Do not lay telecommunications cables unprotected on the floor at any time. If cables must be left on any floor, protect the cables so that they may not be walked on or have any material or equipment placed or rolled on top of them at any time.
- J. Maintain manufacturers' recommended minimum bend radius of the cables, at all times (minimum bend radius may be as small as 2 inches for 4-pair UTP). Do not stretch, stress, tightly coil, bend or crimp the workstation cables during the installation or when leaving them out of the way of other trades during the staging work. The Contractor, at the Contractor's expense, shall replace all abused or stressed cables.
- K. Keep all items protected before and after installation, with dust and waterproof barrier materials as necessary. The Contractor shall be responsible to ensure the integrity of the protective measures throughout the life of the project.
- L. Clean up and remove all debris generated by installation activities. Keep the telecommunications areas free of debris at all times.
- M. Deliver to County's representative, two sets of all special tools specifically needed for proper operation, adjustment and maintenance of cable and cable termination hardware installed under this Contract.
- N. Upon project completion, provide as-built drawings and documentation as defined herein.
- O. Craft personnel shall be qualified to perform the work activities and be knowledgeable of the following:
  - 1. Color coding of standard UTP cables.
  - 2. Bonding and grounding of cable tray and equipment racks.
  - 3. Testing conductors for electrical continuity.





4. Testing of copper conductors for wire mapping, attenuation and worst case near end cross talk and other tests as required by ANSI/TIA-568.1 and 568.2.
  5. Termination or connectorization of unshielded twisted pair cable on all specified connectors and termination.
  6. Generally accepted industry standards, as well as manufacturers written installation instructions, will be used for in-process quality control and final acceptance of the work installation.
- P. Check actual job conditions prior to start of any work. Ensure all preceding trade work associated with the telecommunications system is accurate before proceeding with the installation. The Contractor will be responsible for inspecting the previously performed work of other trades, and commencement of work will serve as evidence of the acceptance of this work as suitable for the work to follow. Notify in writing the Owner and Designer of any discrepancies that will impact the telecommunications system prior to commencement of said work. Examples of work which must be checked include, but are not limited to:
1. Electrical requirements (conduit installation and capacity)
  2. The telecommunications rooms are the size shown on the Project Drawings.
  3. Adequate clearances of doors, riser spaces and ceilings for all component of the telecommunications system.

### 3.03 INSTALLATION

#### A. Equipment Racks and Cabinets

1. Provide, as shown on drawings, rack and cabinets in the respective ER/TRs rooms or termination locations for the mounting of termination panels and IT equipment. Bolt each rack to the floor slab and attach the cable runway system overhead via cable runway elevation kits per the manufacturer's recommended installation instructions. Bond each individual rack and cabinet directly to the grounding busbar located within the room/space.

#### B. Termination Components:

1. Provide fiber combination shelf in rack mount frame for mounting into racks and cabinets as indicated in the project drawings with a minimum of 48 port



capacity. Provide and install correct adapters for fiber termination, complete with designation strips & any required cable managers.

2. Provide Wall Outlets & faceplates containing 8-pin 8-conductor modular connectors, non-keyed (8P8C), typical "RJ45" style; complies with ANSI/TIA-568.2-D, Category 6 or 6A performance specifications as determined by application. Outlet wired with standards compliant T568B pinning. Coordinate faceplate color and jack color with T-series drawings.
  - a. WIRELESS ACCESS POINTS (WAP): Install (2) CAT6A cables per WAP location.
  - b. VIDEO CAMERAS: Install (1) CAT6A cable per location.
  - c. WORK AREA OUTLETS: Install (3) CAT6 cables to each standard Work Area Outlet (WAO).
3. Provide IDF modular termination jacks at patch panels as 8-pin modular connectors, non-keyed (RJ45) connectors; complies with TIA-568.2-D, Category 6 or 6A performance specifications as appropriate to match cable and jacks at both ends. Wired with standards compliant T568B pinning. Coordinate jack colors with T-series drawings. Install black colored blank modular inserts into unused patch panel ports.
4. Provide one 7' and one 10' patch cord for each WAO location as shown on drawings, specified by County or approved as change.
  - a. Patch cord Category shall match the rating of the link for which they are provisioned.
  - b. Plenum locations shall require one CMP and one CM/CMR cord per location. CM cord to be used at ER/TRs and CMP cord to be used in ceiling plenum space.
  - c. Confirm final lengths, quantities, Categories, ratings and colors of cords with County prior to ordering.

#### C. Cable Media:

1. Install riser UTP cable in accordance with this Specification in quantities indicated in the project drawings and terminate all UTP cable pairs (except the 25th pair in each binder group – coil for future use) on patch panels as indicated in the T-series drawings. Comply with the manufacturers' recommendations, and the Telecommunications Distribution Plan Drawings.



2. Install riser fiber cable in accordance with this Specification in quantities indicated in the T-series drawings from each TRs and to the ERs. Comply with the manufacture's recommendations, and the Telecommunications Distribution Plan Drawings.
3. After dressing the cable to its final location, remove only enough sheath to allow the conductors to be splayed and terminated in a neat and uniform fashion. Every effort will be made to maintain sheath integrity by removing only as much sheath as is practical, to accomplish termination. For UTP cables, maintain the manufacturers twisting of the wire pairs through to the point of termination, with a maximum untwist of 1/8".
4. There shall be no splices or mechanical couplers installed between the cable points of origin and termination for the inter-building and intra-building cable.

#### D. Cables:

1. Provide 4-pair Category 6 cables from each workstation telecommunications outlet location (for standard type outlets) or 4-pair Category 6A cables from each camera or WAP telecommunications outlet location to the respective Telecom Room termination location as indicated in the project drawings. Cables to be color-coded consistent with T-series drawings. For additional workstation types as indicated on the telecommunications drawings route the correct amount of Category-rated cable from each workstation telecommunications outlet location to the respective termination location. Utilize the cable tray system for the routing of cables whenever possible. Terminate all cables onto 8-pin modular connectors at the outlet location. Terminate the four-pair cables onto rack mounted, metal modular data jack insert patch panels.
2. Where telecommunications outlets are wall mounted inside enclosed offices, route cables overhead from the termination location (ERs/TRs) via the overhead cable tray network to the outlet area, and down a conduit stub-upto a junction box at the bottom of the conduit. Mount outlets with an appropriate faceplate.
3. Where workstation outlets are mounted in drywall partitions to support seating in the common areas, route cables from the termination location (IDF) to the accessible ceiling area within the commons area and down a conduit stub-up to a junction box at the bottom of the conduit. Mount outlets with an appropriate faceplate.
4. Cables shall be neatly bundled and dressed to their respective termination



device. Each terminating device shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.

5. Cable bundles shall not be painted.
6. Cable bundles shall be wrapped in Velcro tie wraps. No nylon tie wraps shall be used in any location of the install.



E. Cable Runway and Non-Continuous Cable Supports (Multi-Tiered J Hook Assemblies):

1. Provide cable runway and associate runway components in the TRs, ERs and termination locations as shown on the T-series drawings. Mount cable runway overhead at the indicated height following manufacturer's installation instructions at all times.
2. Provide threaded rod ceiling support assemblies spaced 5' on center, wall angle support kits, or triangular support brackets to support the cable runway over head (where required) as indicted in the T-series drawings.
3. Ground each cable runway section to the next. Ground each cable runway system to the nearest telecommunications grounding bus-bar located within the respective telecom rooms. Provide waterfall pieces for the gradual transition from end of cable runway or whenever cables exit the cable runway.

F. Identification:

1. Provide label identification on all outlet faceplates installed under this Work. Labels should be machined-generated labels with the outlet ID as per TIA-606, and approved by the Owner prior to use.
2. Provide on all termination panels installed under this Work, machine-generated designation strips with the cable ID and pair number, in uppercase lettering.
3. Provide on all patch panels installed under this Work, machine-generated label with the cable ID, and fiber strand number in uppercase lettering.
4. Provide on all telecommunications cables installed under this work a machine-generated label with the cable ID, in black uppercase lettering on a permanent adhesive, white label stock, covered with permanent water resistant sealer. Labels shall be placed on both ends of the cable and no more than 6" from the point at which the cable is broken out into individual copper pairs or strands from the connector or termination block or patch panel. Labels shall be placed parallel with the cable. All labels shall be readily visible.
5. Hand lettered label stock will not be accepted for final installation. Hand lettered stock is only acceptable for use with temporary labeling required during construction phases.



6. If at any time during the project, the label becomes illegible or removed, the Contractor shall immediately replace it with a duplicate preprinted label.
7. All cable IDs shall be both physically and visually accessible upon completion of the project.

#### 3.04 COPPER CABLE TESTING AND VERIFICATION

- A. Verify and test all Category 6 and 6A cables with a Fluke DTX series Level IIIe tester or newer, that has been properly calibrated by the manufacturer within the prior 12 months. Verification and documentation of latest factory certification must be provided by the Contractor prior to testing.
- B. The tester interface adapters shall be PM06 universal permanent link adapters and must be in new condition with the adapter cable and assembly not indicating any twisting or kinking resulting from coiling and storing of the tester interface adapters.
- C. Baseline accuracy of the copper test equipment must exceed TIA Level IIIe, as indicated by independent laboratory testing.
- D. Copper Test equipment must be capable of verifying Category 3, Category-5e, Category-6 and Category-6A links or channels independent of termination hardware configuration (IDC or 110-style) for levels of performance.
- E. Copper Test equipment shall be capable of storing full frequency sweep data for all tests and printing color graphical reports for all swept measurements.
- F. The testing device shall be provided by the Trade Contractor and approved by the Designer, and Owner prior to use. It is the responsibility of the Trade Contractor to get written authorization from the Designer and Owner to commence testing with their proposed device. Failure to gain approval is at the Trade Contractor's risk and expense.
- G. Category-3 testing of every copper cable pair shall be tested for, and comply with, TIA-568.2-D standards and must include each of the following:
  1. Wire Map
  2. Length
  3. Opens



4. Shorts
  5. Continuity
  6. Polarity, or Pair Reversals
  7. Proper Labeling
  8. Others as may be noted in the Contract Documents
- H. Category 5e and 6 cables shall be tested for, and comply with, all of the above and TIA-568,2-D standards related to the following:
1. Attenuation/Insertion Loss
  2. NEXT (Near End Cross Talk )
  3. PS-NEXT (Power Sum Near End Cross Talk)
  4. FEXT (Far End Crosstalk)
  5. ELFEXT (Equal Level Far End Cross Talk)
  6. PS-ELFEXT (Power Sum Equal Level Far End Cross Talk)
  7. Propagation Delay
  8. Delay Skew
  9. Return loss
  10. PSFEXT (Power Sum Far End Crosstalk)
  11. Attenuation to Cross Talk Ration (ACR)
  12. PSACRF (Power Sum Attenuation to Crosstalk Ratio, Far End)
- I. Category 6A cables shall be tested for, and comply with, all of the above and TIA-568.2-D standards related to the following:
1. AACRF (Alien Attenuation to Crosstalk Ratio, Far End)
  2. AFEXT (Alien Far End Crosstalk)
  3. ANEXT (Alien Near End Crosstalk)
  4. PSANEXT (Power Sum Alien Near End Crosstalk)
  5. PSAACRF (Power Sum Alien Attenuation to Crosstalk Ratio, Far End)
- J. Category cables terminated with a Field-installable modular plug shall be tested using the Modified Permanent Testable Link (MPTL) procedures as specified in ANSI/TIA-568.2-D::
1. The MPTL consists of a jack at the patch panel end, and a Field-Terminable Modular Plug at the remote/device end. MPTL links may only be installed upon written instructions from the County.
  2. The MPTL shall be tested with a Permanent Link Adapter on the Main Unit and a Patch Cord Adapter Suitable for Category 6A testing on the Far End or Remote Test Equipment



3. The Permanent Link Adapter RJ45 plug must meet the requirements for NEXT, FEXT and Return Loss in accordance with ANSI/TIA-568.2-D Annex C.
4. The Patch Cord Adapter must contain a test jack which meets the requirements for NEXT, FEXT and Return Loss in accordance with ANSI/TIA-568.2-D Annex C
5. Twisted pair Category 5e, 6, 6A, 7 or 7A patch cords are not permitted for testing as their performance degrades with use and can cause false Return Loss failures
6. All test parameters resulting from the MPTL test must comply with all of the above according to the rating of the cable system under test.

### 3.05 FIBER CABLE TESTING AND VERIFICATION

- A. All optical fiber cables/strands must be tested in the end-to-end, completed system with a Fluke Opti-fiber Tier-2 optical fiber testing device and appropriate fiber mandrel that provides the following:
  1. Measuring insertion loss
  2. Analyzing the OTDR trace
  3. Grading the connector end face
  4. End face image of connector(s) embedded into certification report.
- B. All tested fiber strands must meet the FOTP requirements put forth by TIA/EIA 526, TIA/EIA-455 (method-B), TIA/EIA 492AAAC, TIA/EIA TSB-63, and TIA/EIA TSB-140 requirements and the TIA-568.3 standard. Any optical fibers failing to meet these standards or the more stringent performance requirements stated above, must be removed and replaced, at no cost to the Owner, with fibers that prove, in additional testing, to meet or exceed the performance standards set forth.
- C. Optical fiber splices, fusion or mechanical, shall not exceed a maximum optical attenuation stated in section 2, above, when measured in accordance with field testing procedures
- D. The system loss measurements shall be provided at 850 and 1310 nanometers for multimode fibers and 1310 and 1550 nanometers for single-mode fibers.
- E. The testing of all optical fiber cables shall include bi-directional, end-to-end tests using both a hand-held Optical Time Domain Reflectometer (OTDR) and a light power meter testing device. The signature trace of the cable must include each of the following:





1. Attenuation per kilometer
  2. Attenuation uniformity
  3. End-to-end integrity
  4. Total length of each strand
  5. Total insertion light loss
  6. Insertion loss at each incident throughout the cable path
- F. After Optical fiber verification testing in one (1) direction has been completed and certified, all optical fiber strands are to be measured in the opposite direction. All test parameters shall be indicated for both directions on each strand in the test documentation.
- G. All fiber test results shall include an image of both connector end faces embedded into the final test report (hard and soft copy) for a baseline reference of each connector.
- H. The allowable loss budgets shall be as follows:
1. MMF:  $(\text{All cable loss per km}) \times (\text{km of fiber in link}) + (0.30\text{dB LOMMF}) \times (\text{number of connectors}) = \text{maximum allowable loss}$
  2. Loss numbers for the installed link shall be calculated by taking the sum of the bi-directional measurements and dividing that sum by two.
  3. Any link not meeting the requirements of the standard shall be brought into compliance by the contractor at no charge to the Owner.
- I. Any installed component in the TIA/EIA fiber-related and/or industry standard verifications testing parameters found to be below performance standards for that particular channel and/or link, testing procedure, and manufacturer specified performance criteria shall be immediately replaced and retested by the Trade Contractor at no additional cost to the Owner until all deficiencies are rectified to the satisfaction off all testing procedures.

### 3.06 TEST DOCUMENTATION

- A. A complete set of test results shall be presented to the Designer and Owner at least one (1) week before the placement of active electronics in the IT spaces. The Trade Contractor shall identify the types of cable tester(s) used during the testing and verification when presenting the results for each type of cable and each test procedure, unless otherwise indicated.
- B. All verification and test results shall be submitted to the Designer and Owner in both paper and electronic formats printed directly from the testing device software application. Paper results must be neatly presented in a three (3) ring binder and



sectioned according to floor and cable type, OSP, Category-6A, Category-6, (and Category-5e, Category-3 if appropriate), and optical fiber cables must be divided into separate sections with each floor. Electronic results must be presented on CD-ROM disc(s) in the testing device's native file type with a copy of the electronic software used to generate the test results for review by the Owner, Designer and the contractor selected connectivity and cable group representative(s).

- C. Trade Contractor shall warrant in writing that one hundred percent (100%) of the installation meets requirements specified under subsections above. Owner reserves the right to conduct, using Trade Contractor equipment and /or labor, a random re-test of up to five (5) percent of the cable plant to confirm documents results. Complete (100%) random re-testing, if performed, shall be at the expense of the Owner, using standard labor rates if no failures are found. If any failures are found in the 5% verification testing performed by the Owner, the re-testing expense shall be the Trade Contractor's. Any failing cabling shall be re-tested and restored to a passing condition. In the event more than two percent (2%) of the cable plant fails during re-test, the entire cable plant shall be re-tested and restored to a passing condition at no additional cost to the Owner.

### 3.07 FIRE STOP – PENETRATION SEALANT

- A. Provide fire-resistant materials of a type and composition necessary to restore fire ratings to all wall or floor ceiling penetrations. Material must be properly classified and meet all national and local codes.
- B. All penetrations through fire rated floors and walls shall be sealed to prevent the passage of cold smoke, fire, toxic gas or water through the penetrations, before, during or after a fire. The fire rating of the penetration seal shall be at least that of the floor or wall into which it is installed, so that the original fire rating of the floor or wall is maintained as required by Article 300-21 of the National Electrical Code.
- C. No flammable material may be used to line the chase or hole in which the firestop material is to be installed.
- D. All damming materials to be left in place after the seal is complete shall be non-flammable.
- E. The sealant shall remain resilient and pliable to allow the removal and or addition of cable without necessity of drilling holes. It shall adhere to itself perfectly to allow any and all repairs to be made with the same material. It shall allow for



vibration, expansion and/or contraction of anything passing through the penetration without affecting the seal, or cracking, crumbling and spalling.

- F. When sealant is injected into a penetration, the material shall expand to surround all the items within the penetration and maintain pressure against the walls of the penetration as well as the pass-through items. The material shall cure within five minutes and be fire resistant at that time. No heat shall be required to further expand the material to prevent the passage of fire and smoke or water.
- G. The materials shall have been subjected to fire exposure in accordance with standard time-temperature curve in the Standard, UL ASTM E 119 and NFPA 251. The fire stop material shall have also been subjected to the hose stream test in accordance with UL 10B.

### 3.08 AS BUILT DRAWINGS AND CABLE LIST

- A. The Contractor shall provide the following “As-Built” drawings to the owner. These as-built drawings shall include all work described within this specification section, including, but not limited to the following:
  - 1. A complete backbone connectivity diagram showing backbone interconnection and cable routing. Each cable type and routing shall be noted.
  - 2. Finalized, detailed elevations of the Voice and Data MDF illustrating all punch-down locations and rack elevations.
  - 3. Finalized, detailed elevations of the IDF(s) illustrating punch-down locations and equipment rack locations
  - 4. Finalized equipment rack elevations illustrating vertical location of termination hardware (e.g. fiber boxes, patch panels, etc.) within all telecommunications areas.
  - 5. Finalized outlet layout floor plans including room/area numbers, outlet numbers and the corresponding cable identification numbers.

### 3.09 MANUFACTURER’S LITERATURE

- A. Where the Specifications and/or Project Drawings call for an installation to be made in accordance with the Manufacturer’s recommendations, a copy of such recommendations shall always be kept on the job site, and shall be available to the Owner.
- B. Contractor shall follow manufacturer’s instructions where they cover points not specifically indicated on Project Drawings and Specifications. If said instructions differ from the Project Drawings and Specifications, it is the responsibility of the



Contractor to obtain clarification from the Owner in writing before commencing work.

### 3.10 TRAINING

- A. Provide training for the Owner-appointed employees to operate and maintain the installed technology utility system. Training will include two (2) full day sessions that include, but are not limited to: a description of the system, a tour of the facilities, and a manufacturer-provided tutorial on using the cable testers and documentation software.

### 3.11 ACCEPTANCE

- A. The installation will not be accepted until all work is complete and properly documented, as noted above and in the Project Drawings and not until all punch list items discovered are completed to the Owner's satisfaction and after the successful completion of the Acceptance period.
- B. Following the completion and compliance of all requirements noted above and in Division One, the Owner will issue a Notice of Completion confirming that the Technology Portion of the project is complete. A forty-five (45) day Acceptance period will begin immediately following the issuance of this Notice of Completion
- C. During the acceptance period, the Voice Data Communication System, as described herein and in the Project Drawings, must be up and operational. If there is a major system failure, the Acceptance period will begin again, once the failure is resolved and the system is back up and running. Major system failures are defined as failures that impact 10% or more of the user connections.
- D. This Acceptance period shall be considered outside any Warranty period provided by the Contractor or Manufacturer. Once the forty-five (45) days Acceptance period has successfully passed, the Warranty period shall begin.
- E. The project manager must be available to answer questions about the installation and to attend site visits and meetings during the acceptance period, as deemed necessary by the Owner.
- F. Contractor shall submit all applications for Manufacturer extended warranty on behalf of Owner before completion of the Acceptance Period.

----- END -----