SECTION 27100
CABLE PLANT

PART 1 - GENERAL

1.1. SECTION INCLUDES

A. (Reserved)

1.2. PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. (Reserved)

1.3. PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

A. Section [07840-Firestopping]: Supply of firestopping for placement by this Section.

B. Section [09900-Painting]: Supply of paint for placement by this Section.

1.4. RELATED SECTIONS

A. Section [05164-Space Frames]: Steel grid for rack support.

1.5. REFERENCES

A. ANSI/ICEA S-83-596-1994 - Fiber Optic Premises Distribution Cable.

B. EIA/TIA-455 - Output Far-Field Radiation Pattern Measurement

C. EIA/TIA-492AAAA-A 1998 - Detail Specification for 62.5-mm Core Diameter/125-mm Cladding Diameter Class Ia Multimode, Graded Index Optical Waveguide Fibers.

D. EIA/TIA-568B.1-2000 - Commercial Building Telecommunications Wiring Standard.

E. EIA/TIA-569A - Commercial Building Standard for Telecommunications Pathways and Spaces.

F. EIA/TIA-606 - Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.

G. EIA/TIA-607 - Commercial Building Grounding and Bonding Requirements for Telecommunications.

H. EIA/TIA TSB67 - Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling Systems.

I. IEEE 802.3 - Standard for Information Technology, Telecommunications and information exchange between systems, Local and metropolitan area networks, Specific requirements, Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications.

J. NEC - National Electrical Code.

K. REA PE-71.A: Specification for Inside Wiring Cable.

L. TDM BICSI - Building Industry Consulting Services International Telecommunications Distribution Methods Manual.

1.6. DEFINITIONS

A. (Reserved)

1.7. SYSTEM DESCRIPTION

A. (Reserved)

1.8. DESIGN REQUIREMENTS

A. (Reserved)

1.9. PERFORMANCE REQUIREMENTS

A. Copper wiring installation shall support Gigabit Ethernet.

B. Fiber optic cabling installation shall support Ten Gigabit Ethernet.

C. Outdoor conduit formations shall allow for standard cable racking without changing formation as it enters manhole.

1.10. SYSTEM TOLERANCES

A. (Reserved)

1.11. SUBMITTALS FOR REVIEW

A. Submittals: Follow Section [01300].

B. Shop Drawings: Conform to sheet names, CAD layering, line styles, and symbols as indicated in BICSI TDM Manual, 9th Edition.
    1. Telecommunication drawings.
        a) Indicate layout cabling and pathway runs, and single point ground system.
        b) Indicate exact location of conduit system.
        c) Indicate each floor with triangles denoting approximate location of each drop, numbered according to Owner numbering specifications (Section 3.4.E).
    2. Distribution frames: Show layout of applicable equipment including incoming distribution racks, patch panels and LAN equipment.

C. Product Data: Provide information on the following:
    1. Equipment support racks
    2. 110 punch down blocks
    3. Telecommunication cabling (backbone and horizontal)
    4. Fiber optic type ST connectors
    5. Telecommunication outlet/connector assembly RJ-45 jacks.
    6. Patch panels (copper and fiber optic)
    7. Power strips
    8. Cable hangers
    9. Floor outlet boxes
    10. External mounted raceway
    11. Data equipment racks.

D. Samples: (Reserved)

E. Submit evidence of optical fiber attenuation according to EIA/TIA 455-46, -61, or -53.

1.12. SUBMITTALS FOR INFORMATION

A. Submittals: Follow Section [01300].

B. Test Reports: Submit test reports as indicated with Record Documents.

C. Submit evidence of installer qualifications including test plan, professional references, and labeling scheme.
   1. Include names and locations of two projects successfully completed using fiber optic and copper communications cabling systems in similar environments.
   2. Include written certification from users systems have performed satisfactorily for not less than 18 months.
   3. Include specific experience in installing and testing structured telecommunications distribution systems using fiber optic and Category 5 or higher, cabling systems.
   4. Provide a list of at least five professional references for similar projects. Include Company names, Contacts, phone numbers and a description of projects

D. Provide a complete and detailed test plan for the telecommunications cabling system including a complete list of test equipment for the UTP and OFN components and accessories. Include procedures for certification, validation, and testing. Furnish factory reel tests for fiber optic cables.

1.13. PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section [01700].

B. Record actual locations of outside plant, including cables, pairs, and conduit, including "as built" record CAD drawings and cable records in a machine-readable format. Indicate final telecommunications cabling configurations, including location, gage, pair assignment and patch panels after telecommunications cable installation.

C. Provide plastic laminated schematic of telecommunications cable system showing cabling, distribution frames, and equipment rooms keyed to floor plans by room number.

D. Submit conduit mandrel test results with close out documents.

E. Confirm actual manhole locations on record drawings.

F. Detach fiber reel cut length data sheets and provide with closeout submittals.

G. Submit written accounting identifying test results with closeout documents.

H. Provide test record indicating conductor pairs not meeting test criteria.

I. Provide test results indicating wiring structure meets or exceeds requirements of type of system installed (i.e., Category 5e, Category 6, and related items) according to EIA/TIA-568B and TSB-95.

J. Provide test results for every strand of fiber tested. Measure optical fibers for information transmission capability according to EIA/TIA 526-14 (OFSTP-14) for multimode fiber and EIA/TIA 526-7 (OFSTP-7) for singlemode fiber. Test optical fibers bi-directionally for loss and performance using an optical time domain reflectometer.

K. Provide a typed list of wiring runs in an electronic format previously agreed to by Owner in the following method:
   1. Building Name
   2. Patch Panel Location (Room No.)
   3. Wall Jack Location (Room No.)
   4. Wire/Jack Number

L. Provide tags removed from fiber optic cable reels.

1.14. OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section [01700].

B. Include operational and maintenance data on telecommunications cabling and pathway system.

1.15. QUALITY ASSURANCE

A. Single Source Responsibility: Use only one brand of various component parts and avoid mixing specific parts of different manufactures on Project.

1.16. QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products of this Section with five years experience.

A. Installer: Company specializing in installing the products of this Section with three years experience, approved and certified as a Systimax Structured Connectivity Solutions installer or approved substitute.

B. Design telecommunications infrastructure under direct supervision of a BICSI Registered Communications Distribution Designer (RCDD) experienced in design of this Work.

1.17. REGULATORY REQUIREMENTS

A. Perform Work according to latest version of appropriate industry standard including, but not limited to the following:
   1. ANSI/ICEA S-83-596-1994
   2. EIA/TIA-568B
   3. EIA/TIA-569A
   4. EIA/TIA-598
   5. EIA/TIA-607
   6. EIA/TIA-606
   7. IEEE 802.3
   8. NEC
   9. State of Tennessee Electrical Code
   10. TIA TSB-67
   11. TDM BICSI
   12. Local, State, and Federal rules, laws, and ordinances

B. In case of discrepancies between standards, building design, and this document, most stringent and generally the most costly requirement shall apply.

1.18. MOCKUP

A. (Reserved)

1.19. PRE-INSTALLATION CONFERENCE

A. (Reserved)

1.20. DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section [01600].

B. Provide protection from weather, moisture, dirt, dust and other contaminants for telecommunications cabling and pathway equipment placed in storage.

C. Package complete cable for shipment on non-returnable wooden reels or returnable steel reels.

D. Ensure top and bottom ends of cable are available for testing.

E. Each cable reel shall have a durable weatherproof label, which shows actual length of cable of reel.

1.21. ENVIRONMENTAL REQUIREMENTS

A. Do not install indoor wiring or cable until building is enclosed and environmental systems are active.

B. Maintain indicated temperature and humidity requirements during and after installation of products of this Section.

C. Do not leave unsheathed cable located outside buildings or underground exposed. Appropriately cover, encase, or protect cable. Seal both ends of cable to prevent ingress of moisture.

1.22. FIELD MEASUREMENTS

A. Verify that field measurements are as [indicated on shop drawings] [instructed by the manufacturer].

1.23. SEQUENCING

A. (Reserved)

1.24. WARRANTY

A. Provide warranty under provisions of Section [01700].

B. Cable and termination equipment shall be manufactured, installed and certified to provide for the Systimax Structured Connectivity Solutions 20 year warranty or approved substitute.

1.25. MAINTENANCE SERVICE

A. Provide maintenance service under provisions of [01700].

1.26. MAINTENANCE MATERIALS

A. Provide maintenance materials under provisions of [01700].

1.27. EXTRA MATERIALS

A. Furnish under provisions of Section [01700].

PART 2 - PRODUCTS

2.1. ACCEPTABLE MANUFACTURERS

A. All cabling to conform to Systimax Structured Connectivity Solutions standard and warranty or approved substitute.

2.2. COMPONENTS - GENERAL

A. Fixed cables and pathway systems for telecommunications systems shall be UL listed or third party independent testing laboratory certified, and shall comply with NFPA 70. Do not use cabling over 12 months old.

B. Do not use screw terminals except where indicated on Drawings.

C. Wiring, General: Provide wiring according to EIA/TIA-568B-5 for unshielded twisted pair wiring, solid wire 24 AWG, containing four twisted pair per sheath. Refer to TSB-95 for standards and testing for cabling as set in EIA/TIA-568B-5.
   1. Data Cable: Blue.
   2. Voice Cable: White.
   3. Install Category 5e in buildings with an established Category 5/5e cable plant, Category 6 in new buildings or buildings without an existing cable plant.
   4. Non-Plenum Category: 4-Pair non-plenum LAN Cable, rated CM, high-speed, high performance, 100-OHM Category 5e/6 cable capable of carrying high bit-rate signaling for extended distances in building distribution systems.
   5. Plenum Category: High-speed, high-performance, 100 ohm cable capable of carrying high-bit-rate signaling for extended distances in building distribution systems; LAN cable; UL Verified Category 5e/6 (4 pair); UL Listed Type CMP for use in air return handling spaces.

D. Modular Jacks: Category 5e or 6 as defined in 2.2.C or highest approved standard.

E. Patch Panels: Category 5e or 6 as defined in 2.2.C or highest approved standard.

F. Cable Management (Patch) Panels: D-Ring type wire manager 1 U horizontal.

G. Fiber Identification Tags: Blank white write-on vinyl tags with clear self-adhesive cover that protects custom message from chemical and outdoor exposure; 2-year life; 3 1/4" x 5 3/4" size; include ties.

H. Manholes: Construct manholes from poured-in-place reinforced concrete, 6 inches thick minimum. Alternatively, provide prefabricated manholes to standard specifications, designed for H-20 loading.

1. Provide access by at least one (1) opening of not less than 30 inches in diameter equipped with a heavy-duty cast iron frame and cover. Install cover flush with ground or street level; label cover as "Telephone."
2. Provide suitable non-corroding cable racks and an access ladder in each manhole. Each cable duct entry point shall permit addition of at least four (4) cable ducts in future. Plug and seal such openings.
3. Provide manholes with pulling eyes of 7/8" diameter set in manhole opposite each duct entrance.
4. Support splice cases located within manholes by at least two cable hooks.
5. Manholes that cannot be easily drained shall have a dry sump in one corner of floor with floor sloped toward sump for drainage of water from manhole.
6. Size hand holes for splicing or cable access according to indicated requirements.
7. Racks: Hot dipped galvanized cable rack components except insulators. Attach racks to manholes with steel support grid as indicated.
   a) Provide racks according to Avaya's Standard Practice Section 632-305-215 for "Cable Racking Cable Arrangements in Manholes."
   b) As a minimum, cable racks shall provide cable support every two linear feet (of manhole/hand hole).
   c) Provide REA accepted racks.
   d) Provide racks with hooks for cable support and cable is to be securely fastened to racks.
   e) Provide racks that meet fiber optic cable manufacturer recommendations.

I. Innerduct: High density polyethylene (HPDE) multi-channel wall pipe; permanently pre-lubricated lining; pre-installed pull line; color as selected by Designer from manufacturer's premium range; sequential footage markings; ultraviolet inhibitors and antioxidants for longer life.

J. Data Equipment Racks: Aluminum universal self support rack 84" height, 19" width, #12-24 threaded pattern, 45 U mounting space.

2.3. COPPER CABLE - INDOOR

J. General: Meet TIA/EIA 568-B standards.

K. All cabling to be terminated according to 568A wiring sequence.

L. Connect data terminations to 8-pin modular jacks except in Telecommunication rooms, connect terminations to high-density 8-pin modular 19" patch panels with "110" punch blocks mounted on rear.

B. Connect voice terminations to 8-pin modular jacks except in Telecommunication rooms, connect terminations to high density 8-pin modular 19" patch panels with "110" punch blocks mounted on rear.

N. Provide inside plant cable and wiring that is to be installed in air plenums as Inside Cable Positive Identification Plenum (ICPIP).

1. Alternatively, provide inside plant cable installed in conduit.

O. Modular Wall Telephones Wall Plates: Industry standard.

2.4. COPPER CABLE - OUTDOOR

N. Outside Plant Cable: meet electrical specifications of TIA/EIA-568-B.

O. Outdoor Copper Buried Cabling: Gopher resistant, 24 gauge PE-89.

P. Conduit: Generally, four (4) inches (ID) diameter minimum, concrete-encased, PVC schedule 40 conduit. Where crossing roadways or high traffic areas, provide concrete-encased PVC schedule 80 or steel conduit.
    1. Provide conduits that resist crushing, splitting, or sagging, and have an estimated life of not less than 20 years.
    2. Provide mechanically sound conduit joints to prevent separation or sagging.
    3. Provide conduit sweeps and bends with radii not less than six times internal diameter of conduit.
    4. Provide no more than two 90-degree bends per conduit run.

2.5. FIBER - INDOOR

N. Both single mode and multimode fiber, when installed, shall meet physical layer transmission specifications as outlined within IEEE 802.3 for the following:
    3. Ethernet
    4. Fast Ethernet
    5. Asynchronous Transfer Mode
    6. Gigabit Ethernet
    7. FDDI
    8. Ten Gigabit Ethernet

O. Optionally, provide cable with more than required number of fibers if fibers meet or exceed required Specifications.

P. Do not bend cable to a radius less than manufacturer's specification.

Q. Single Source: Provide junction panels and cable from the same manufacturer.

R. Color code fibers in cable with distinct and recognizable colors according to Bellcore specification TR20 issue 4.

S. Provide usable fibers in cables according to these Specifications.

T. Information Accompanying Reel: Securely attach the following information available on the cut length data sheet to each reel of fiber optic cable.
    3. Owner order number
    4. Factory reel number
    5. Owner job number
    6. Length of cable
    7. Owner reel number
    8. Weight of cable & reel
    9. Ship date
    10. Manufacturer's name
    11. Manufacturer's cable code and fiber count
    12. Beginning and ending length markings

2.6. FIBER - OUTDOOR

R. Provide usable fibers in cable according to these Specifications. Cables that provide spare fibers will not be acceptable. Provide this cable as non-standard cable from same manufacturer as other cable.

S. Both single mode and multimode fiber, when installed, shall meet physical layer transmission specifications as outlined within IEE802.3 for the following:
   7. Ethernet
   8. Fast Ethernet
   9. Asynchronous Transfer Mode
   10. Gigabit Ethernet
   11. FDDI
   12. Ten Gigabit Ethernet

T. Provide optical fibers sufficiently free of surface imperfections and inclusions to meet optical, mechanical, and environmental requirements of these Specifications.

U. Each optical fiber shall consist of a doped silica core surrounded by a concentric silica cladding.

V. Provide dual layered coating. Provide coatings that can be mechanically stripped without damaging fiber.

W. Factory Quality Assurance Provisions
   7. Provide optical fibers that have been proof tested by fiber manufacturer at a minimum load of 50 kpsi.
   8. Provide 100% attenuation tested optical fibers. Provide attenuation of each fiber with each cable reel.
   9. Measure optical fibers for information transmission capability according to EIA/TIA 455-51 or -30. Test optical fibers bi-directionally for loss and performance using an optical time domain reflectometer.

2.7. FIBER - MULTIMODE

U. Multimode fiber used in cable specified herein shall meet EIA/TIA-492AAAA-A.

V. Multimode fibers shall have the following characteristics:
   9. Core diameter: 62.5 +/- 3.0 mm
   10. Cladding diameter: 125.0 +/- 2.0 mm
   11. Core-to-Cladding Offset: = 3.0 mm
   12. Coating Diameter: 250 +/- 15 mm

W. Multimode fibers shall have the following optical characteristics at wavelengths of 850nm:
   9. Attenuation: 3.50 dB/km maximum.
   10. Bandwidth: 200 MHz-km minimum.

X. Multimode fibers shall have the following optical characteristics at wavelengths of 1300 nm:
   9. Attenuation: 1.0 dB/km, maximum.
   10. Bandwidth: 500 MHz-km, minimum.

Y. Multimode fibers shall have a numerical aperture, as measured by EIA/TIA 455-47 of 0.275 +/-. 015 mm.

2.8. FIBER - SINGLEMODE

W. Single mode fiber used in cable specified herein shall conform to the following:

10. Core Diameter: 8.3 mm
11. Cladding Diameter: 125.0 +/- 1.0mm by fiber end measurement
12. Core-to-Cladding Offset: = 1.0 mm
13. Cladding Non-Circularity: < 2.0% Defined as: [1-mmin. cladding dia. max. cladding dia.)] X 100.
14. Coating Diameter: 250 +/- 15 mm
15. Attenuation Uniformity: No point discontinuity greater than 0.1 dB at either 1310 nm or 1550 nm.
16. Attenuation at Water Peak: Do not exceed 2.1 dB/km at 1383 +/- 3 nm.
17. Cabled Fiber Cutoff Wavelength: Less than 1250 nm.
18. Mode-Field Diameter (Petermann II): 9.3 +/- 0.5 mm at 1300 nm
19. 10.5 +/- 1.0 mm at 1550 nm
20. Zero Dispersion Wavelength ((0):1301.5nm = (0 = 1321.5 nm
21. Zero Dispersion Slope (S0): 0.092 ps/(nm2_km)

X. Single mode fibers shall have maximum attenuation of 0.4db/km at wavelengths of 1310 nm.

Y. Single mode fibers shall have maximum attenuation of 0.3db/km at wavelengths of 1550 nm.

Z. Provide indoor fiber optic cable mechanical and environmental according to ANSI/ICEA S-83-596.

2.9. FIBER - TERMINATION PANELS

Y. Fiber Termination Panels: Sized to provide sufficient space to terminate all fibers of cable installed, use wall mountable fiber distribution center.

Z. Termination panel shall accommodate both splice trays and buffer tubing.

AA. Provide buffer tubing, splice trays, and connector sleeves necessary (according to cable and termination panel manufacturer specifications) for installation of fiber optic cable.

BB. Provide fusion type splicing in termination panels.

CC. Provide matching termination panels (single source responsibility), same make, model, and manufacturer.

DD. Optionally use termination panels that terminate 144 (or multiples of 72) fibers in buildings that have multiple cables to be terminated.

EE. Provide termination panel doors lockable via keys and keyed alike.

2.10. ACCESSORIES

DD. Labeling: Adhesive backed labels, 1/2" wide.

EE. Surface mount raceway: Plastic type latching non-adhesive, secured to wall with anchors and screws three per six foot section..

FF. Paint: Refer to Section [09900] for Paint.

GG. Firestopping: Refer to Section [07840 ]for Firestopping.

HH. Steel Support Grid: Refer to Section [05164] for Support Grid.

II. Outlet Boxes: Desk type and single mounted telephone outlet boxes; 2" by 3" standard electrical boxes.

JJ. Backboard: APA Rated Sheathing, Exposure Durability 2; unsanded; 3/4" thick. Size back board by 12 inches beyond size of electrical panel. Paint backboard with black, nonconductive fire-resistive overcoat.

KK. Conduit: Metallic and PVC.

PART 3 - EXECUTION

3.1. INSTALLERS

B. Installers must be qualified to install and be proficient in Systimax Structured Connectivity Solutions or approved substitute.

3.2. EXAMINATION

A. Office/class/lab terminations indicated are approximate in location, and Owner reserves the right to relocate Data Jacks within a 2'-0" radius before installation at no additional cost.

B. Verify exact location of jacks before start of work. When several jacks are close to one another, Owner reserves the right to group up to four jacks into one gang box. Do not group more than four into a gang box.

C. Exercise care in operations around existing structures and equipment, and be responsible for and promptly repair damage and defacement caused by construction operations.

3.3. PREPARATION

C. (Reserved)

3.4. INSTALLATION, INDOOR - COPPER CABLE

C. Install internal copper cabling according to EIA/TIA 568B and manufacturer’s instructions.

D. Do not exceed manufacturer’s cable pull tensions for copper cables. Provide a device to monitor cable pull tensions. Do not exceed 25 pounds pull tension for four pair copper cables. Do not chafe or damage outer jacket materials. Use only lubricants approved by cable manufacturer. Do not over cinch cables, or crush cables with staples.

E. Install cable management panels between patch panels and above first panel in Telecommunication rooms.

F. Clearly and neatly label wiring jacks, their respective wires, and patch panel locations with adhesive backed labels according to EIA/TIA 606.

G. Numerically base wire/jack numbers upon room number for wall box with an alphabetic character for jack identifier. For example; first jack in room 210A would be 210A-A. If more than 26 jacks were in a room, then 27th would be labeled 210A-AA. Begin numbering from left of main entrance to space and work around room in a clockwise direction.

H. Fill unused spaces on face plates with blank inserts.

I. Pull appropriate number of cables to each location.

J. Mount patch panels to wall-mounted, hinged, brackets or to appropriate communications racks.

K. Install inside plant cabling and wiring according to REA PE-71.A.

L. Provide enough slack on runs to reach location within top 2-3 feet of backboard plywood in Telecommunication room on wall selected for twisted pair panel layout. Do not provide more then 20 feet of slack on runs.

M. Conceal inside plant wiring. Provide concealed, behind the wall conduit, stubbed up into ceiling plenum and recessed outlet boxes in buildings (or sections of it) with interior wall construction of gypsum board over studs or plaster/lathe.
    1. Plug-in outlet centers and surface mounted outlet boxes will be permitted only with prior Owner written approval, in buildings with interiors constructed of concrete block, glazed block or other hard wall construction.
    2. Do not use plug-in outlet centers or cable routing other than as indicated without written permission of Owner or properly processed Change Order.
    3. Do not lay cables directly on suspended ceilings or tie cables to suspended ceiling support hangers.

N. If a suspended ceiling separates cables from public space below, then install cables without use of cable enclosures (troughs, trays, or conduit) in corridors. Support cable with properly spaced D-rings or J-hooks. Do not attach cable to utility piping, or other existing services.

O. Where installed in open corridors (corridors without suspended ceilings), install cable in conduit or enclosed metal troughs or trays.

P. Where installed in stairways, install cable in conduit or enclosed metal trays or troughs. Route cable over doorways.

Q. Do not droop cable over 8" in any length of run. Do not locate cables such that they touch light fixtures or other electrical devices. Do not untwist Category 5E UTP cables for more than 1/4" from termination point to maintain cable geometry.

R. Fixed Wall Outlets:
    1. Run conduit vertically from recessed outlet box and stub out above ceiling far enough to permit attachment of bushing or cap.
    2. Mounting Height: Mount outlets in locations as indicated.
        a) Standard outlet: Locate outlet 18" from finished floor to centerline of bottom outlet if vertically oriented or to centerline of outlets if horizontally oriented.
        b) Wall phone outlet: 48" AFF to centerline of device.

3.5. INSTALLATION, INDOOR - HANGERS AND SUPPORTS

Q. Provide required hangers, supports, sleeves, clamps, and related items, as required and as indicated on drawings.

R. Properly group and align horizontal runs of conduits using substantial hangers, straps, and related items. Install hangers and supports at intervals not exceeding NEC recommendations.

S. Thread supporting rods at ends with allowance for adjustments. Wire and strap hangers will not be permitted. Support conduit and fittings with hangers, straps, and related items, using bolts and lead expansion sleeves.

T. Support twisted pair runs using studs or drive pins with metal hangers, D-rings, or J-hooks, spaced at a maximum of 10 feet on center.

U. Cable runs shall maintain a minimum distance of six (6) inches from fluorescent lights, motors, and other sources of EMI radiation.

V. Loosely tie wrap parallel run cables exceeding two in number every 10'-0". Do not exceed twenty (20) cables per bundle.

W. Provide continuous wiring runs without splices. Do not exceed 295 feet distance limitation specified in EIA/TIA 568B standards for wiring runs.

3.6. INSTALLATION, INDOOR - FIBER

V. Determine exact cable path based upon criteria set forth in Specifications and EIA/TIA 568B code.

W. Install fiber in conduit according to EIA/TIA 569-A standards.

X. Provide fiber optic cable continuous from end to end (without splices) except as required for termination.

Y. Terminate all fiber strands of specified cable.

3.7. INSTALLATION, OUTDOOR - CABLE PLANT

X. Place buried metallic and fiber optic cable for outside plant in conduit. Where fiber is not buried with copper, bury a tracer wire with fiber. Provide nylon pull ropes (1/4 inch minimum diameter) in conduits.

Y. Provide direct buried cable with warning tape placed 12 inches above cable before closing trench. Buried cable not in concrete encased duct is placed 24 to 30 inches deep.

Z. Install cables pulled into new or existing conduits in such a way as to maximize available conduit space and allow for ease of future installation. Use innerduct where applicable.

AA. Handle cable according to manufacturers' specifications and recommendations, including, but not limited to, minimum bend radius, pulling tension, sheath wrinkling, and related items and according to prudent standards of practice.

BB. Encase conduit in concrete with at least 4 inches of concrete between conduits and external surface. Bury conduit to a depth of at least 36 inches. Make changes to and from steel to PVC conduit with appropriate adapters.

CC. Seal conduit joints to prevent entry of water, sand, concrete, or soil. In making joints, coat ends and couplings with joint adhesive or sealing compound approved by duct manufacturer. Wipe off excess compound.

DD. Seal points where buried conduit enter a manhole, hand hole, or building to prevent entry of water, sand, or soil. Plug unused conduit ducts at such points to block passage of water, gas, or animals. Place suitable non-deteriorating plugging compound around cables in conduit ducts where they enter a manhole or building to block passage of water, gas, or animals.

EE. Place buried warning tape (non-conductive) approximately 12 inches directly above construction before final fill.

FF. Provide trench width for duct bank between 12" and 24" greater than outside edge of duct bank therein.

GG. Install conduits using approved conduit spacers. Provide 36 inches minimum installation depth to top of duct bank.

HH. Avoid damage to trees, shrubs, bushes, and related items. Use hand excavation in trenching within 2'-0" from utility lines, shrubbery, foundations, and as indicated.

II. Locate manholes as indicated on Drawings and approved shop drawings. Place manholes to reduce entry of water and blocking of traffic when they are opened for access.

JJ. Tag and identify fiber cables in each manhole with a highly visible plastic tag identifying cable as fiber optic, number of fibers in cable, and uniquely labeled (identified).

KK. Do no more than 600 feet of trench excavation before backfilling. Close trench within 24 hours of Owner approval. Test sections after backfilling. If a section fails to pass test, re-excavate and resolve problem at no additional cost to Owner.

LL. Restore trenching work and excavation to their original condition, with road surfaces and sidewalks patched in an approved manner. Re-seed or re-sod grass areas with same type of ground covering as previously in place.

MM. Coordinate restoration work with Owner.

3.8. INSTALLATION, OUTDOOR - COPPER CABLE

LL. Provide splices according to manufacturers' highest requirements for maintaining integrity and strength of signal. Provide sealed, filled, and re-enterable splices.

3.9. INSTALLATION, OUTDOOR - FIBER

LL. Determine exact cable path based upon criteria set forth in Specifications and EIA/TIA 568B code.

MM. Install fiber in conduit according to EIA/TIA 569-A standards.

NN. Provide fiber optic cable continuous from end to end (without splices) except as required for termination.

OO. Terminate all fiber strands of specified cable.

3.10. INTERFACE WITH OTHER PRODUCTS

NN. Paint exposed work to match adjacent walls or ceilings.

OO. Patch and fire stop openings as required by applicable fire and building codes. Seal openings with firestopping material for cables that penetrate exit corridors and stairways to maintain integrity of corridors and stairways as a safe means of egress according to federal, state and local codes.

PP. Move and relocate existing Owner furniture and equipment as required to place station wiring and outlets. No claims for excess labor will be permitted.

QQ. Cover marks and disfigurations left from previously removed telephone equipment with wall plates or repair marks and disfigurations.

RR. Hang conduit, raceways, electrical equipment and other similar system components supported by roof joists from top chord or bottom chord panel point. Alternatively, provide a panel point by applying a vertical web member. Do not exceed a maximum load of 250 pounds.

SS. Hang conduit, raceways, electrical equipment, and related items, which are supported by roof or floor beams from beams with clamp attachments that engage both edges of beam flange. Locate hangers directly below beam webs. Limit hanger load to 1000 pounds in area above mechanical room and 250 pounds in remaining areas, unless otherwise approved by Designer.

TT. Provide additional supports, clamps, web members, and related items, required to comply with above requirements, as applicable.

UU. Install telephone and electrical panel back boards where required.

3.11. FIELD QUALITY CONTROL

TT. Field inspection and testing will be performed under provisions of Section detailing systems testing, except as indicated in this Section. Provide services of an RCDD to oversee intermediate and final inspections for all system segments (e.g., telecommunication rooms, pathways, raceways, voice/data cabling, and related items).

UU. For each jack wired, arrange, pay for, and test wiring structure. Ensure that it meets or exceeds requirements of system type installed (i.e., Category 5e, Category 6, and related items) according to EIA/TIA-568B and TSB-95.

VV. Test terminated fibers after installation by performing double ended tests per EIA/TIA FOTP 171, OFSTP-14 (for multimode fiber) and OFSTP (for singlemode fiber). Provide test results to Owner. For testing, parameters are determined as follows:

1. Determine cable lengths by termination points of cable markings.
2. Use Fiber Optic Cable Manufacturer's Typical Attenuation values specified.
3. Use attenuation loss specifications furnished by manufacture of connectors.

WW. Perform FOTP 171 testing on multimode fiber at 850 nm and 1300 nm and on single mode fiber at 1310 nm and 1550 nm.

XX. Ensure that test value of each fiber optic cable and terminators as measured by FOTP 171 Test Method B is no more than the sum of manufacturer's specifications for individual components as noted above.

YY. Copper Pair (Voice) Testing:

1. Test pairs in copper cables after splicing and terminating, on an end-to-end basis. Test each pair immediately after installation of cable according to manufacturers' recommendations and industry standards. If more than 1% of pairs in a cable fail any test, entire cable will be deemed unacceptable by Owner. Replace unacceptable material with new material and repeat tests until passing is achieved.
2. Test locations after installation. Send a written accounting identifying test results to Owner. Test pairs for continuity, polarity, and loop resistance. Owner reserves right to require additional testing shall more than 1% of tested stations fail any test.

ZZ. Outdoor conduits shall pass a 3-3/4" diameter by 6" long mandrel end-to-end. Perform mandrel tests before trench closing. Notify Designer 48 hours before mandrel tests.

3.12. ADJUSTING

ZZ. Adjust work under provisions of Section detailing Adjusting.

3.13. CLEANING

ZZ. Clean work under provisions of Section detailing Cleaning.

AAA. Restore buildings to their prior condition after installation of wire and equipment.

BBB. Clean Telecommunication rooms of debris.

3.14. DEMONSTRATION / TRAINING

ZZ. Provide systems demonstration and training under provisions of Section regarding systems demonstrations and training.

AAA. Offer a minimum of four [4] hours of on-site training and demonstration to Owner personnel.

3.15. SCHEDULES

ZZ. (Reserved)

END OF SECTION