9-090702 – Addendum # 003
Resident Engineer's Office and Data Center
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Missouri Department of Transportation

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SECTION 16700 - COMMUNICATIONS CABLING AND TERMINATION EQUIPMENT

PART I – GENERAL

1.01 SUMMARY OF WORK

A. The work covered by this document includes: the construction, labor required to perform and complete the Work, all materials required to perform and complete the Work, and equipment required to perform and complete such Work, coordination with the General Contractor, Engineered Designed Facilities and coordination with other trades.
B. The scope of Work includes:

1. Installation, termination, and testing of high pair copper OSP building backbone cables between the TTB in computer room and the Communications Closet.
    a. Installation of a 25 pair 24 AWG OSP cable for Telephones.
2. Installation, termination and testing of multimode optical fiber backbone cable between the patch panel in the Computer Room and the Data Communications Room in the Administration Building.
    a. Installation of a 24 strand Indoor/Outdoor multimode optical fiber cable.
    b. Termination of the 24 strand multimode optical fiber in the Computer Room will be with SC connectors into a wall mounted fiber patch panel.
    c. Termination of the 24 strand multimode optical fiber in the District Office will be with SC connectors into an existing fiber patch panel .
3. Installation, termination and testing of six(6) 6 strand interlocking armor multimode optical fiber cable between the Data cabinets in computer room and the wall mounted rack fiber patch panel mounted in the cabinet in the Data Communications Room.
    a. Termination of the 6 strand interlocking armor multimode optical fiber cable will be with SC connectors into a rack mounted fiber patch panel.
4. Installation and testing of fiber and copper connectors.
5. Labeling and documentation of all cables, faceplates and patch panels installed under this Work.
6. Installation of J-hooks, cable tray, wire management, cable support, cable tie-wraps, spiral wrap, pull lines and accessories to provide a complete and working cable system.
7. Fire-stopping rated wall penetrations specifically provided for the distribution of telecommunications cables. Wall ratings shall be maintained.

8. Preparation and submission of submittals, documentation, shop drawings, cabling schedules, cable test results and "as-built" drawings.
9. Provide a manufacturer's warranty for all EIA/TIA 568-B Category 5e 4 pair cables, multi-pair cables, optical fiber cables and all termination hardware and accessories for a period "Lifetime" from the date of acceptance of the work.

1.02 RELATED WORK

A. Installation of conduits, stub ups, pull-boxes, raceways, plywood backboards, floor-boxes, grounding bus bars and electrical outlets as specified in Division 16.
B. Cutting, patching and painting of walls unless damaged performing the work described here in.
C. Installation of workstation devices: computers, data switches, terminals, telephones, and similar equipment installed by owner and their representatives.

1.03 DESCRIPTION

A. The general conditions for contracts of construction, referred to in the contract documents as the General Conditions, together with the following articles of the Communications Cable & Termination Equipment Specification. Which 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.
B. All articles or pads of articles of the General Conditions not so amended, modified or supplemented by this Telecommunications Cabling Specification shall remain in full force and in effect. Should any discrepancy become apparent between the General Conditions and the Telecommunications Cable & Equipment Specification, the Contractor shall notify Owner/Engineer, in writing, and the Owner/Engineer shall interpret and decide such matters in accordance with the provisions of the General Conditions.
C. The Contractor shall comply with all applicable governmental regulations, standards and with all local ordinances or codes.

1.04 SPECIAL CONDITIONS

A. Standards, specifications, drawings, cable schedules and codes, referred to herein shall be considered part of these specifications.
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. Contractor shall include in their price all costs to be incurred relative to the furnishing and installation of the system described herein.
C. The General Conditions accompanying this Specification is hereby made part of the requirements for the work under this Division of the Specification.
D. It is the intent of these specifications for the Contractor to provide a complete workable cabling system ready for the Owner's use. It is the intent of these Specifications to create an EIA/TIA 568-B compliant cabling system to support high speed data applications up to1 Gigabit Ethernet. System acceptance shall be judged on its ability to perform by submission of test results from a Level IIe (or better) tester.
E. Any item not specifically shown on the drawings or called for in the specifications, but normally required to conform to the system design intent shall be considered as part of the Contract.

F. Any given item of equipment or material shall be the product of one manufacturer throughout the facility. Multiple manufacturers of any one item shall not be permitted, unless specifically noted otherwise.
G. This specification is an equipment and performance specification. Actual installation shall be as indicated on the Electrical Drawings. Any discrepancies found between the Specification and the Drawings shall be immediately brought to the attention of the Owner/Engineer. Installation and details indicated on the Drawings shall govern if they differ from the Specifications.
H. Certain terms such as "shall, provide, install, complete, start up" are not used in some parts of these specifications. This does not indicate that the items shall be less than completely installed or that systems shall be less than complete.

1.05 SITE VISIT & FIELD CONDITIONS

A. The Contractor shall verify all dimensions and distances in the field and document the material, component quantities and cable lengths to be furnished and installed.
B. Existing site conditions, Contract Documents for all other trades 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.
C. Contract Documents will be available for review through the General Contractor.

1.06 ABBREVIATIONS AND DEFINITIONS

A. Utilize the following nomenclature for discernment on the Drawings and within the Specifications:

1. National Electrical Code (NEC)
2. Occupational Safety and Health Ad (OSHA)
3. American National Standards Institute (ANSI)
4. Building Industry Consulting Services International (BICSI)
5. National Fire Protection Association (NFPA)
6. Institute of Electrical and Electronics Engineers (IEEE)
7. Underwriters' Laboratories, Inc. (UL)
8. American Society of Testing Materials (ASTM)
9. EIA/TIA (Electronic Industries Association/ Telecommunications Industry Association)
10. Federal Communications Commission (FCC)
11. Authority having jurisdiction (AHJ)

B. Utilize the following definitions for discernment within the Specifications:

1. "PROVIDE" or "FURNISH" means to supply, purchase, create, transport, place, install, connect, test and turn over to Owner, complete and ready for regular operation, the particular work referred to.
2. "SUPPLY" means to purchase, procure, acquire, and deliver complete with related accessories.
3. "INSTALL" means to move from property line, set in place, join, unite, fasten, link, attach, set up or otherwise connect together before testing and turning over to Owner of material and equipment. Such installation shall be complete and ready for regular operation, for the particular work referred to.

4. 'WIRING" means the inclusion of all fittings, conductors, connectors, connector strips, connections, termination and all other items necessary and/or required in connection with such work.
5. "AS DIRECTED" means as directed by the Owner or his representative.
6. "CONCEALED" means embedded in masonry or other construction, installed behind wall furring or within wall partitions, or installed within hung ceilings.
7. "EXPOSED" means not installed underground or "CONCEALED" as defined above.
8. "AS BUILT" means an actual representation of the building, room, location, or device.

1.07 SUBMITTALS

A. Provide submittals in accordance with the project schedule and general requirements defined in the General Conditions.
B. Testing Procedures and Documentation.
1. Provide sample test data sheets to Owner/Owner Representative prior to any UTP or optical fiber testing for acceptance of all information to be supplied.
2. Provide unaltered native test result records saved by the tester and transferred onto a CD-ROM. CD-ROM shall include any software tools required to view, inspect, and print any selection of the test reports.
3. Provide test data summary reports along with final test results delivered on paper and electronically with a minimum of the following information.
a. ID of link in accordance with approved naming convention
b. Pass/Fail evaluation of link under test
c. Date and time test results were saved in tester
d. Identification of Owner site
e. The calibration date of the test equipment.
4. Contractor's labor force shall have certified technicians trained by the manufacturer and provide copies of certifications for all technicians who will install the system and execute the tests. Submissions for each of the technicians are as follows:
a. Optical fiber terminations. Certifications for training of the manufacturers connectors and splicing methods to be used on the project.
b. Cat 5e terminations. Certifications for the training of the manufacturers connectors to be used on the project.
c. CAT 6 terminations. Certifications for the training of the manufacturers connectors to be used
d. UTP Cable Testers - Certifications for use of Level IIe (or better) UTP cable testers to be used on the project.
e. Optical Fiber Cable Testers - Certifications for use of optical loss power meters testing equipment to be used on the project.

5. Provide a letter from the component manufacturer, stating that the product set offered as part of this bid meets their requirements to ensure that a Lifetime Link Warranty will be offered to Engineered Designed Facilities.

C. Contractor Qualifications:

1. Contractor Organization - Must show evidence of a minimum of (5) years contracting experience performing similar Work in the size and scale of this project. The contractor must also show the ability to offer a manufacturer's Lifetime structured cable system Performance Warranty as described here in.

2. Specialist: Installation of telecommunications systems shall be performed under the direct supervision of a specialist trained and authorized by the manufacturer. Submit for the installation specialist the following:

a. Field superintendent's name

b. Office telephone number and address

c. A list of three projects of equal size and complexity to this Contract, which were directly supervised by the proposed superintendent-specialist.

d. For Each Project List: The name of the project, location, project description, construction cost, name, e-mail address and telephone number of the owner's representative, date installation started and date installation was completed.

D. Shop Drawing:

1. Provide point-to-point-wiring diagrams for all cables installed under this Work.

2. Provide cable termination schedules for all cables installed under this work with the following information:

a. Backbone cables, cable ID, individual strand/cable pair number, and termination device number port/cable pair position.

b. Workstation cable - outlet ID, cable ID, floor, room number, corridor number (ceiling mount), IDF, cabinet number, termination device number and port/cable pair position.

c. Provide detailed plan views and elevations of all telecommunications spaces showing field conditions, ancillary room components, dimensions, equipment racks, termination blocks, patch panels and cable paths.

d. Provide drawings to show evidence of coordination with other trades.

e. Provide sample reports showing the proposed format for cable test reports.

f. Provide to the General Contractor a construction schedule showing the various work tasks, time periods, duration and staffing requirements.

g. 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.

h. 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. Failure to submit Shop Drawings may result in Contractor re-work of installed material. Any such re-work shall not be charged back to the Owner.

i. Each Shop Drawing shall contain job title and reference to the applicable Drawing and Specification article. Provide for Owner's documentation, a Finish Statement in form stipulated by the Architect and signed by the Contractor, stating that the Work was completed in compliance with the Contract Documents and that the installation was proper for the conditions of application and use.

E. Record Drawings:

1. Provide to the Owner, Record Drawings annotated with the changes mode during the installation of the work so as to be a complete set of "as built" plans. Drawings shall be in printed form and on CD Auto-Cad 2004 format. Coordinate with owner the requirements for data transfer.
2. Provide CAD system diagram at each data closet with outlet identifications indicated on floor plan Diagrams shall be mounted in a protective frame and securely attached to the wall.
3. Provide Owner with two (2) sets of Operation and Maintenance Manuals including wiring diagrams, parts list, 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 Owner not more than one week after project completion.

1.08 QUALITY ASSURANCE

A. Contractor is solely responsible for quality control of the Work. Contractor shall comply with all Quality Control requirements specified herein and in the General Conditions.
B. All materials furnished shall be new and unused and free from defects. All materials shall meet all applicable codes provided a standard has been established for the material in question. Equipment and materials of the same type shall be a product of the same manufacturer throughout.
C. All products and materials shall be clean, free of defects, and free of damage and corrosion.
D. Manufacturers of products shall be ISO 9001 certified and employ Six Sigma methodology in their manufacturing process.

1.09 CODES, REGULATIONS & STANDARDS

A. The installation shall comply fully with all government authorities, laws and ordinances, regulations and codes applicable to the installation.
B. If any change in plans or specifications is required to comply with governmental regulations; the Contractor shall notify the Owner/Engineer of the change at the time of submitting the construction schedule.
C. Local electrical and building codes may differ from national codes. Follow the most stringent code or recommendations. Where there are instances of ambiguity refer to the Owner/Engineer for interpretation.
D. All materials and installation "means and methods" shall be equal to or exceed the following standards:

1. ANSI/TIA/EIA-568-B.1-2001, Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements.

2. ANSI/TIA/EIA-568-B.2-2001, Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted-Pair Cabling Components.
3. ANSI/TIA/EIA-568-B.2-1-2002, Commercial Building Telecommunications Cabling Standard, Part 2: Category 6 Cabling Components.
4. ANSI/TIA/EIA-568-B.3-2000, Commercial Building Telecommunications Cabling Standard, Part 3: Optical Fiber Cabling Components Standard.
5. ANSI/TIA/EIA-569-A-2001 (Including 5 addendums), Commercial Building Standards for Telecommunications Pathways and Spaces
6. ANSI/EIA/TIA-570-1991, Residential and Light Commercial Telecommunications Wiring Standard
7. ANSI/TIA/EIA-606-1993, The Administration Standard for the Telecommunications infrastructure of Commercial Building
8. ANSI/TIA/EIA-607-1994, Commercial Building Grounding and Bonding Requirements for Telecommunications
9. Uniform Building Code (UBC)
10. National Electrical Code (NEC/NFPA 70)
11. National Electrical Safety Code (NESC IEEE C 2)
12. Local Codes, amendments, and ordinances.

1.10 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 their 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 progress status of the installation to the General Contractor to allow them to update their project schedules.
E. Contractor shall note that the construction schedule may dictate that work must be carried out simultaneously on more than one floor.
F. Attend all construction meetings, at the project site or other location, as requested by the Owner, Engineer, and/or General Contractor.
G. 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.

1.11 DELIVERY, STORAGE AND HANDLING

A. 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.
B. Store materials suitably sheltered from the elements, but readily accessible for inspection until installed. Store all items subject to moisture damage in dry spaces. Provide space requirements for storage with the submittals. The General Contractor shall assign storage space.

1.12 CERTIFICATION & WARRANTY

A. All work and all items of equipment and materials shall be warranted for a minimum period of one year, from the date of acceptance of the work. Where a manufacturers warranty is longer than one year, the Contractor shall offer the extended warranty. The Contractor shall, upon notification of any defective items, repair or replace such items within 24 hours without cost to the Owner, all to the satisfaction of the Owner/Engineer.
B. Furnish a warranty in accordance with the General Conditions and Division 1.
C. Furnish a manufacturer's "Channel Link" performance warranty of all TIA/EIA 568-B category 5e-workstation cables, multi-pair cables and optical fiber cables for a minimum period of Lifetime, from the date of acceptance of the work. The Channel Link Performance Warranty shall be issued and signed by the component manufacturer and shall list the MODOT as the holder of the warranty. The Channel Link Performance Warranty shall cover the testing and replacement of the labor and material *for* all "Channel Link' components. The category 5e structured cable system shall be a complete certified system as offered by a single manufacturer. The system and all components shall be performance matched, be backward compatible with category 5 and systems, approved for use with a single manufacturer and guaranteed by the manufacturer - both components and installed systems. The cable must be approved for use with the manufacturer's system.
D. Provide along with your bid response, a letter from the manufacturer, stating that the product set offered as part of the bid response, shall meet their requirements to ensure that a Lifetime Performance Warranty shall be offered to MODOT.

PART 2 – PRODUCTS

2.01 DESCRIPTION

A. Provide telecommunications cable and termination equipment with performance levels and capacities as noted herein.

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.

2.03 PART NUMBERS

A. Part numbers provided in this Specification have 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.

2.04 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.

2.05 BASE BID MANUFACTURERS

A. 4-Pair UTP Cables
    1. Superior Essex or approved equivalent
B. Multi-Pair Copper Cable
    1. Superior Essex or approved equivalent
C. Optical Fiber Cable
    1. Superior Essex or approved equivalent
D. 8 position 8 conductor Modular Connectors & Faceplates
    1. Leviton or approved equivalent
E. Optical Fiber Patch Panels
    1. Leviton or approved equivalent
F. Optical Fiber Connector
    1. Leviton or approved equivalent
G. Wire Management Hardware
    1. Leviton or approved equivalent
H. Equipment Racks
    1. Customer provided
J. Raceway
    1. Hubbell or approved equivalent

K. Labels
    1. Dymo Rhino Pro 5000 or approved equivalent.

2.06 CABLE MEDIA

A. 4-Pair Cable Unshielded Twisted Pair – CMP
    1. Physical specifications: 4 twisted pair - 24 AWG, plenum, solid copper conductors, 100-Ohm nominal impedance +/-15%. Electrical characteristics: Guaranteed NEXT of 3dB greater than TIA.EIA 568 B.2 specification across frequency range and guaranteed ACR of 21 dB at 100MHz.Cable construction: round cable, individually insulated conductors under a common plenum rated sheath with Color Tip technology.
        a. Manufacturer: Superior Essex or equivalent
        b. Type: 52-200-28 plenum or approved equivalent
B. Multi-Pair Copper UTP Cable – PE-89 25 Pair
    1. Physical Specifications: 24 AWG, solid copper conductors. Cable Construction: individually insulated conductors, grouped in 25-pair units under a shielding and a black, linear low-density polyethylene jacket.
        a. Manufacturer: Superior Essex or equivalent
        b. Type: 09-097-02 or approved equivalent

C. Optical Fiber Cable – Indoor/Outdoor 24 strand

1. Multi-mode laser optimized 50 micron/125 micron. Performance Characteristics for multi-mode: Fiber attenuation shall not exceed 3.5dB/km @850nm wavelength or 1.5dB/km @1 300nm. Minimum bandwidth shall be 700mhz @ 850nm and 500mhz @ 1300nm. 1 Gigabit Ethernet distance guarantee 750 meters @ 850 nm and 600 meters @ 1300 nm. Cable Construction: Multiple 900micron color coded fibers combined with aramid and water-blocking elements to obtain proper strength and water-blocking characteristics, covered with an outer flame, chemical, and sunlight resistant black outer jacket.
    a. Manufacturer: Superior Essex or equivalent
    b. Type: W3024AGO1 or approved equivalent

D. Optical Fiber Cable – Interlocking armor CMP 06 strand

1. Multi-mode laser optimized 50 micron/125 micron. Performance Characteristics for multi-mode: Fiber attenuation shall not exceed 3.5dB/km @850nm wavelength or 1.5dB/km @1 300nm. Minimum bandwidth shall be 700mhz @ 850nm and 500mhz @ 1300nm. 1 Gigabit Ethernet distance guarantee 750 meters @ 850 nm and 6000 meters @ 1300 nm. Cable Construction: Interlocking armor tight buffered, individually insulated conductors, reinforced with a fibrous type strength member under a common plenum rated sheath.
    a. Manufacturer: Superior Essex or equivalent
    b. Type: L4006AGO1 or approved equivalent

2.07 TERMINATION HARDWARE

A. Connectors

1. Non-keyed 8-pin modular connectors flat front, with Retention Force Technology suitable to terminate UTP 4-pair cables. Complies with EIA/TIA -568B category 5e performance. Outlet wired with standards compliant T568-B pinning. Suitable to be mounted in corresponding faceplate, or mounting plate. (Coordinate color with Engineered Designed Facilities)
    a. Manufacturer: Leviton or equivalent
    b. Type: 41291-2QX or approved equivalent (Coordinate color with Engineered Designed Facilities)
    c. Type: 5G110-RX5 or approved equivalent (Coordinate color with Engineered Designed Facilities)

B. Optical Fiber Connectors

1. Multimode SC epoxy connector, pre-radiused zirconia, with strain relief boot, low insertion loss, suitable for use with specified and supplied optical fiber cables. Typical insertion loss no greater than 0.25 dB per connector.
    a. Manufacturer: Leviton or equivalent
    a. Type: 49990-MSC or approved equivalent

1. Multimode ST epoxy connector, pre-radiused zirconia, with strain relief boot, low insertion loss, suitable for use with specified and supplied optical fiber cables. Typical insertion loss no greater than 0.25 dB per connector.
    a. Manufacturer: Leviton or equivalent
    b. Type: 49990-MST or approved equivalent

C. Outlet Faceplates

1. Outlet faceplate suitable to be installed over a standard dual gang electrical junction box, capable of mounting approved non-keyed 8-pin modular connectors flat front.
    a. Manufacturer: Leviton or equivalent
    b. Type: 41290-DMX or approved equivalent (Coordinate color with MODOT)
    c. Type: 41290-SMX or approved equivalent (Coordinate color with MODOT)

D. Outlets

1. A standard dual gang electrical junction box shall be roughed into the walls, floor and furniture that will become fixed.

2.08 Equipment Cabinets

1. Provided by MODOT.

2.09 Building Entrance Protection Blocks

1. Designed to safeguard buildings and personnel from dangerous electrical surges.
    a. Manufacturer: Porta Systems or equivalent
    b. Type: 24100-110-M110PC or approved equivalent
    c. Type: 24050-110-M110PC or approved equivalent
    d. Type: 24025-110-M110PC or approved equivalent
    e. Type: 24100-110-M110PCS27 or approved equivalent

2.10 Wire Management Hardware

A. Cable Managers

1. Wall mounted distribution (D) rings.
    a. Manufacturer: Leviton or equivalent
    b. Type: 491RU-HFO or approved equivalent

B. J- Hooks

1. Ceiling mounted J- Hook/ hanger/ brackets with fasteners.
    a. Manufacturer: Erico or equivalent
    b. Type: CAT21 or approved equivalent

C. Velcro cable ties

1.Velcro strips 8" length, releasable and reusable
    a. Manufacturer: Leviton or equivalent
    b. Type: 43108-008 or approved equivalent

2.11 Labels

A. Labels

1. Machine printed, self-adhesive, smudge resistant labels for cables and faceplates. Labels shall be appropriately sized for cable diameter. Labels shall be appropriately colored for faceplate color contrast.
    a. Manufacturer: Dymo or equivalent
    b. Type: Rhino Pro 5000 or approved equivalent

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verification of Conditions: Examine the areas to receive the work and the conditions under which the Work would be performed. 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 this Specification with the Drawings and Specifications of other trades. Report any discrepancies between them to the Owner/Engineer, 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 Owner/ Engineer any repairs or changes made necessary in the Contract Work, caused by his neglect shall be made by him at his own expense.

C. The Contractor shall maintain a current copy of this Specification and associated Telecommunications Drawings at the job site at all times.
D. The Contractor shall maintain a complete file of Shop Drawings and other submissions at the job site at all times. Shop Drawings and all other submissions shall be made available to the Owner/Engineer at their request.
E. 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 Engineer 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 neat and workmanlike installation standards.
F. The Contractor shall perform all tests required by local authorities in addition to tests specified herein.
G. Do not allow telecommunication cables to run parallel with electrical cables/conduits, unless they are separated by a minimum of 12 inches.
H. Any telecommunications cables that must cross over electrical cables/conduits shall do so only at 90-degree angles.
I. Ensure that all telecommunications cable supports (J-hooks, cable tray, conduits, etc.) 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. When required, anchor J-hooks to the structure above. Provide J-hooks at a maximum interval of every 5-feet.
J. Do not lay telecommunications cables unprotected on the floor at any time in the workstation areas. 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.

K. Maintain manufacturer's recommended minimum bend radius of the cables. 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 of the work. The Contractor, at the Contractors expense shall replace all abused or stressed cables.
L. Keep all items protected before and after installation, with dust and water proof barrier materials as necessary. The Contractor shall be responsible to ensure the integrity of the protective measures throughout the life of the project.
M. The Contractor shall protect all telecommunications equipment from damage, at all times during the construction. Do not install equipment in the telecommunications areas until the other trades hove completed their work in the areas so that the equipment will not be moved or damaged. Cover all racks and components with plastic to ensure dust does not contaminate the ports on the patch panels.
N. Ensure that safe ingress and egress, from all work areas, are maintained during movement and installation of materials.
0. Clean up and remove all debris generated by installation activities. Keep the telecommunications areas free of debris and dust at all times.
P. Upon project completion, provide an as-built drawings, cable test results and documentation as defined herein prior to final payment.
Q. Craft personnel shall be qualified to perform the work activities and be knowledgeable of the following:

1. Color coding of standard UTP cables.
2. Color coding of optical fiber cables.
3. Bonding and grounding of cable tray and equipment racks.
4. Testing conductors for electrical continuity.
5. Testing multi-mode optical fiber conductors for loss budgets at a wavelength of 850nm and 1300nm.
6. Testing of copper conductors for length, wire mapping, Insertion Loss, Return Loss, NEXT, PS-NEXT, ELFEXT, ACR, PS-ACR at all frequencies up to 100 MHz for category 5e cables.
7. Termination or connection of unshielded twisted pair cable on all specified connectors, electrical protection blocks and termination.
8. Termination of optical fiber cables on all specified connectors.
9. 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.

3.03 INSTALLATION

A. Equipment Cabinets

1.Owner will provide 19-inch wide, 84-inch high equipment cabinets in the telecommunication for the mounting of 8 position 8 conductor modular patch panels, optical fiber patch panels and Owner provided equipment. Ground each individual cabinet to the grounding bus bar, tied to Main Electrical Service Ground, located within the room.

B. Cable Media

1. Install backbone and workstation in accordance with this Specification, the approved Cable Termination Schedule, the manufacturer's recommendations, and the Telecommunications Distribution Drawings.

2. After dressing the cable to its final location, remove only enough jacketing to allow the conductors to be splayed and terminated in a neat and uniform fashion. Every effort will be made to maintain jacketing integrity by removing only as much jacketing as is practical, to accomplish termination. For twisted pair cables, maintain the manufacturers twisting of the wire pairs through to the point of termination.
3. There shall be no splices or mechanical couplers installed between the cable points of origin and termination.
4. Terminate all cables neatly, with enough slack to pull off, test and re-terminate each cable as needed.
5. When pulling cables through conduits, leave in-place all draglines for future use.
6. Install Velcro wire to organize and bundle all category rated cabling within the HER and DCR. Install the approved Velcro strips long enough to overlap at least 1.5" around the installed cables.
7. 4-Pair UTP CMP Cables
    a. Provide category 5e 4-pair cables to each telecommunication outlet located at all workstation positions from the respective serving telecommunication cabinet. Utilize the in ceiling cable support rings system, access floor system and conduit system for the routing of cables. Terminate all cables with 8 position 8 conductor modular connectors onto blank patch panels in the telecommunication cabinets. Terminate all cables with 8 position 8 conductor modular connectors at the workstations.
8. Multi-Pair Copper TP Cable: OSP
    1. Provide a 25 pair of 24 AWG OSP cable from the HER to the Industrial Technology (IT) Building for Telephones. Terminate the cable at each end onto lightning protection.
9. Optical Fiber Cables: Indoor/Outdoor Tight Buffered
    2. Provide a 24-strand multi-mode optical fiber cable from the communication to the Administration. Terminate the cables with SC or ST connectors as required. Mount into the optical fiber patch panels at each end.
10. Connectors
    1. Provide category 5e 8 position 8 conductor modular connectors for the termination of all 4-pair cables. Provide an accompanying faceplate and/or mounting plate at the appropriate outlet location.
    2. Provide multi-mode SC and ST connectors suitable for use on the approved multi-mode optical fiber cables installed under this Work.
11. Identification
    1. Provide on all outlet faceplates installed under this Work, machine-generated labels with the outlet ID, in uppercase lettering.
    2. Provide on all termination blocks installed under this Work, machine-generated designation strips with the cable ID and pair number, in uppercase lettering.
    3. Provide identification of all cables terminated on Owner furnished patch panels, machine-generated label with the cable ID and port 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 a permanent water resistant sealer. Labels shall 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. All cables shall be labeled in accordance with the approved cable termination schedule.
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 QUALITY CONTROL

A. Inspection and Testing

1. Testing each cable prior to system cutover and hand-off to the owner.
2. Test end-to-end each 4-pair cable as per EIA/TIA 568-B for the following:
   a. Wire-map, length, attenuation, worst case near end cross talk (NEXT), power sum near end crosstalk (PSNEXT), Return Loss, equal level far end crosstalk (ELFEXT). Power sum equal level far end crosstalk (PSELFEXT, return loss, attenuation to crosstalk ratio (ACR) and power sum attenuation to crosstalk ratio (PSACR). Testing shall be bi-directional and shall be performed for all combination of pairs, at all frequencies up to 100 MHz for category 5e cables using a Level Ile or better tester.
3. End-to-end testing of each optical fiber cable shall be done using a power meter and appropriate method for length, polarity and attenuation. Attenuation loss shall be less than the manufacturer's maximum expected loss for the cables and connectors.
   a. Test multi mode optical fiber cables, end-to-end and bi-directional, in accordance with OFSTP-14, method B.
   b. Test single mode optical fiber cables @131 Onm and 1550nm in accordance with OFSTP-14, method B.
   c. Compare measured optical fiber link attenuation to calculated link attenuation to determine acceptance. Any links that fail shall be corrected by the Contractor at no additional cost. Calculated links are shown in the following parameters and the manufactures or approved equivalent expected losses for cabling and connectors:
      i. Description Wavelength Allowable Maximum Attenuation
      ii. Multimode 50/125 at 850 nm 3.5 dB and 1300 nm 1.5 dB
      iii. Mated Connectors 0.75

4. After the installation is complete, in addition to any other required testing as described herein, and at such times as the Owner/Engineer directs, the Contractor shall be present while the Owner conducts an operating test for approval. The installation shall be demonstrated to be in accordance with the requirements of this specification. Any defects revealed shall be corrected promptly at the Contractor's expense and the tests performed again.
5. After review of the completed test results, the Owner/Engineer reserves the right to retest up to 100 of the installed cables, utilizing the Contractor's tester and the Contractor's labor.

3.05 FIRESTOPPING

A. Provide fire-resistant materials of a type and composition necessary to restore fire ratings to all wall or floor or ceiling penetrations. Material must be properly classified and meet all national and local codes.
B. All penetrations through fire rated walls shall be sealed to prevent the passage of cold smoke, fire, toxic gas or water through the penetration, either 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 the National Electrical Code (NFPA-70).
C. No flammable material may be used to line the chase or hole in which the fire stop material is to be installed.
D. When used, provide only non-flammable damming material.
E. The sealant shall remain resilient and pliable to allow the removal and/or addition of cable without the 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, and crumbling.
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 1 9 and NFPA 251. The fire stop material shall have also been subjected to the hose stream test in accordance with UL 1479.

End of Section