## SECTION 27 05 00

Contractor Requirements and Specifications
Stanford University – Information Technology Services

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1.0 **COMMUNICATION CONTRACTOR’S (CC’S) REQUIREMENTS:**

1.1 **GENERAL REQUIREMENTS:**

All work contained herein shall conform to the construction drawings and specifications, and all applicable Federal, State, County, City, Local laws, ordinances, rules, permits, and regulations. The aforementioned laws, ordinances, rules, permits and regulations are hereby incorporated and become a part of the Contract Documents as though they were written herein.

All Work shall be performed in accordance the Stanford University’s General Conditions for Construction Projects. Further information can be found at: http://web.stanford.edu/group/fms/fingate/suppliers/dobusiness/index.html

The Communication Contractor (CC) shall furnish all labor, supervision, subcontractors, construction equipment, transportation, licenses, permits, taxes, safety supplies, consumable supplies, all materials not furnished by Stanford and all other incidental items and cost required to complete the Work in accordance with the Contract Documents.

CC shall schedule and perform the work in the most economical, safe and efficient manner taking into consideration all applicable governmental and Stanford University requirements and restrictions.

CC shall obtain the necessary documentation to comply with the latest edition of applicable construction standards and specifications and material manufacturers specifications.

During the prosecution of the Work, CC shall comply with the construction standards and specifications contained herein and develop additional specifications as required to include special instructions from manufacturers, fabricators or suppliers as well as special construction requirements of Stanford or authorities having jurisdiction over the Work or work areas.

The contractor's Project Manager and on-site installation supervisors and technicians shall be vendor certified installers to perform the applicable Work:

- Have detailed knowledge of the applicable structured cable system.
- Be skilled at all equipment and materials used under the Contract.
- Be competent to troubleshoot and fix problems associated with Contractor provided materials.

Normal business hours are 8:00 AM to 5:00 PM, Monday through Friday. Work outside the range of normal business hours will be permitted as long as it is scheduled in advance through the Information Technology Services Facility Engineer (ITSFE).

Scheduled work hours on new building or major renovation projects shall be coordinated with the General Contractor’s Project Superintendent.

1.2 **FIELD PROJECT MANAGEMENT**

The CC shall provide Project Management as required. The Project Manager shall supervise the CC’s personnel, coordinate the work, and ensure that all work is performed in a safe and quality manner in accordance with all applicable standards, specifications, methods and procedures. This rule shall be in-force at all times when craft personnel are on-site.

The Contractors Project Manager will be required to attend a weekly project status meeting with the ITSFE.

1.3 **SAFETY REQUIREMENTS:**

Stanford is committed to providing a safe working environment for students, faculty, staff, visitors, the public and workers on construction projects throughout the campus.

Implementation of safe working practices is a requirement for all Contractors.

In construction areas, all CC personnel shall wear personal protection devises as appropriate for the work location and work operation being performed i.e. hardhats, work boots, safety eye protection, reflective vest, etc. Additional General Contractor requirements may apply such as required safety meetings, jobsite specific personal protective equipment, etc.

The CC shall ensure that all debris associated with work have been removed from work site at the end of each shift. The CC shall also ensure that all building fixtures have been
reinstalled to their original condition at the end of each shift. Any deviation from this requirement shall be only with approved, written consent.

CC shall minimize noise, odors, dust and disruption to the public and building occupants during performance of its work under this contract.

CC shall clean up their work area each day and remove debris properly and legally off Stanford's property. Stanford's dumpsters are not to be used. Materials and supplies to be used for the Project shall be neatly stacked out of circulation paths. All exits pathways, hallways, thoroughfares, and entrance and egress pathways shall be cleaned so as to keep dirt from being tracked into the building. At the completion of the Work, all excess material, debris, tools and supplies shall be removed from the Project site.

If adequate clean up is not performed each day by the CC, the Stanford's Representative is authorized to make other arrangements to have the clean up performed at the Contractor's or Consultant's expense.

All exposed holes, pits, pipes, etc. either inside or outside the building, shall be barricaded and/or plated to ensure the site is adequately secured when CC personnel are not present. All ladders, hanging wires, pipes, or other items protruding into a pedestrian travel way must be removed or secured each night.

When driving on Stanford's Property, CC's personnel shall observe all traffic safety regulations and pay particular attention to pedestrians, bicyclists and joggers. The maximum speed limit is 25 MPH and 10 MPH inside restricted Pedestrian Zones. All loose material and debris on vehicles shall be adequately secured and tied down. It is the responsibility of the successful CC to secure any parking permits prior to the first day of work.

For general parking information, permit requirements, and Pedestrian Zone requirements, go to the Stanford Parking and Transportation website: http://transportation.stanford.edu/parking_info/ParkingInformation.shtml

When working in the street areas, the CC shall conform to the most stringent traffic control requirements as applicable from the State Of California, Manual Of Traffic Controls. The CC shall submit a Traffic Plan to be included in the Contract. It will delineate the type and location of all traffic control devices including signs, flashing lights, delineators, cones and flaggers.

If work requires a shutdown of gas, electricity, ventilation, heating, plumbing or any other utility or alarm system, it must be (1) approved by the Stanford's Representative and the building occupants, and (2) scheduled a minimum of five (5) working days in advance of the planned shutdown. This includes minor shutdowns of even one circuit. All panel boxes, gas valves, etc. shall have notices provided by the CC securely attached to them while out of service.

During breaks or when only a portion of the work is completed, do not leave tools exposed where someone may accidentally be injured or may attempt to use them. Do not leave doors or windows unsecured or open during breaks. At the completion of each day’s work, all doors, windows or other openings shall be adequately secured for the night.

1.4 **CC'S PERSONNEL IDENTIFICATION:**

All CC personnel working on this project shall (1) wear a valid company picture identification card and (2) wear clothing that identifies the individuals their company name (uniform type shirt, etc.) This requirement shall be in effect throughout the duration of the project.

The CC’s personnel may be required to wear Stanford issued, Contractor Identification Badges when performing work at some locations such as; both hospitals, the School of Medicine buildings and student residences. If required, the CC shall provide the names and other identification as required of all personnel assigned to the project so that badges may be prepared. Upon completion of the project, Stanford issued Contractor ID badges shall be returned to the ITSFE.

1.5 **PERMIT REQUIREMENTS:**

CC shall secure all permits, clearances and agreements not furnished by Stanford.

CC shall obtain and pay for all work permits required by governmental authorities and other permits required for CC’s construction operations including but not limited to Contractor licenses, construction bonds, transportation, equipment, labor and or other general permits.
In applicable Medical Hospital and Clinic areas, the CC shall obtain, administer, and close out Above Ceiling Permits. A permit is required for each work order request. An approved final inspection copy of the permit shall be provided to the ITSFE with all other closing documentation and final invoicing.

1.6 HEALTH INSURANCE PORTABILITY and ACCOUNTABILITY ACT (HIPAA)

The CC shall provide and maintain HIPAA Level 1 coverage with each person assigned to work in applicable Medical Hospital and Clinic Buildings.

1.7 INFECTIOUS DISEASE CONTROL – STANFORD HOSPITAL, LPCH

In applicable Medical Hospital and Clinic areas, the CC shall obtain, administer, and close out Infectious Disease Control Permits. Also, in applicable patient areas of the Stanford Hospital and Lucille Packard Children’s Hospital (LPCH), the CC shall use a portable containment unit (tent) engineered to control the spread of dust and airborne contaminants before opening and performing work above the ceiling. The containment unit shall be equipped with a HEPA-filtered negative air machine. A HEPA-filtered vacuum shall also be used to clean-up work area, the inside of the containment unit and the clothing of work personnel prior to their opening and exiting of the containment unit. The CC shall review and/or demonstrate the infectious disease control methods and procedures and work plan to the Stanford Hospital Staff.

1.8 WATER POLLUTION:

CC will make every effort to prevent the pollution of surface water runoff from the construction project by keeping pollution out of storm drains, by reducing the exposure and discharge of materials and wastes to storm water, and by reducing erosion and sedimentation (Reference: Special Conditions For Storm Pollution Prevention). http://lbre.stanford.edu/sem/storm_water

1.9 HAZARDOUS / TOXIC MATERIALS

In the event Contractor encounters on the project site material reasonably believed to be asbestos, polychlorinated biphenyl (PCB), or other hazardous materials which have not been rendered harmless, Contractor shall immediately stop work in the area affected and report the condition to the Project Manager (ITSFE) in writing. The Work in the affected area shall not thereafter be resumed except by written agreement of Project Manager (ITSFE) and Contractor if in fact the material is asbestos, PCB, or other hazardous material and has not been rendered harmless. The Work in the affected area shall be resumed in the absence of asbestos, PCB, or other hazardous materials, or when such materials have been rendered harmless.

**DETAILED HAZARDOUS MATERIAL HANDLING PROCEDURES ENCOUNTERED DURING CONSTRUCTION WORK ACTIVITIES IS DETAILED ON THE STANFORD ENVIRONMENTAL HEALTH & SAFETY WEBSITE:**

http://www.stanford.edu/dept/EHS/prod/mainrencon/Haz_Mat_Procedures_4=01.pdf

CC shall be responsible for any and all costs for the removal and corrective measures associated with toxic materials or hazardous materials caused by the CC fault or through its negligence. Stanford and governing authority shall determine corrective action.

1.10 NEW BUILDING / MAJOR REMODEL CONSTRUCTION SITE COORDINATION:

When working on new building or major remodel building projects, the Cabling Contractor’s Project Manager or on-site Supervisor shall be required to regularly attend scheduled on-site project status/safety meetings with the General Contractor’s Construction Superintendent. The CC shall coordinate its ongoing work activities and material logistics with the GC’s Construction Superintendent.

1.11 CHANGES IN THE WORK:

Change Orders: The ITSFE, without invalidating the Contract, may order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions, the Contract Sum and the Contract Time being adjusted accordingly. All such changes in the Work shall be authorized by Change Order, and shall be performed under the applicable provisions of the Contract Documents. Charges or credits resulting from a change shall be determined in one or more ways as specified in the Stanford University General Conditions For Construction Projects, Article 12, Paragraph 12.1.3.
Field Orders: In emergency situations, or to permit orderly progress of the Work, a Field Order may be issued by the ITSFE. The Field Order may authorize work on a cost reimbursement basis in accordance with Stanford University General Conditions For Construction Projects, Article 12, Paragraph 12.1.3, and a not-to-exceed a given dollar estimate.

1.12 PROGRESS PAYMENTS
Please see: http://web.stanford.edu/group/fms/fingate/suppliers/getpaid/index.html for terms and conditions

1.13 PAYMENT
Please see: http://web.stanford.edu/group/fms/fingate/suppliers/getpaid/index.html for terms and conditions

1.14 RELEASE OF LIENS
Unless otherwise provided by Stanford, neither the final nor any part payment of the sums retained or withheld by Stanford will become due until the Contractor has delivered to Stanford: (i) a complete release signed by the Claimant of any and all liens, claims, or rights to withholdings arising out of this Contract, or (ii) receipts in full in lieu thereof; and if required by Stanford in either case; (iii) an affidavit that so far as Contractor has knowledge or information, the release or receipts include all the labor and materials for which such a lien, claim, or right to withholdings could be filed. Contractor may, if any subcontractor or other possible claimant refuses to furnish a release or receipt in full, furnish a bond satisfactory to Stanford conditioned upon Contractor indemnifying Stanford against any claim by lien or otherwise. If any lien, claim, or right to withholdings remains unsatisfied after all payments are made, Contractor shall pay to Stanford a sum equivalent to all moneys that the latter may be compelled to pay in discharging such lien, claim, or right, including all costs and attorney's fees.

2.0 SPECIFICATIONS
2.1 CONSTRUCTION DRAWINGS
2.1.1 General
The Cabling Contractor (CC) will receive access to electronic, or hard copies, at the discretion of the ITSFE, of all applicable drawings and specifications required to perform the Work. It will be the responsibility of the CC to produce hard-copy prints, for their own use, from these files in order to perform the Work. Please Note: All files, drawings or other information provided is proprietary and not to be re-distributed without written consent from the ITSFE.

2.1.2 Horizontal & Building Backbone
Unless otherwise specified, the footages for cable and materials shown on the construction drawings are based on available plant records, architectural drawings or the engineer's route or path assumptions. It is the CC’s sole responsibility, prior to ordering and placing, to verify all distances and quantities required to perform the Work in accordance with the contract requirements.

2.1.3 Campus Backbone (Underground & Building Entrance Plant)
Unless otherwise specified, distances shown on the drawings, are wall to wall conduit lengths between serviceable locations.. The CC must make allowances for additional cable to facilitate pulling, splicing operations or maintenance hole racking changes. It is the sole responsibility of the CC to include enough media in their bid to complete the Work, per the contract requirements.

2.2 FIELD CONDITIONS
2.2.1 General
Unless otherwise specified, pull-strings (tapes, ropes) have been provided in conduits reserved for this project.

2.2.2 **Horizontal & Building Backbone**

Unless otherwise specified, the Electrical Contractor (EC) will provide pull strings in "ring and string" construction and conduits to TSO outlets. Unless otherwise specified, the CC shall place a usable 3/4" woven, 2,500 pound rated pull tape with footage markers (Example - Neptco Muletape -WP2500P) in all riser conduits, concurrently with all new cable placements, to facilitate future over-ride cable placements. Pull tape with footage markers must be continuous from one end of conduit to the other, without splices. Proper industry approved methods must be used to ensure that pull tape is not spiraled around cables.

2.2.3 **Campus Backbone (Underground & Building Entrance Plant)**

Unless otherwise specified, the GC or EC shall be responsible to place a new 3/4" woven, 2,500 pound rated pull tape with footage markers (Example - Neptco Muletape - WP2500P) in all underground or under-slab conduits. Pull tape with footage markers must be continuous from one end of conduit to the other, without splices. Proper industry approved methods must be used to ensure that pull tape is not spiraled around cables.

2.3 **COMMUNICATION CONTRACTOR (CC) RESPONSIBILITIES AND SUBMITTALS**

2.3.1 **General**

Prior to commencement of work, the CC shall submit a written report detailing project management structure including emergency contacts and procedures.

Submit a Gantt chart to reflect the proposed full project timeline and tasks sequence (at the discretion of the ITSFE - required on major projects).

Verify that all work required in the field is adequately described in the plans. All discrepancies shall be brought to the attention of the ITSFE prior to the start of construction.

Prior to the commencement of work, the CC shall submit a written request for approval, the names of all proposed sub-contractors, together with a detailed summary of work to be performed by each subcontractor.

Prior to the commencement of work, the CC shall submit a detailed written request for approval, in advance of execution, for all job changes and adjustments in compensation due to scope of work changes or work extras, i.e.

- Design changes
- Material changes or substitutions
- Scheduling and or sequence changes

Unless otherwise specified, the CC shall obtain all necessary permits and licenses (including building permits), pay all fees, and provide all construction work notifications.

CC shall comply with all applicable laws, ordinances, rules and regulations.

2.3.2 **Horizontal & Building Backbone**

The Horizontal & Building Backbone system shall comply with the following specifications as required. Nothing in these specifications shall be misconstrued to permit work not conforming to the most stringent of applicable codes. It is assumed that Bidders have access to, and knowledge of, the following reference materials to ensure conformity to the specifications:

- Underwriters Laboratories (UL): Applicable listings and ratings.
- National, State, and Local OSHA, electrical, building, and fire codes.
- IEEE (Institute of Electrical and Electronic Engineers) 802.3 Ethernet, 802-3Z Ethernet
- FCC Part 68.500.

2.3.3 Campus Backbone (Underground & Building Entrance Plant)
The Campus Backbone Plant system shall comply with all applicable specifications and regulations, some of which are listed below. Nothing in these specifications shall be misconstrued to permit work not conforming to the most stringent of applicable codes. The CCs are expected to have access to the latest editions of the following reference materials to ensure conformity to the specifications:
- Underwriters Laboratories (UL): Applicable listings and ratings.
- National, State, and Local OSHA, electrical, building, and fire codes.
- OSHA, CFR Standards-29, Section 1910 (current edition)
  - 1910.268 Telecommunications
  - 1910.146 Permit-Required Confined Spaces

2.3.4 Outside Plant Communications Conduit System (Reference Only)
The detailed standard for constructing outside plant communications conduit systems is contained in Stanford University - Facility Design Guidelines (FDG), Stanford Communications Underground Pathways & Spaces. The FDG is available for viewing on the Stanford FDG website: (http://maps.stanford.edu/fdg_available)

2.4 STANFORD RESPONSIBILITIES

2.4.1 General
The Information Technology Services Facility Engineer’s (ITSFE’s) responsibilities include, but are not limited to:
- Provide drawings and other detailed information.
- Explain drawings and specifications as required.
- Advise zone and building managers of work to be performed and the preliminary work schedule. Identify contact personnel.
- Site and Traffic Plan preparation and approval.
- Provide information to CC as provided in this Specification.
- Review CC’s construction schedule
- Conduct work in progress quality reviews.
- Perform final work acceptance review.
- Approve CC invoicing for payment.
- Execute written Request for Change Order to the CC.
If available, provide limited outside storage space for CC materials (i.e., Puichon cable yard). Stanford shall not be liable for damage, loss, or theft of stored materials. Provide labeling and numbering format for marking all plant facilities i.e. Telecommunications Service Outlets (TSO’s), copper, fiber and coaxial cables, patch panels etc. Provide format/form for cable testing documentation.

2.4.2 Horizontal & Building Backbone
Arrange for access to all buildings and grounds on a scheduled basis as coordinated with the building managers.

2.4.3 Campus Backbone (Underground & Building Entrance Plant)
Provide an approved University Architect/Planning Office (UA/PO) traffic plan for managing traffic around an underground conduit construction site. Including alternate access for delivery and Marguerite shuttle vehicles. Provide an approved UA/PO site for use as a laydown area for underground conduit construction material and equipment storage, if available.

3.0 APPROVED PRODUCTS

3.1 PAIRED COPPER CABLES

3.1.1 Horizontal Cabling
The ITSFE shall specify the cable category type to be installed, i.e. Cat 5e, Cat 6, Cat 6A.

- Horizontal cable in non-plenum air spaces shall be NEC Type CMR if specified by the ITSFE.
- Horizontal cable in plenum air spaces shall be NEC Type CMP
- Approved UTP cable manufacturers are as follows (in alphabetical order)
  - Berk-Tek
  - Panduit
  - Superior Essex

NOTE: The CC shall submit for approval, the cable manufacturer’s specification sheet for all CC provided cable.

When EIA/TIA Category 6 horizontal cable is specified, it shall be:

- Superior Essex (NextGain) Category 6eX CMP 54-272-5B
- Superior Essex (NextGain) Category 6eX CMR 54-272-5A
- Cables shall be equipped with a green outer jacket.

When Category 6 horizontal cable is specified, for Stanford Hospital and Clinics ONLY, it shall be:

- Panduit PUR6504xx CMR (Color as specified by the ITSFE)
- Panduit PUP6504xx CMP (Color as specified by the ITSFE)

When EIA/TIA Category 6A horizontal cable is specified, it shall be:

- Superior Essex (NextLAN) 10 Gain Cable (6H-272-2B).
- Cables shall be equipped with a Purple outer jacket.

When EIA/TIA Category 6A horizontal cable is specified, for Stanford Hospital and Clinics ONLY, it shall be:

- Panduit – PUR6A04xx-UG CMR (Color as specified by the ITSFE)
3.1.2 Building Backbone Cabling

Unless otherwise specified, all building backbone cable shall be Category 3 rated, 24 AWG solid conductor.

- Unless otherwise specified, cables shall be equipped with a white, gray, or beige outer jacket.
- Building backbone (riser) cable in non-plenum air spaces shall be NEC Type CMR. Unless otherwise specified, ARMM Series Riser Cable should be installed.
- Building backbone (riser) cable in plenum air spaces shall be NEC Type CMP.

NOTE: The CC shall submit for approval, the cable manufacturer’s specification sheet for all CC provided cable.

3.1.3 Campus Backbone (Underground & Building Entrance Plant)

Underground cable shall be RUS 7 CFR 1755.890 rated, filled core cable, 26 or 24 AWG as specified in the construction drawings.

Building Entrance cable shall be RUS 7 CFR 1755.890 rated, filled core cable, 24 AWG minimum.

The non-filled transition cable (building entrance transition splice to the termination panel), shall be AR Series Riser Cable (ARMM) as specified in the construction drawings.

NOTE: The CC shall submit for approval, the cable manufacturer’s specification sheet for all CC provided cable.

3.2 COAXIAL CABLES

3.2.1 General

CommScope Cable is the preferred manufacturer for hard-line and semi-rigid coaxial cables. Cables by other manufacturers MUST be pre-approved, in writing, by the ITSFE.

3.2.2 Horizontal

Unless otherwise specified on the construction drawings, horizontal cables for broadcast (CATV) shall be RG-6 or RG-11 as specified below:

- Horizontal cable in non-plenum air spaces shall be NEC Type CATV with a black outer jacket.
  - CommScope RG-6, F6SSVV (use LRC Connector SNS6QS)
  - CommScope RG-11, F11SSVV (use LRC Connector SNS11QS)
- Horizontal cable in plenum air spaces shall be NEC Type CATVP with a white outer jacket.
  - CommScope RG-6, 2227 or 2227K (use Gilbert Connector GF-6-AHP-328)
  - CommScope RG-11, 2287 or 2287K (use Gilbert Connector GF-11-AHP-450)
### 3.2.3 Building Backbone

Building backbone (riser) cable in non-plenum air spaces shall be NEC Type CATVR. Building backbone (riser) cable in plenum air spaces shall be NEC Type CATVP. CommScope is the preferred vendor for semi-rigid and hard-line cable. Approved cable types are as follows:

**CommScope: RG6 coaxial**
- F11SSVV PVC Jacket (use LRC Connector SNS6QS)
- F11SSEF PE Jacket/Flooded (use LRC Connector SNS6QS)

**CommScope: RG11 coaxial**
- F11SSVV PVC Jacket (use LRC Connector SNS11QS)
- F11SSEF PE Jacket/Flooded (use LRC Connector SNS11QS)

**CommScope: P3 .500" coaxial**
- P-3 75-500 JCA (jacketed)
- P-3 75-500 JCASS (jacketed, flooded)
- P-3 75-500 JCAR (CATVR riser rated)

**CommScope: P3 .750" coaxial**
- P-3 75-750 JCA (jacketed)
- P-3 75-750 JCASS (jacketed, flooded)

### 3.2.4 Campus Backbone (Underground & Building Entrance Plant)

Unless otherwise specified, cable shall be jacketed with flooding compound under the jacket.

### 3.3 FIBER CABLES

#### 3.3.1 General

Unless otherwise specified, Corning is the preferred fiber cable manufacturer. Any proposed substitution MUST be pre-approved, in writing, by the ITSFE. A hybrid cable shall be used when multi-mode and single-mode fiber types are required inside a single sheath. Multi-mode fiber shall be 62.5 micron (OM1) as specified on the construction drawings. Single-mode fiber shall be zero-water-peak (OS2). Unless otherwise specified, the following transmission parameters shall apply for all 62.5 multi-mode fiber cables:

- Corning Performance Code Option = 30
- Maximum Attenuation (dB/km) @ 850nm = 3.5
- Maximum Attenuation (dB/km) @ 1300nm = 1.0
- Maximum LED Effective Bandwidth (MHz/km) @ 850nm = 200
- Maximum LED Effective Bandwidth (MHz/km) @ 1300nm = 500
- Serial Gigabit Ethernet Distance (m) @ 850nm = 300
- Serial Gigabit Ethernet Distance (m) @ 1300nm = 550
- Serial 10 Gigabit Ethernet Distance (m) @ 1300nm = 300

Unless otherwise specified, the following transmission parameters shall apply for all single-mode loose tube fiber cables:

- Corning Performance Code Option = 01
- Maximum Attenuation (dB/km) @ 1310nm = 0.4
- Maximum Attenuation (dB/km) @ 1383nm = 0.4
- Maximum Attenuation (dB/km) @ 1550nm = 0.3
- Serial Gigabit Ethernet Distance (m) @ 1310nm = 5000
1. Serial 10 Gigabit Ethernet Distance (m) @ 1310nm = 10000

Unless otherwise specified, the following transmission parameters shall apply for all single-mode tight buffer fiber cables:

- Corning Performance Code Option = 31
- Maximum Attenuation (dB/km) @ 1310nm = 1.0
- Maximum Attenuation (dB/km) @ 1383nm = 1.0
- Maximum Attenuation (dB/km) @ 1550nm = 0.75
- Serial Gigabit Ethernet Distance (m) @ 1310nm = 5000
- Serial 10 Gigabit Ethernet Distance (m) @ 1310nm = 10000

3.3.2 Horizontal

Horizontal cable in non-plenum air spaces shall be Corning MIC® Riser Cable (NEC Type OFNR).

Horizontal cable in plenum air spaces shall be Corning MIC® Plenum Cable (NEC Type OFNP).

Where specified, the ITSFE will identify the fiber type for all TSO cabling requiring optical fiber.

3.3.3 Building Backbone

Building Backbone (riser) cable in non-plenum air spaces shall be NEC Type OFNR as follows:

- Corning FREEDM® LST™ Gel-Free Cable.
- Corning FREEDM® Loose Tube, Gel-Free Cable.
- Corning FREEDM® One Riser Cable.
- Corning MIC® Riser Cable.
- Corning MIC® Unitized Riser Cable.
- Corning Fan-Out Riser Cable.
- Corning Hybrid Cables.

Building Backbone (riser) cable in plenum air spaces shall be NEC Type OFNP as follows:

- Corning MIC® Plenum Cable.
- Corning MIC® Unitized Plenum Cable.
- Corning Fan-Out Plenum Cable
- Corning Hybrid Cables.

3.3.4 Campus Backbone (Underground & Building Entrance Plant)

Cable shall be of loose tube design with water blocking technology as follows:

- Corning FREEDM® LST™ Gel-Free Cable Interlocking Armored Cable.
- Corning FREEDM® Loose Tube, Gel-Free Interlocking Armored Cable.

Building entrance cables meeting the UL-1666 OFNR specification may enter a building without a transition splice, i.e. Corning FREEDM® LST™ Gel-Free Cable or Corning FREEDM® Loose Tube, Gel-Free Cable.

3.4 ACCESS CONTROL DOOR CABLES

3.4.1 Cable Types

Belden bundled access control cables shall be ordered from Anixter Inc. as follows:

- Belden Non-Plenum Cable Bundle: Anixter Part Number SP0807-79
  - one 3-pair, 22 AWG, stranded conductors, individually shielded twisted pair with drain wires
  - one 6-conductor, 22 AWG, stranded conductors
  - one 4-conductor, 22 AWG, stranded conductors
• one 4-conductor, 18 AWG, stranded conductors
• one CAT 6

- Belden Plenum Cable Bundle: Anixter Part Number SP0807-80
  • one 3-pair, 22 AWG, stranded conductors, individually shielded twisted pair with drain wires
  • one 6-conductor, 22 AWG, stranded conductors
  • one 4-conductor, 22 AWG, stranded conductors
  • one 4-conductor, 18 AWG, stranded conductors
  • one CAT 6

3.5 CABLE SPLICE CLOSURES & SPLICE MODULES

3.5.1 Copper Splice Closures

Splice closures in maintenance holes and splice boxes shall be as follows:

- Preformed #8000624: Straight and branch splice configurations up to 300 pair cable (in/out).
- Preformed #8000626 or #8000630 Straight and branch splice configurations 400 pair cable and larger.
- Additional endplates, washers or other closure accessories may be required.
  The CC will be responsible for providing all hardware required for a complete and professional installation.

Splice closures in pull boxes and pedestals shall be a Better Buried Closure (3M Company) and encapsulated with gravity filled, re-enterable compound. Applicable cables sizes are generally 50 pair or less.

Building entrance transition splices and building backbone splices shall be K&B Vault and Riser Closure (fire retardant) manufactured by 3M Company.

3.5.2 Copper Splice Modules

Splice modules shall be 710 type, manufactured by 3M Company or other licensed vendor.

- Outside plant splices shall be made with filled 710 modules, e.g. 3M 3M710-S-C-1-25.
- Inside plant applications shall be made with Fire Retardant (dry only) 710 modules, e.g. 3M 3M710-S-D-1-25.

3.5.3 Fiber Splice Closures

Fiber splice closures shall be as follows:

- First Choice: Corning SCF-6C28 6", SCF-8C28 8"
- Alternate (with written ITSFE pre-approval): Preformed Line Products - Coyote Closures
3.6 COPPER WIRING BLOCKS (BUILDING ENTRANCE & BUILDING BACKBONE CABLES)

3.6.1 Wall-Mounted
Building entrance cables shall be terminated on wall-mounted 110 Wiring Blocks in the Main Telecommunications Room (MTR). Unless otherwise specified, acceptable alternatives are:

- 110-Style Wall-Mount Frames:
  - Leviton 41MB2-SMF, 300-pair Basic Mounting-Frame
  - Leviton 41MB2-3FT, 300-pair Wall-mounting Frame Kit Connectors
  - Leviton 41880-300, Vertical Cord Manager, Basic Unit

- Wiring Blocks:
  - Leviton 100-pair: 41AW2-100 w/legs
  - Leviton 100-pair: 41AW2-200 w/legs
  - Leviton 300-pair: 41AW2-300 w/legs
  - Leviton 100-pair: 41DR2-100
  - Leviton 100-pair: 41DR2-200
  - Leviton 300-pair: 41DR2-300

3.6.2 Rack-Mounted
Building backbone cables incoming to the TR(s) will generally be mounted on 19" equipment racks. Unless otherwise specified, acceptable alternatives are:

- Straight:
  - Leviton Wiring Block (Category 5e), 100-pair: 41DR2-100
  - Leviton Horizontal Cord Manager: 49253-LPM (above and below each 41DR2-100).

3.7 PATCH PANELS

3.7.1 Category 5e – Patch Panels
Leviton Patch Panels shall be used as follows, unless otherwise specified:

- Printed Circuit Style:
  - Leviton 24-port, 5G596-U24 (Cat-5E) / 69586-U24 (Cat-6)
  - Leviton 48-port, 5G596-U48 (Cat-5E) / 69586-U48 (Cat-6)
  - Note: When installed in 19" two-post equipment racks, a Leviton Cable Management Bar (49005-DMB) or equivalent may be specified at the rear of each patch panel.

- Modular Style:
  - Leviton 24-port, 69270-U24
  - Leviton 48-port, 69270-U48
  - Note: When installed in 19" two-post equipment racks, a Leviton Cable Management Bar (49005-DMB) or equivalent may be specified at the rear of each patch panel.

3.7.2 Category 6A - Patch panels (when specified by ITSFE)
Leviton (NextLAN) eXtreme 10G QuickPort Patch Panels shall be used, as follows:

- 24-port, 6910G-U24
- 48-port, 6910G-U48
- 6910G-P48 – 48 Port Pre-loaded w/Quick Port Connectors
  - Note: Unless otherwise specified, a Leviton Cable Management Bar, 49000-DMB shall be installed at the rear of each Leviton 6910G patch panel installed in 19" two-post equipment racks.
3.8 COAXIAL CONNECTORS

3.8.1 General
LRC Connectors are required for non-plenum cable use, unless otherwise specified. Gilbert Connectors are preferred for plenum cable use, unless otherwise specified.

3.8.2 Horizontal & Building Backbone (Inside Building Plant)
RG-6 semi-rigid coaxial horizontal cable shall have F-connectors installed at the Telecommunications Room (TR) and TSO face-plates as follows:

- Non-plenum rated applications: Snap N Seal LRC part #SNS6QS. Note: Requires a special tool. LRC part # IT-1000.
- Plenum rated applications (RG-6): Gilbert part #GF-6-AHP-328.

RG-11 semi-rigid coaxial horizontal cable shall have F-connectors installed at the Telecommunications Room (TR) and TSO face-plates as follows

- Non-Plenum Rated Cable: LRC Connector SNS11QS
- Plenum Rated Cable: Gilbert Connector GAF-11-AHP-450

Rigid coaxial horizontal cable shall use the following connectors:

- .500" Non-Plenum Rated Cable: LRC Connector, EI-500-K3
- .750" Non-Plenum Rated Cable: LRC Connector, EI-750-K3

3.8.3 Campus Backbone (Underground & Building Entrance Plant)
Rigid coaxial campus backbone cable shall use the following connectors

- .500" Cable: LRC Connector, EI-500-K3
- .750" Cable: LRC Connector, EI-750-K3
3.9 FIBER OPTIC CLOSET CONNECTOR HOUSINGS

3.9.1 General

Unless otherwise specified, Corning Closet Connector Housings shall be used as follows:

- Wall Mount:
  - 12/24-fiber capacity, Corning Part No. WCH-02P
  - 24/48-fiber capacity, Corning Part No. WCH-04P
  - 36/72-fiber capacity, Corning Part No. WCH-06P
  - 72/144-fiber capacity, Corning Part No. WCH-12P

- Rack Mount:
  - 24/48-fiber capacity, Corning Part No. CCH-01U
  - 48/96-fiber capacity, Corning Part No. CCH-02U
  - 72/144-fiber capacity, Corning Part No. CCH-03U
  - 144/288-fiber capacity, Corning Part No. CCH-04U

3.10 FIBER OPTIC CONNECTOR HOUSING PANELS, AND CONNECTORS

3.10.1 General

Unless otherwise specified, Corning Connector Housing Panels, Corning Anaerobic-Cure Connectors, and Corning Adapters and adapter panels, shall be used. When use of vacant space in existing patch panel housings is specified, the appropriate vendor specific components shall be used.

Existing closet connector housings containing blank panels shall use the following connectors and appurtenant hardware as specified in the construction drawings:

- LC type connectors, in lieu of existing ST connectors, for terminating multi-mode Outside (Underground) / Building Entrance Cables.
- LC type connectors, in lieu of existing SC connectors, for terminating single-mode Campus Backbone (Underground & Building Entrance) Cables.
- LC type connectors, in lieu of existing SC connectors, for terminating Building Backbone & Horizontal (Inside Building Plant Cables i.e. riser, horizontal).

New closet connector housings:

- LC type connector panels and connectors shall be used for terminating multi-mode and single-mode fibers in horizontal, building backbone and campus backbone applications.
- The following connector panel housing and connector colors shall be used (Corning standard):
  - 62.5 multi-mode (OM1) = Beige
  - 50.0 multi-mode (OM2) = Black
  - 50.0 multi-mode (OM3 / OM4) = Aqua
  - Single-mode (OS1/OS2) = Blue
  - Single-mode APC (OS1/OS2 Angle Polished Connector) = Green

3.10.2 Existing Closet Connector Housings (vacant panel space)

Horizontal and Building Backbone Cable Connectors:

- Unless otherwise specified, horizontal multi-mode fiber optic connectors shall be Corning Anaerobic-Cure LC type connectors. Applicable Corning adapters and/or housings panels shall be specified. Black dust caps shall be installed.
- Unless otherwise specified, horizontal single-mode fiber optic connectors shall be Corning Anaerobic-Cure LC type connectors. Applicable Corning adapters and/or housings panels shall be specified. Dust caps shall be installed.

Campus Backbone Cable Connectors (Underground & Building Entrance):
Unless otherwise specified, multi-mode fiber optic cable connectors shall be Corning Anaerobic-Cure LC type connectors. Applicable Corning adapters and/or housings panels shall be specified. Dust caps shall be installed.

Unless otherwise specified, single-mode fiber optic connectors shall be Corning Anaerobic-Cure LC type connectors. Applicable Corning adapters and/or housings panels shall be specified. Dust caps shall be installed.

3.10.3 New Closet Connector Housings:
Corning LC type connector panels and Corning Anaerobic-Cure LC connectors shall be used for terminating multi-mode and single-mode fibers in horizontal, building backbone and campus backbone applications.

- Single-mode connector (OS1/OS2): Corning 95 201-98-SP
- 50.0 micron multi-mode (OM3/OM4) connector: Corning 95-051-98-SP-X
- 62.5 micron multi-mode (OM1) connector: Corning 95-101-98-SP

3.11 EQUIPMENT RACKS AND CABLE MANAGEMENT SYSTEMS

Unless otherwise specified, two-post universal racks and cable management systems manufactured by Chatsworth Products Inc. (CPI) shall be used.

The following is a partial list of materials typically required for a 7’ height equipment rack, 7’ height cable management products, and appurtenant cable tray system products that may be specified for a standard wiring application.

- Universal Self-Support Rack 7'H x 19"W, part # 48353-503.
- Master Cabling Section, Single-sided 6"W X 7'H, part # 30092-703.
- Master Cabling Section, Double-sided 6"W X 7'H, part # 30095-703.
- Evolution Master Cabling Section, Double-sided 6"W X 7'H, part # 35513-703.
- Master Cabling Section, Single-sided 10"W X 7'H, part # 30093-703.
- Master Cabling Section, Double-sided 10"W X 7'H, part # 30096-703.
- Evolution Master Cabling Section, Double-sided 12"W X 7'H, part # 35524-703.
- Evolution Single Sided Horizontal Cable Manager 19"W X 1RMU, part # TS1002643.
- Evolution Single Sided Horizontal Cable Manager 19"W X 2RMU, part # 35441-702.
- Rack Installation Kit (concrete floor), part # 40604-003.
- Rack Installation Kit (wood floor), part # 40607-001.
- Line-Up Spacer Kit, part # 40602-500.
- Base Cross-Angle, part # 41021-501.
- Base Dust Cover, part # 41050-519.
- Upper Jumper Tray, part # 13183-519.
- Lower Jumper Tray, Double; part # 12187-519.
- Cable Runway Elevation Kit, part #10506-002.
- Cable Runway Elevation Kit, part #10506-006.
- Rack to Runway Mounting Kit, part # 12730-X12.
- Rack to Runway Mounting Kit, part # 12730-X18.
- Rack to Runway Mounting Kit, part # 12730-X24.
- UL Classified 12” Cable Runway, part # 11275-012.
- UL Classified 15” Cable Runway, part # 11275-015.
- UL Classified 18” Cable Runway, part # 11275-018.
- UL Classified 24” Cable Runway, part # 11275-024.
- UL Classified Butt-Splice Kit, part # 16301-001.
- UL Classified Junction-Splice Kit, part # 16302-001.
- UL Classified Junction-Swivel-Splice Kit, part # 16488-001.
- UL Classified Butt Swivel-Splice Kit, part # 16487-001.
- UL Classified Junction-Splice Kit, part # 11302-001.
- Vertical Rack Busbar Kit P/N 40161-072.
- Horizontal Rack Busbar Kit P/N 10610-019.
- 20” TMGB Grounding Busbar Kit P/N 40158-020.
- 12" TGB Grounding Busbar Kit P/N 40156-012
- Busbar Insulator Assemblies P/N 10622-000
- Upper Jumper Tray (6" width), e/w cross aisle feed bends, part # SK-5258-519.
- Bar 19"W, 3/8" x 1-1/2" (component part for aisle crossing assemblies), part # SK-5288-019.

The CC shall refer to the construction drawings for placement and layout of equipment racks and cable tray systems.

All equipment racks and cable runway systems shall be grounded per ANSI J-STD-607-A.

### 3.12 TSO - WALLPLATES, MODULES & HOUSINGS

**Category 5E:** Unless otherwise specified, Leviton’s Quickport® Multimedia Outlet System of faceplates, modules and couplings shall be used. Specific TSO configurations and part numbers are shown on the construction drawings. Multi-media connector/adapter types are as follows:

- Cat 5e Voice Connector: Leviton 5G110-RW5
- Cat 5e Data Connector: Leviton 5G110-RO5 (RL5 for SOM-IRT in new buildings)
- Cat 5e Universal Connector: Leviton 5G110-RL5
- Fiber LC Duplex Adapter: Leviton 41085-SLW
- CATV F Type Adapter: Leviton 40831-0BW

**Category 6 :** Unless otherwise specified, **for Stanford Hospital and Clinics ONLY**, Panduit’s Flush Mounted Faceplate system shall be used. Multi-media connector/adapter types are as follows:

- Cat 6 Connector: Panduit Mini-Com CJ688TGxx (Color as specified)
- Fiber LC Duplex Adapter: As specified on construction drawings.
- CATV F Type Adapter: As specified on construction drawings.

**Category 6 :** Unless otherwise specified, Leviton’s Flush Mounted Quickport Multimedia Outlet System (MOS) shall be used. Multi-media connector/adapter types are as follows:

- Cat 6 Voice Connector: Leviton 61110-RW6
- Cat 6 Data Connector: Leviton 61110-RV6 (RL6 for SOM-IRT in new buildings)
- Cat 6 Universal Connector: Leviton 61110-RV6
- Fiber LC Duplex Adapter: Leviton 41085-SLW
- CATV F Type Adapter: Leviton 40831-0BW

**Category 6A :** Unless otherwise specified, **for Stanford Hospital and Clinics ONLY**, Panduit’s Flush Mounted Faceplate system shall be used. Multi-media connector/adapter types are as follows:

- Cat 6A Connector: Panduit Mini-Com CJ6X88TGxx (Color as specified)
- Fiber LC Duplex Adapter: As specified on construction drawings.
- CATV F Type Adapter: As specified on construction drawings.

**Category 6A :** Unless otherwise specified, Leviton’s Flush Mounted Quickport Multimedia Outlet System (MOS) shall be used. Multi-media connector/adapter types are as follows:

- Cat 6A Voice Connector: Leviton 6110G-RW6
- Cat 6A Data Connector: Leviton 6110G-RP6 (RL6 for SOM-IRT in new buildings)
- Cat 6A Universal Connector: Leviton 6110G-RP6
- Fiber LC Duplex Adapter: Leviton 41085-SLW
- CATV F Type Adapter: Leviton 40831-0BW

Wall-phone jacks connected to the VoIP voice network shall be a Leviton 4108W-0SP faceplate equipped with an applicable Category 5e or Category 6A 8-pin RJ-45 Modular Connector (unless otherwise specified).

Unless otherwise specified, TSO faceplates, wallplates, and inserts shall be white in color. Unless otherwise specified, snap-in connector colors are as follows:

- 568B Voice = White
- 568B Data = Orange (Blue for SOM-IRT in new buildings)
- 568B Universal = Blue
- 50 micron fiber (OM3/OM4) = Aqua
- 62.5 micron fiber (OM1) = Beige
- 8.3 micron fiber (OS1/OS2) = Blue
- F-type coax = Metallic

3.13 FIRE-STOPPING
The approved pathway through wall and floor penetrations, up to 8” thick, is the E-Z Path by STI (sleeves). The ITSFE shall specify the size, quantity and location(s) of E-Z Path pathways at engineered penetration points. The CC may identify subsequent E-Z Path penetration points for horizontal cabling but must obtain pre-approval from the ITSFE as to location and size, prior to installation.
For cable tray penetrations through rated walls, intumescent fire-stop pillows shall be installed (E-Z Path Series SSB Firestop Pillows or equivalent).

3.14 UN-INTERRUPTIBLE POWER SUPPLY (UPS)
A UPS system is required to provide a minimum of 20 minutes of emergency battery backup power for building areas provisioned with VoIP services. The size and model number of the UPS unit(s) provided by the CC, will be specified by the ITSFE in the contract documents.
Unless otherwise specified by the ITSFE, the UPS shall be an American Power Conversion (APC) model unit.
When specified by the ITSFE, the CC shall provide, install and power-up the specified American Products Conversion (APC) UPS model unit, equipped with an APC Network Management and Environmental Card. The UPS will be jointly activated with the ITS Installation & Maintenance Team.
Unless otherwise specified, the UPS shall be mounted in the bottom of the designated 19”W equipment rack with an appropriate support shelf and bracket. The supply cord(s) shall be plugged into an electrical bus-way outlet.

3.15 POWER DISTRIBUTION UNIT (PDU)
The ITSFE will specify the PDU brand and model number to be installed. The CC shall provide, install and power-up two (2) one-circuit or one (1) 2-circuit 120V/20A PDU in each designated 19”W equipment rack. The PDU(s) shall be equipped with NEMA 5-20R straight blade outlets (accepts 5-15P or 5-20P). The supply cord(s) shall be equipped with a NEMA L5-20P twist-lock plug.
Unless otherwise specified, the PDU will be horizontally mounted at the mid-point of each designated 19”W equipment rack. The supply cord(s) shall be plugged into the designated electrical bus-way outlet(s).
4 INSTALLATION

4.1 PLACING

4.1.1 General

The CC shall provide the cable manufacturer's specification sheet, documenting the cable performance specifications, for all CC provided and placed cable. These results shall be in the original form provided by the manufacturer. A copy of the manufacturer's specification sheet, in paper copy or computer file disk, shall be included in the "as-built" and testing documentation.

It is the responsibility of the CC to verify the integrity of all fiber optic and hard-line coaxial cables prior to placement. Stanford recommends that the CC perform on-spool OTDR and/or TDR readings prior to placement.

Only approved cable pulling compounds are to be used, in accordance with industry standards. Spillage or excess pulling compound must be cleaned from building cable entrance sections and surrounding surfaces.

All cables within buildings and maintenance holes shall be supported to meet applicable NEC regulations, BICSI guidelines, and Industry standards.

CC shall ensure that all fiber and coaxial cables are not twisted, flexed, bent, or crushed during installation. Manufacturer's minimum bend radius and pulling tensions shall be observed for all pulls.

Unless otherwise specified or approved by the ITSFE in writing, all fiber optic cables will be installed without splices.

Fiber slack loops shall be coiled at termination and or splice locations as specified on the construction drawings. Unless otherwise specified, the minimum pre-termination length is 50’ ends at MH splice locations and 35’ at each fiber termination shelf enclosure location. MTR and TR cables shall be storage coiled on Leviton Fiber Storage Rings (Inside Plant = PN# 48900-IFR, Outside Plant = PN# 48900-OFR).

A usable 3/4” woven, 2,500 pound rated pull tape with footage markers (Example - Neptco Muletape -WP2500P) shall be concurrently installed with all cables (less than full size) that are placed in underground conduits, building entrance conduits, and riser conduits, to facilitate future cable over-rides. The 3/4” woven, 2,500 pound rated pull tape with footage markers (Example - Neptco Muletape -WP2500P) shall be new and free of splices, and installed in such a way as to not spiral around the cables.

The CC is responsible for maintaining barrier systems associated with communication construction activities during the construction interval (water intrusion prevention, fire wall rating maintenance). A temporary barrier system must be re-installed in applicable locations at the end of each workday.

4.1.2 Horizontal & Building Backbone

Horizontal cables (TSO cables) shall be placed in one end-to-end length between the TR and the TSO (no cable splices).

Cable slack shall be provided at both ends of horizontal cables (TSO cables). The amount of required cable slack depends on the size and layout of the connecting hardware in the TR and at the TSO. Cable slack shall be stored in an extended loop or in a figure-eight configuration to alleviate stress (not in bundled loops). Unless otherwise specified by the ITSFE, provide the following minimum amount of cable slack:

- In the TR = 10 feet (cable runway loop).
- In suspended ceiling above a wall TSO outlet: 3 feet
- In suspended ceiling below a poke-thru outlet: 3 feet
- In the TSO outlet:
  - UTP CAT 5e, Cat 6, CAT 6A: 8 inches
RG-6 coax: 8 inches
Fiber optic: 3 feet (install in fiber storage ring)

CABLE SLACK NOTE: Depending on the number of CAT 6A cables specified in an outlet box, there may be insufficient space in the outlet box for cable slack storage to maintain minimum cable bend radius requirements. If this condition occurs, cable slack shall be pulled back thru the conduit, to accessible ceiling space, to properly place the inserts in the faceplate (two-person operation).

Cable, and conduit runs shall follow walls. Diagonal runs across open ceiling spaces are not acceptable. Coordinate placement around ceiling fixtures, ducts, etc. to maximize access for following workers.

Unless otherwise specified, the CC shall be responsible for determining the route and quantity of J-hangers in overhead ceiling space where Stanford provided cable tray or cable support systems are not provided. Attaching or draping cables to ceiling wire grid, other pipes, light fixtures, etc. is not permitted.

J-hangers (or pre-approved equivalent, in writing) containing Category 5e and Category 6 cables shall be installed on a maximum 60" center-to-center span. Shorter spans may be specified to meet applicable standards based on cable size (OD"), total number of cables and total cable weight. The first and last J-hanger, in a J-hanger run, shall be a maximum 12" from the originating support point, e.g. cable tray or terminating support point e.g. conduit to wall outlet.

J-hangers (or pre-approved equivalent, in writing) Category 6A cables shall be installed on a maximum 48" center-to-center span. Shorter spans may be specified to meet applicable standards based on cable size (OD"), total number of cables and total cable weight. The first and last J-hanger, in a J-hanger run, shall be a maximum 12" from the originating support point, e.g. cable tray or terminating support point e.g. conduit to wall outlet.

When surface mounted raceway is required, the CC shall use a product comparable to Panduit LD10 type or larger. The surface mounted raceway shall be sticky back and shall be secured at each end and then every 2' in between with the appropriate fastener for the surface behind the raceway.

Floor mounted equipment racks and cabinets shall be securely mounted to the floor. Rack to Runway mounting plates shall be used to secure the top of the rack to the cable runway. The bottom plate of the rack shall be secured with four (4) Hilti brand HDI 5/8" sleeve anchors w/ 2 9/16" embed-flush mounted into existing concrete. Installed per ICBO ER-2895 and field test to 37 ft. lbs. torque.

Unless otherwise specified, Wireless Access Point TSO’s mounted above T-Bar ceiling shall be installed on a T-Bar Box Hanger (Erico 512A). The TSO number shall be labeled on the exposed side of the T-Bar ceiling support rail (visible from floor).

Unless otherwise specified, a 25’ slack coil of cable(s) shall be placed at each Wireless Access Point TSO located above T-Bar ceilings or in cable trays.

Access control cables (Belden five-cable bundle) shall be installed from the Access Control Panel area in the designated MTR/TR to a Security Junction Box located at each specified door. Unless otherwise specified by the ITSFE, the Contractor shall provide a minimum 20’ length of coiled cable bundle at each end for termination by others. The bundled cable shall be labeled with the assigned TSO number at each cable coil end location.

4.1.3 Campus Backbone (Underground & Building Entrance Plant).

Underground cable shall be placed in assigned ducts.

The CC shall ensure that vacant ducts, assigned for cable placements, are clear and clean by pulling a duct brush completely through the duct in both directions until the duct is clean.
Prior to placing larger size copper cables in vacant conduit (2.5” diameter or greater cable in 3.5” conduit, 3.0” diameter or greater cable in 4” conduit) the CC shall prove the conduit by pulling an equivalent sized cable slug through the conduit, i.e. 10’ section of 1800-24F, 3000-26F, 3600-26F thru 4” conduit.

Cable in MH’s, splice boxes and applicable pull boxes shall be racked and securely supported on assigned walls using appropriate hardware provided by the CC. Cables shall be pushed into MH/SB corners as appropriate for the type and size cable (no diagonal placements). Cables shall not block future cable placements, access to existing splice or equipment cases, or personnel entry.

Both ends of all building entrance conduits shall be sealed to prevent water intrusion, immediately after cable placement, and at the end of each day, with Quick Plug or other approved Stanford equivalent.

- Plug all ducts exiting maintenance holes or pull boxes into buildings.
- Plug all ducts entering buildings from the outside plant system.

4.2 SPLICING

4.2.1 General

The CCPM shall obtain a current cable report (copper, fiber) from the ITSFE prior to the scheduled opening of any working cable plant by the CC’s splicing technician.

The CC’s splicing technician shall, on a shift basis, notify ITOC (IT Operations Center 650-723-1611) prior to opening or creating splice points in working fiber or copper cable plant. The CC’s splicing technician shall notify ITOC when the splice is temporarily closed, at the end of a work shift, or is final complete. At the call-in notification, the splicing technician shall provide ITOC with a job site working Cellular Phone Number for field contact. The CC shall maintain a log of all opening/closing notification calls to ITOC and all trouble calls from the SCC.

The CC splicing technician shall conduct a verification and pretest of cable counts or fibers involved in a rearrangement splicing operation (transfers, section throws, etc.). All record discrepancies shall be resolved with the Order Management Group with assistance from the ITSFE.

- Copper Cable:
  - Pre-test: Verify that jumpers, at the originating location, are in fact in place to the pairs as shown on the cable report. The pretest is a DC metallic test, i.e. shorts, grounds, crosses, opens, splits, and punchbacks, on non-working lines.
  - Post-test: Following completion of rearrangement splicing of copper, a post test shall be performed of all vacant pairs involved in the work. The post-test is the same as those performed for the pre-test.

- Fiber Cable:
  - Verify that patch cords, at the originating location, are in fact in place to the fibers as shown on the cable report. The pretest is an OTDR and power meter test of non-working fibers.
  - Post-test: Following completion of rearrangement splicing of fiber, a post test shall be performed of all vacant fibers involved in the work. The post-test is the same as those performed for the pre-test.

4.2.2 Copper Cable Splicing:

Copper cables, five (5) pair or larger, shall be spliced using the Modular Splicing System. Two modular splice types shall be used as specified on the construction drawings. The two splice types are as follows (see Division 17150.002, current issue):

- Straight
- Facility (future cable rearrangement point)

Copper cable pairs that are theoretical (unassigned) shall be clear cap terminated in 710 modules in the splice enclosure.
Copper splices shall be bonded with an approved braid or bar across the splice opening to maintain sheath bond integrity. Splice cases to be bonded to MH/SB bonding / grounding ribbon system.

In new joined sections of copper cable, all pairs joined shall be 100% good and usable (end to end).

Copper transfer or section throw splicing shall be performed using an approved Cable Transfer Switch.

Copper building backbone cable sheaths shall be grounded, with ground braid wire, to the Telecommunications Main Grounding Busbar (TMGB) or Telecommunications Grounding Busbar (TGB) in each MTR and TR.

Copper underground splice cases shall be bonded to the grounding ribbon in maintenance holes with a # 6 AWG ground wire.

Copper underground splice cases shall be properly racked, supported and secured in the appropriate splice bay location in MH’s and splice boxes. The CC is responsible for providing and placing all required cable hooks.

Copper underground cable splices shall be “sealing’ tested to ensure that the splice is waterproof. The sealing test shall be performed in conformance with the splice closure manufacturer’s specifications, i.e. apply pressure, soap and check for leaks, release pressure.

4.2.3 Fiber Splicing:

Fiber splices shall be fusion unless otherwise specified. Each fusion fiber splice shall not exceed 0.15 dB loss.

Fiber underground splices will be performed in a clean and temperature controlled environment. Fusion splicing shall not be performed inside MH’s or splice boxes. Fiber splicing shall be performed in an environment that is clean and temperature controlled e.g. fiber splicing trailer, fiber splicing van, or fiber splicing tent.

Fiber splices in MH’s and splice boxes shall racked, coiled and secured in a manner that allows for the splice case to be periodically brought out of the MH into a fiber trailer, van or tent for splice access. A minimum of 50’ feet of terminated cable should be in the fiber cable(s) slack coils in MH’s.

Fiber underground cable splices shall be pressure tested to ensure that the splice is waterproof. The pressure test shall be performed in conformance with the splice closure manufacturer’s specifications, i.e. apply pressure, soap and check for leaks, release pressure.

4.3 TERMINATING

4.3.1 General

CC shall individually and properly ground all equipment racks, cable runways, frames, and other supporting structure in compliance with the NEC requirements.

Grounding shall conform to ANSI J-STD-607-A and NEC articles 250 and 800. (Reference this specification Paragraph III.E for regulatory specifications) NEC Article 800-40 requires a minimum #6 AWG to a maximum 3/0 AWG depending on the length of the ground wire run.

4.3.2 Horizontal Cables (Distribution)

Copper cables:

- Voice/data TSO’s shall be wired to the 568B Wiring Standard unless otherwise specified:
  - As specified by the ITSFE, Leviton Category 5e, Leviton Category 6 and Leviton 6A or Systimax Category 6 and 6A patch panels shall be used at TR locations for terminating the horizontal cables to TSO’s.
  - As specified by the ITSFE, Leviton Category 5e, Leviton Category 6and 6A or Systimax Category 6 and 6A modular connectors shall be used to terminate the horizontal cables at the TSO as follows: the ‘A’ and ‘B’
voice cables shall be terminated on white modular inserts, the ‘M’ and ‘N’
data cables shall be terminated on blue modular inserts for CAT5e;
green for CAT6 and purple for CAT6A (Stanford Campus and Medical
School and Medical) where Universal plant is not deployed. All Stanford
Medical Center and Buildings shall be terminated with blue connectors.
The terminating sequence is A/B 48-port voice patch panel and M/N from
the 48-port data patch panel.

- Universal TSO’s shall be wired to the 568B Wiring Standard.
  - As specified by the ITSFE, Category specific RJ-45 modular patch
    panels shall be used at TR locations for terminating the horizontal cables
to TSO’s. The terminating sequence is ‘A’, ‘B’, ‘C’, ‘D’, etc. for horizontal
cable(s) from a TSO.
  - As specified by the ITSFE, Category specific RJ-45 modular connectors
    shall be used to terminate the horizontal cables at the TSO. The
    terminating sequence is ‘A’, ‘B’, ‘C’, ‘D’, etc. for horizontal cable(s) at the
    TSO.
- Copper and coaxial cable slack, stored in TSO outlets, shall not exceed 12”.

Fiber cables:
- Cable slack stored in TSO outlets shall be a minimum 36” unless otherwise
  specified. A Leviton Fiber Storage/Spacer Ring (41290-DRW) shall be used with
  all dual-gang 4”x4” outlets. Fiber storage for poke-thru TSO’s (i.e. RC4A Type
  Wiremold floor mount type) shall be coiled in the ceiling space below the poke-
thru. Fiber storage for other floor- mounted outlets shall be coiled at the feed end
  of the entrance conduit to the outlet box.
- Unless otherwise specified, LC connectors shall be used to terminate fibers in
  existing TR closet connector housings and the corresponding TSO.
- Unless otherwise specified, LC connectors shall be used to terminate fibers in
  new TR closet connector housings and the corresponding TSO.
- Fiber pair polarity reversals (F1: transmit-receive, F2: receive-transmit) shall be
  administered at the TSO.

4.3.3 Building Backbone Cables (Riser Cables)

Copper Cables:
- Unless otherwise specified, copper cables shall be wall-mount terminated on 110
  wiring blocks in the MTR and rack-mounted terminated on 110 wiring blocks in
  the TR.

Fiber cables:
- TR closet connector housings shall be fully equipped for a complete installation
  including all panels filled with connector panels as specified. Dust caps shall be
  installed on all connectors. Unused slots shall be filled with blank panels.
- Hybrid fiber cables shall be direct terminated in fiber termination shelf enclosures
  as follows:
  - Terminate multi-mode fibers first (left side)
  - Terminate single-mode fiber second (right of multi-mode.).
- Multiple hybrid cables within the same closet connector housing shall be
  terminated as follows: cable 1 multi-mode, cable 1 single-mode, cable 2 multi-
  mode, cable 2 single-mode, etc.
- Unless otherwise specified, in existing closet connector housings, fiber cables
  shall be direct terminated using SC connectors.
- Unless otherwise specified, in new closet connector housings, fiber cables shall
  be direct terminated using LC connectors.

4.3.4 Campus Backbone Cables (Underground & Building Entrance Plant)
Closet connector housings shall be fully equipped for a complete installation including all panels filled with connector panels as specified. Dust caps shall be installed on all connectors. Unused slots shall be filled with blank panels.

Hybrid fiber cables shall be direct terminated in fiber termination shelf enclosures as follows:
- Terminate multi-mode fibers first (left side)
- Terminate single-mode fiber second (right of multi-mode).

Multiple hybrid cables within the same closet connector housing shall be terminated as follows: cable 1 multi-mode, cable 1 single-mode, cable 2 multi-mode, cable 2 single-mode, etc.

Unless otherwise specified, in existing closet connector housings, fiber cables shall be direct terminated anaerobic LC connectors.

Unless otherwise specified, in new closet connector housings, fiber cables shall be direct terminated using LC connectors.

4.4 COPPER CABLE TESTING

4.4.1 General

The CC may be required to field demonstrate the calibration and testing procedures with the ITSFE. The CC shall confirm the demonstration requirement before the start of field test operations.

All cable pairs in new cable sections shall be 100% good plant. All pairs shall be usable. Unless pre-approved by the ITSFE, all copper certification testing shall be performed using test equipment manufactured by Fluke Networks. Test results shall be provided using Fluke Networks’ Linkware Management Software.

Test Equipment shall be equipped with the most current software upgrades to meet applicable testing standards. Calibration of the testing instruments must be current per the manufacturer’s specifications. Test cords, adapters and connectors shall be maintained in good order. Test instruments must be identified on the applicable summary test forms as to make, model, software generic, and calibration date.

All tests shall be performed by trained technicians which have successfully attended an appropriate training program, and have obtained a certificate as proof thereof. These certificates may have been issued by any of the following:
- Manufacturer of the test equipment used for the field certification.
- Training organizations (e.g., BICSI, A Telecommunications Association headquarters in Tampa, Florida; ACP [Association of Cabling Professionals™] Cabling Business Institute located in Dallas, Texas.

4.4.2 Horizontal Cable (Distribution Cables)

Balanced Twisted-Pair Cable Tests shall be auto-test performed on each 4-pair cable, from the TR termination to the TSO, per the following test specifications (Category 5e = ANSI/EIA/TIA 568-B.1 and B.2, Category 6 = ANSI/TIA/EIA 568B2-1, Category 6A = ANSI/TIA-568B.2-10):
- Wire map (continuity)
- Length
- Insertion loss
- NEXT loss
- ELFEXT
- Propagation delay and delay skew
- Return loss
- Power sum near-end crosstalk (PSNEXT) loss
- Power sum equal level far-end crosstalk (PSELFEXT)
- Alien cross-talk (Compliance with ANSI/TIA-568-B.2-10 Augmented Category 6A Standard)
Non-compliant Horizontal cables shall be repaired or replaced and the circuit re-tested. The CC shall perform a certification test for each UTP cable. The CC shall submit a summary report of the Cable Certification Report test results to the ITSFE electronically. The CC shall also provide a electronic copies of the individual Cable Certification Report test results from the test device (Fluke Networks Linkware Management Software).

4.4.3 Access Control Door Cables
Access control door cables shall be Wire Map tested. The CAT 6 cable shall be temporarily RJ-45 jack terminated on both ends and testing performed as outlined in ANSI/EIA/TIA 568-B.1 and B.2 (Category 6).

4.4.4 Building Backbone Cables (Riser Cables)
New cable pairs shall be end-to-end tested as follows:
- DC loop resistance
- Wire map
- Continuity to remote end
- Shorts between two or more conductors
- Crossed pairs
- Reversed pairs
- Split pairs
The CC shall submit test results and loop resistance measurements, in a summary report, to the ITSFE on a computer file disk (See attached Copper Test Form 2).

4.4.5 Campus Backbone Cables (Underground Cables & Building Entrance Cables)
Cable pairs shall be end-to-end tested as outlined ANSI/EIA/TIA 758 as follows:
- DC loop resistance
- Wire map
- Continuity to remote end
- Shorts between two or more conductors
- Crossed pairs
- Reversed pairs
- Split pairs
An end-to-end TDR length and loop resistance measurement shall be performed on one (1) pair in each end-to-end cable with the same overall make-up and the same originating and terminating location. The ITSFE shall provide a cable make up diagram for the counts to be tested.

The CC shall submit a summary report of the non-auto and auto-test results to the ITSFE electronically (See attached Copper Test Form 2).

In advance of a scheduled splicing operation to rearrange or energize existing cable (pairs joined, severed, transferred, etc.), the CC shall perform a verification and pretest of all applicable cable pairs (old way, new way). All record discrepancies shall be resolved with the ITSFE and the Order Management Group.

Following completion of rearrangement splicing involving existing cable, a post-test shall be performed of those vacant pairs involved in the work. The post-test is the same as that performed for the pre-test.

4.5 COAXIAL CABLE TESTING
4.5.1 General
The CC may be required to field demonstrate the testing and test-set calibration procedures with the ITSFE. The CC shall confirm the demonstration requirement before the start of field test operations.

All new hard-line and semi-rigid coaxial cable shall be 100% good plant. Field test instruments shall be equipped with the most current software upgrades to meet standards limits. Calibration of the testing instruments must be current per the
manufacturer’s specifications. Test cords, adapters and connectors shall be maintained in good order. Test instruments must be identified as to brand, software generic, and calibration date on the applicable summary test forms.

Testing shall be performed to warrant that each link meets a defined specification. The CC shall submit a summary report of the non-auto and auto-test results to the ITSFE electronically (See attached Coaxial Test Form 1 and Form 2). The CC shall retain the original test measurements from the test device.

### 4.5.2 Horizontal Cables (Distribution Cables)

All Horizontal semi-rigid coaxial cable (RG6, RG11) shall be tested using a 75-ohm terminator and an ohmmeter. To perform the test the CC shall first test the coax cable using the ohmmeter to confirm that there are no shorts on the cable being tested. The CC shall then place the 75ohm terminator at the TSO location and retest with the ohmmeter at the TR location.

The CC shall submit a summary report of the non-auto and auto-test results to the ITSFE electronically (See attached Coaxial Test Form 1).

### 4.5.3 Building Backbone Cables (Riser Cables)

All Building Backbone (riser), hard-line coaxial cable shall be Structural Return Lost (SRL) tested after placement, unless otherwise specified. Any cable with an SRL of -29.0 dB or less shall be considered good. Any cable with an SRL greater than -28.9 shall be replaced.

The CC shall submit a summary report of the non-auto and auto-test results to the ITSFE electronically (See attached Coaxial Test Form 2).

### 4.5.4 Campus Backbone Cables (Underground Cable & Building Entrance Cable)

Underground and building entrance hard-line coaxial cable shall be tested after placement.

All campus backbone, hard-line coaxial cable shall be Structural Return Lost (SRL) tested after placement, unless otherwise specified. Any cable with an SRL of -29.0 dB or less shall be considered good. Any cable with an SRL greater than -28.9 shall be replaced.

The CC shall submit a summary report of the non-auto and auto-test results to the ITSFE electronically (See attached Coaxial Test Form 2).

### 4.6 Fiber Cable Testing

#### 4.6.1 General

The CC may be required to field demonstrate the testing and test-set calibration procedures with the ITSFE. The CC shall confirm the demonstration requirement before the start of field test operations.

All new fiber cable sections shall be 100% good plant. All fibers shall be usable.

Unless pre-approved by the ITSFE, all fiber certification testing shall be performed using Corning cable Systems Optical Sources, Meters, Testers and Kits with Data Storage Capabilities. Test results shall be provided using Corning Cable Systems, OTS-View reporting software for creating comprehensive certification reports.

Calibration of the testing instruments must be current per the manufacturer’s specifications. Test cords, adapters and connectors shall be maintained in good order. Test instruments must be identified on the applicable summary test forms as to make, model, software generic, and calibration date.

Tests shall be performed by trained technicians which have successfully completed an appropriate training program, which includes testing with an Optical Loss Test Set (OLTS) and an Optical Time Domain Reflectometer (OTDR), and have obtained a certificate as proof thereof. These certificates may have been issued by any of the following:

- Manufacturer of the test equipment used for the field certification.
Training organizations (e.g., BICSI, A Telecommunications Association headquarters in Tampa, Florida; ACP [Association of Cabling Professionals™] Cabling Business Institute located in Dallas, Texas).

The CC shall perform a Tier 1 fiber certification test for each fiber (attenuation, length, polarity).

The CC shall perform a Tier 2 certifying OTDR test of each fiber, for certain fiber types as specified below.

Multimode backbone links are to be tested at 850 nm and 1300 nm in accordance with ANSI/TIA/EIA-526-14-A, Method B.

Single-mode backbone links are to be tested at 1310 nm and 1550 nm in accordance with ANSI/TIA/EIA-526-7, Method A.1.

Fiber connector and splicing losses shall not exceed the following:

- Connector losses shall not exceed .50 dB per mated pair.
- Connector loss combined with a pigtail fusion splice shall not exceed .90 dB loss per mated pair.
- Each fusion fiber splice shall not exceed 0.15 dB loss.

In advance of a scheduled splicing operation, to rearrange or energize existing Campus Backbone fiber cable (fibers joined, severed, transferred, etc.), the CC shall perform a verification and pretest of all applicable fibers (old way, new way). All record discrepancies shall be resolved with the ITSFE and the Order Management Group.

- The CC shall submit a summary report of the test results to the ITSFE electronically (Fiber Test Form 4). The CC shall also provide an electronic copy of the individual Tier 1 and Tier 2 fiber certification test results from the test device (Corning Cable Systems, OTS-View reporting software).

Following completion of rearrangement splicing involving Campus Backbone fiber cable existing fibers, a post-test shall be performed of those vacant fibers involved in the work. The post-test is the same as those performed for the pre-test.

- The CC shall submit a summary report of the test results to the ITSFE electronically (Fiber Test Form 4). The CC shall also provide an electronic copy of the individual Tier 1 and Tier 2 fiber certification test results from the test device (Corning Cable Systems OTS 600 Series, OTS-View reporting software).

4.6.2 Horizontal Cables (Distribution Cables)

Multi-mode:

- The CC shall perform Tier 1 bi-directional attenuation testing of every fiber at the 850 nm and 1300 nm wavelengths.
- The maximum allowable attenuation for a multimode link is based on the loss of two mated connector pairs (one pair at the telecommunications outlet/connector and one pair at the TR) plus 90 meters (295 feet) of optical fiber cable at the worst-case attenuation coefficient (dB/km).
62.5/125 µm:

- **850 nm**: 2 connector pairs @ .75 dB each = 1.5 dB + 90 meters worst-case cable attenuation @ .315 dB = 1.82 dB Total Loss @ 850 nm.
- **1300 nm**: 2 connector pairs @ .75 dB each = 1.5 dB + 90 meters worst-case cable attenuation @ .09 dB = 1.59 dB Total Loss @ 1300 nm.

50/125 um:

- **850 nm**: 2 connector pairs @ .75 dB each = 1.5 dB + 90 meters worst-case cable attenuation @ .27 dB = 1.77 dB Total Loss @ 850 nm.
- **1300 nm**: 2 connector pairs @ .75 dB each = 1.5 dB + 90 meters worst-case cable attenuation @ .14 dB = 1.64 dB Total Loss @ 1300 nm.

Single-Mode (tight buffer):

- The CC shall perform Tier 1 bi-directional attenuation testing of every fiber at the 1310 nm and 1550 nm wavelengths.
- The maximum allowable attenuation for a single-mode link is based on the loss of two mated connector pairs (one pair at the telecommunications outlet/connector and one pair at the TR) plus 90 m (295 ft.) of optical fiber cable.
  - **1310 nm**: 2 connector pairs @ .75 dB each = 1.5 dB + 90 meters worst-case cable attenuation @ .09 dB = 1.59 dB Total Loss @ 1310 nm.
  - **1550 nm**: 2 connector pairs @ .75 dB each = 1.5 dB + 90 meters worst-case cable attenuation @ .0675 dB = 1.57 dB Total Loss @ 1550 nm.

The CC shall submit a summary report of the Tier 1 fiber certification test results to the ITSFE electronically (Fiber Test Form 1). The CC shall also provide an electronic copy of the individual Fiber Certification Report test results from the fiber certification test device (Corning Cable Systems, OTS-View reporting software).

Tier 2 certification OTDR testing of horizontal fiber cable is not required unless end-to-end attenuation readings are high.

### 4.6.3 Centralized Cable (Centralized Fiber To The Desk)

**Multi-mode**:

- The CC shall perform Tier 1 bi-directional attenuation testing on every fiber at the 850 nm and 1300 nm wavelengths.
- The maximum allowable attenuation for a single-mode link is based on use an intermediate fusion splice or interconnect patch panels as follows:

  - **Intermediate fusion splice**:
    - **850 nm**: 2 connector pairs @ .75 dB each = 1.5 dB + 300 meters worst-case cable attenuation @ .90 dB + fusion splice @ .15 dB = 2.55 dB Total Loss @ 850 nm.
    - **1300 nm**: 2 connector pairs @ .75 dB each = 1.5 dB + 300 meters worst-case cable attenuation @ .45 dB + fusion splice @ .15 = 2.10 dB Total Loss @ 1300 nm.

  - **Intermediate patch panel**:
    - **850 nm**: 4 connector pairs @ .75 dB each = 3.0 dB + 300 meters worst-case cable attenuation @ .90 dB = 3.9 dB Total Loss @ 850 nm.
1300 nm: 4 connector pairs @ .75 dB each = 3.0 dB + 300 meters worst-case cable attenuation @ .45 dB = 3.45 dB Total Loss @ 1300 nm.

The CC shall submit a summary report of the Tier 1 fiber certification test results to the ITSFE electronically (Fiber Test Form 2). The CC shall also provide an electronic copy of the individual Fiber Certification Report test results from the fiber certification test device (Corning Cable Systems Series, OTS-View reporting software).

Tier 2 certification OTDR testing of horizontal fiber cable is not required unless end-to-end attenuation readings are high.

4.6.4 Building Backbone Cables (Riser Cables)
The CC shall perform Tier 1 bi-directional attenuation testing on every fiber at both wavelengths.

- Multi-mode: 850 and 1300 nm.
- Single-mode: 1310 and 1550 nm.

An attenuation equation shall be used to determine acceptance values based on standard component requirements at each applicable wavelength. Link attenuation is calculated as:

\[
\text{Link attenuation} = \text{Cable attenuation} \cdot \text{Cable attenuation (dB)} = \text{Attenuation coefficient (dB/km)} \times \text{length (km)} + \text{connector attenuation} + \text{splice attenuation}
\]

Unless otherwise specified, the CC shall perform Tier 2 bi-directional OTDR testing at both wavelengths, on every fiber, in building backbone fiber cables more than 300 feet in length.

- Multi-mode: 850 and 1300 nm.
- Single-mode: 1310 and 1550 nm.

After Tier 1 bi-directional attenuation and Tier 2 OTDR testing is completed, the CC shall review the test data to ensure that each fiber’s end-to-end attenuation loss does not exceed the maximum attenuation allowance value, as determined by the following formula:

1. Multiply the cable length by the normalized cable attenuation (dB/km).
2. Add the attenuation allowance (dB) for each connector pair in the path.
3. Add the attenuation allowance (dB) for each splice along the cable route.
4. Identify those fibers that exceed the maximum attenuation loss allowance value for follow-up corrective action.

The CC shall correct all fibers exceeding the end-to-end insertion loss allowance limits.

The CC shall submit a summary report of the Tier 1 fiber certification test results to the ITSFE electronically (Fiber Test Form 3). The CC shall also provide an electronic copy of the individual Fiber Certification Report test results from the fiber certification test device (Corning Cable Systems OTS 600 Series, OTS-View reporting software).

The CC shall perform a Tier 2 certifying OTDR test of each fiber cable more than 300 feet in length. The CC shall submit a summary report of the Tier 2 OTDR fiber certification test results to the ITSFE electronically (Fiber Test Form 3). The CC shall also provide an electronic copy of the individual Fiber Certification Report test results from the fiber certification test device (Corning Cable Systems, OTS-View reporting software).

4.6.5 Campus Backbone Cables (Underground Cables & Building Entrance Cables)
The CC shall perform Tier 1 bi-directional attenuation testing on every fiber at both wavelengths.

- Multi-mode: 850 and 1300 nm.
- Single-mode: 1310 and 1550 nm.

The CC shall perform Tier 2 bi-directional OTDR testing on every fiber at both wavelengths.
- Multi-mode: 850 and 1300 nm.
- Single-mode: 1310 and 1550 nm.

An attenuation equation shall be used to determine acceptance values based on standard component requirements at each applicable wavelength. Link attenuation is calculated as:

\[
\text{Link attenuation} = \text{Cable attenuation} \{\text{Cable attenuation (dB) = Attenuation coefficient (dB/km) x length (km)}\} + \text{connector attenuation + splice attenuation}
\]

After Tier 1 bi-directional attenuation and Tier 2 OTDR testing is completed, the CC shall review the test data to ensure that each fiber's end-to-end attenuation loss does not exceed the maximum attenuation allowance value, as determined by the following formula:

1. Multiply the cable length by the normalized cable attenuation (dB/km).
2. Add the attenuation allowance (dB) for each connector pair in the path.
3. Add the attenuation allowance (dB) for each splice along the cable route.
4. Identify those fibers that exceed the maximum attenuation loss allowance value for follow-up corrective action.

The CC shall correct all fibers exceeding the end-to-end insertion loss allowance limits. The CC shall submit a summary report of the test results to the ITSFE electronically (Fiber Test Form 4). The CC shall also provide an electronic copy of the individual Fiber Certification Report test results from the fiber certification test device (Corning Cable Systems, OTS-View reporting software).

4.7 LABELING: CABLE, TERMINATING EQUIPMENT, TR'S & TSO'S

4.7.1 General

The CC shall provide and install labeling for all cable, terminating equipment, Telecommunications Rooms (TR's), and TSO's.

All labels shall be machine generated (Note: Hand-written labels or cable tags are not acceptable).

The CC shall affix a permanent label on both sides of all fire-stops. The CC shall also provide digital images of both sides of each penetration, with location indicated on the tag. The label shall be red with black numbering. The label shall contain the following additional information:

- Cabling Contractor name, address, and contact phone numbers
- Installers name
- Installed date
- UL listing number (fire stop product)
- F rating

**WARNING FIRE-STOP SEAL - DO NOT DISTURB**

CABLING CONTRACTOR NAME: __________________________________________
CABLING CONTRACTOR ADDRESS: _______________________________________
CABLING CONTRACTOR PHONE NO: _______________________________________
INSTALLER'S NAME: ____________________________________________________
INSTALLED DATE: _____________________________________________________
UL LISTING NUMBER (FIRE STOP PRODUCT): _______________________________
F RATING: ___________________
The CC shall affix a Telecommunications Ground Warning Tag on both ends of each grounding and bonding cable. An acceptable tag is Panduit Part No. PT-BGND.

**TELECOMMUNICATIONS GROUND WARNING TAG**
(PANDUIT P/N PT-BGND)

4.7.2 **Horizontal Cables (Distribution Cables & TSO's)**

The CC shall label all cabling at the TR and the TSO as indicated on the TSO bible sheets (CC provide labels). Final TSO and block labeling methods are to be approved by Stanford before labeling is done on outlets and blocks. Machine generated label samples shall be submitted to ITSFE before installation.

All TSO's shall be identified at the TR using typed designation strips on the termination blocks or ports. The CC shall review the correct color-coding for labels with the ITSFE before installation.

The CC shall label each TSO in a way that identifies the serving TR terminal number, TSO number and cable port designation. The label shall be applied to both the front and top of the faceplate. A TSO shall be identified follows:

A TSO wired with universal port(s), fiber port and CATV ports shall be identified as follows:

- Category 6/6A 4-pair = A, B, C, etc.
- Fiber (OS2/OM1/OM3/OM4) duplex fiber = F1, F2, etc.
- RG-6 coaxial = V1, V2, etc.

At both the TR and TSO locations RG6 and RG11 coax cables will be identified by the TSO number marked on a Panduit Marker Tie (part # PLM1M-M 3-7/8"). Note: the marker ties must be firmly secured a minimum of 2'-3" from the connector.
Wireless TSO’s installed above T-Bar Ceilings shall have the TSO Number labeled on the underside of the T-Bar grid rails to be visible from below. Use clear tape with contrasting lettering.

4.7.3 Building Backbone Cables (Riser Cables)

Riser cables shall be identified on both ends, at splice locations, and all other visible locations such as MTR’s (MDF’s) and TR’s (IDF’s) with a Thermal Transfer Marker Plate, i.e., Panduit M300X100Y6T or Brady PTL-12-109-YL (Note: Hand written labels or cable tags are not acceptable).

Fiber closet connector housings shall be properly and clearly labeled on the front cover plate. In addition, the documentation labels provided with the connector housing shall be fully completed. The following are examples of typical labeling.
TYPICAL CORNING PCH-01U & PCH-04U HOUSING LAYOUTS

PCH-04U – MTR U0.2

PCH-01U – TR U0.3
CONN 1-36 = NFI04070, 1-36, (12-50M/24S)
4.7.4 Campus Backbone Cables (Underground Cables & Building Entrance Cables)
Underground and building entrance cables shall be identified on both ends, at splice locations, and in all other visible locations such as maintenance holes, pull boxes, MTR’s and TR’s with a Thermal Transfer Marker Plate, i.e., Panduit M300X100Y6T or Brady PTL-12-109-YL (Note: Hand written labels or cable tags are not acceptable).

**COPPER CAMPUS BACKBONE / BUILDING ENTRANCE CABLE**
THIS LABEL MUST BE ON BOTH ENDS OF THE CABLE, SPLICES, AND ALL VISABLE PASS THRU LOCATIONS (CLOSETS, MH’S)

```
Q011, 1-1200
1200-24F
```

- # of Pairs: 1200
- Gauge: 24
- Filled
- Cable ID: Q011
- Pair ID: 1-1200

**FIBER CAMPUS BACKBONE / BUILDING ENTRANCE CABLE**
THIS LABEL MUST BE ON BOTH ENDS OF THE CABLE, SPLICES, AND ALL VISABLE PASS THRU LOCATIONS (CLOSETS, MH’S)

```
NFO04510/07340, 1-144
144F (24F 62.5MM, 120F SM)
```

- # of Fibers: 144
- Mode Type: (24F 62.5MM, 120F SM)
- Fiber ID: NFO04510/07340, 1-144
- From/To: Quad & Bldg

110-Type wiring blocks shall be labeled as follows:
'GREEN LABEL':
INCOMING

110 FEEDER & ENTRANCE LABELING
(LEFT SIDE OF LEVITON 41DRP-100)

Q011, 1-25 + 51-75

110 BACKBONE LABELING

Q011-01, 1-25 + 51-75

'BLUE LABEL':
OUTGOING

Entrance & Backbone cables shall be terminated using C-5 connectors.
4.8 BARRIER SYSTEMS

4.8.1 Fire Stopping

All conduits, sleeves, and penetrations of fire-rated walls, into which communication cables are pulled, or reserved for communications cables, shall be sealed with an approved fire-retardant method and material in accordance with the “Underwriters Laboratories Inc.” “Fire Resistance Directory”.

The CC shall install the E-Z Path by STI (sleeves) for wall and floor penetrations, up to 8” thick. The ITSFE shall specify the size, quantity and location(s) of E-Z Path pathways at engineered penetration points. The CC may identify subsequent E-Z Path penetration points for horizontal cabling but must obtain pre-approval from the ITSFE as to location and size, prior to installation.

For wall and floor penetrations thicker than 8”, the use of metallic conduit shall be approved. Metallic conduit sleeves shall be 4” minimum. The ITSFE shall pre-approve the size, quantity and location(s) of the pathways.

For cable tray penetrations of rated walls, intumescent fire-stop pillows shall be installed (E-Z Path Series SSB Firestop Pillows or equivalent).

The CC shall affix a permanent label on both sides of all fire-stops. The label shall be red with black numbering. The label shall contain the following additional information:

- Cabling Contractor name, address, and contact phone numbers
- Installers name
- Installed date
- UL listing number (fire stop product)
- F rating

The location of all fire-stops shall be noted on the “as built” drawings. The ITS CAD Team will subsequently transcribe these locations onto an OSHPD layer of TSO Bible Sheet Drawings (Stanford Hospital and School Of Medicine Buildings (See Par. 5.2). A digital photo is required for each fire-stop (See Par. 5.4).

4.8.2 Water Intrusion:

Both ends of all building entrance conduits shall be sealed to prevent water intrusion, immediately after cable placement, with Quick Plug or other ITSFE approved equivalent. Vacant ducts shall be sealed with an approved watertight compression type duct plug device.
5  DOCUMENTATION (REQUIRED FOR FINAL INVOICE PAYMENT)

5.1 GENERAL

All hard copy documentation shall be submitted to the ITSFE in a three-ring binder (labeled and tabbed as appropriate).

Digital photos and test result CD’s, or USB mass-storage devices, shall be placed in the three-ring binder in a protective sleeve.

Unless otherwise specified, all documentation shall be delivered to the ITSFE with 10 workdays of the final Project Work completion.

The CC’s final invoice will not be approved for payment until all documentation is received.

5.2 AS BUILT DRAWINGS:

The CC shall provide “As Built” drawings to the ITSFE for all work changes that impact plant records or asset management requirements.

- On phased projects, periodic “As Builts” may be requested by the ITSFE as phases are completed. The phased “As Builts” shall be delivered to the ITSFE within 5 workdays of phased Work completions.
- Final “As-Built” drawings shall be delivered to the ITSFE with 10 workdays of the final Project Work completion.

The location of all fire-stops shall be noted on the “as built” drawings. The ITS CAD Team will subsequently transcribe these locations onto an OSHPD layer of TSO Bible Sheet Drawings (Stanford Hospital and School Of Medicine Buildings).

5.3 MANUFACTURERS SPECIFICATIONS (CC PROVIDED CABLE OR OTHER SPECIAL MATERIALS):

The CC shall provide the manufacturer’s specification sheets (cut sheets), documenting the performance specifications, for all CC provided and placed cable or other special materials. It is highly recommended that the CC review all specification sheets with the ITSFE, prior to placement, to ensure that the specifications are correct.

A copy of the entire manufacturer’s specification sheets, paper copy or computer file disk (CD), shall be included in the final “as-built” and testing documentation binder.

5.4 FIRE-STOPS – DIGITAL PHOTOS:

The CC shall provide a digital photograph of both sides of all fire-stops, including the “legible” fire stop label, after installation is complete.

The digital photograph shall identify the location of the fire-stop e.g. Quad & Building Number, floor, and room number (per the Bible Sheet drawing location).

The digital Fire-Stop photographs shall be provided to the ITSFE electronically in MPEG format.

5.5 TEST RESULTS DOCUMENTATION:

5.5.1 General:

The CC shall provide the ITSFE with all test results documentation as described in sections 4.4, 4.5, and 4.6 of this document.

The CC shall submit a summary report of the non-auto and auto-test results to the ITSFE electronically (See attached Copper Test Form 1 & Form 2, Coaxial Test Form 1 & Form 2, and Fiber Test Form 1, Form 2, Form 3 & Form 4). The CC shall also provide an electronic copy of tests results from the certification test device (Copper cables = Fluke Networks Linkware Management Software. Fiber cables = Corning Cable Systems, OTS-View reporting software).
Paper copy test forms and computer file disks test results (CD’s) shall be submitted in the same three-ring binder (CD or USB mass-storage device placed in an appropriate protective page sleeve).

The CC shall provide test results to the ITSFE as follows:

- **Campus & Building Backbone Cable**: Summary test result forms (CD) shall be delivered to the ITSFE within 5 workdays of cable placement. These summary test results are required to activate the cables for assignment in the records database.

- **Horizontal Cables**: On phased projects, periodic “summary test results” may be requested as phases are completed e.g. a floor, a TR, etc. Summary test result forms shall be delivered to the ITSFE within 5 workdays of phase work completions. Phased test results are required to activate service order requests.

Final auto-test results shall be delivered to the ITSFE with 10 workdays of the final Work completion.

### 5.5.2 Copper Cable Facilities:

- **Horizontal**: Use attached Windows Excel document form “Copper Test Form 1”.
- **Cable Certification Report**. Provide computer file copy of individual test results from the test device (Fluke Networks Linkware Management Software).

**Building Backbone**: Use attached Windows Excel document form “Copper Test Form 2”.

**Campus Backbone**: Use attached Windows Excel document form “Copper Test Form 2”.

### 5.5.3 Coaxial Cable Facilities:

- **Horizontal**: Use attached Windows Excel document form “Coaxial Test Form 1”.

**Building Backbone**: Use attached Windows Excel document form “Coaxial Test Form 2”.

**Campus Backbone**: Use attached Windows Excel document form “Coaxial Test Form 2”.

### 5.5.4 Fiber Cable Facilities:

- **Horizontal**:
  - Fiber Certification Report Summary. Use attached Windows Word document form “Fiber Test Form 1”.
  - Tier 1 Fiber Certification Report. Provide computer file copy of individual test results from the test device (Corning Cable Systems, OTS-View reporting software).

- **Centralized**:
  - Fiber Certification Report Summary. Use attached Windows Word document form “Fiber Test Form 2”.
  - Tier 1 Fiber Certification Report. Provide computer file copy of individual test results from the test device (Corning Cable Systems, OTS-View reporting software).

- **Building Backbone**:
  - Fiber Certification Report Summary. Use attached Windows Word document form “Fiber Test Form 3”.
  - Tier 1 Fiber Certification Report. Provide computer file copy of individual test results from the test device (Corning Cable Systems Series, OTS-View reporting software).

- **Campus Backbone**:
  - Tier 2 Fiber OTDR Report. Provide computer file copy of OTDR traces from the test device for sections longer than 300 feet (Corning Cable Systems, OTS-View reporting software).
- Fiber Certification Report Summary. Use attached Windows Word document form "Fiber Test Form 4".
- Tier 1 Fiber Certification Report. Provide computer file copy of individual test results from the test device (Corning Cable Systems, OTS-View reporting software).
- Tier 2 Fiber OTDR Report. Provide computer file copy of OTDR traces from the test device (Corning Cable Systems, OTS-View reporting software).

END OF DOCUMENT