Section 27 0500
General Requirements for Communications Systems
Part 1 - General
1.1 - Description of Work

A. The work of this Section consists of providing all required labor, supervision, materials and equipment (except equipment furnished by the Owner to be installed by the Contractor) to satisfactorily complete the work shown on the drawings and/or specified in all Sections of Division 27 and all other work and miscellaneous items, not specifically mentioned, but reasonably inferred for a complete and fully operating facility. The work shall include but not be limited to the following:
   1. Furnish and install all required in-place equipment, conduits, conductors, cables and any miscellaneous materials for the satisfactory interconnection and operation of all associated communication systems.

1.2 - 1.2 Related Work

A. This Section provides the basic Communication Requirements which supplement the General Requirements of Division 1 and apply to all Sections of Division 27.

1.3 - Regulatory References

A. All products, services, materials and documentation provided by the Installer shall meet the requirements of the following where applicable:
   1. National Electrical Manufacturer's Association (NEMA)
   2. American National Standards Institute (ANSI)
   3. National Fire Prevention Act (NFPA)
      a. National Electric Code 2020 (NEC)
   4. Relevant State Electric and Fire Codes
   5. Institute of Electrical and Electronic Engineers (IEEE)
   6. Underwriters Laboratories, Inc. (UL)
   7. Telecommunications Industry Association / Electronic Industries Alliance (TIA/EIA)
      a. TIA-526-7A Fiber-Optical Power Loss Measurements SM
      b. TIA-526-14C Fiber Optical Power Loss Measurements MM
      c. TIA-568_0-D Generic Telco Cabling Customer Premises
      d. TIA-568_0-D1 Generic Telecom Cabling for Customer Premise Addendum
      e. TIA-568_1-D Commercial Building Telcom Infrastructure Std
      f. TIA-568_1-D1 Commercial Building Infrastructure Standard Addendum
      g. TIA-568_2D Balanced Twisted Pair Cabling and Components
      h. TIA-568_3-D Optical Fiber Cabling Components Standards
      i. TIA-569-E Telecom Pathways and Spaces
      j. TIA-598-D Optical Fiber
      k. TIA-598-D Optical Fiber Addendum
      l. TIA-598-D1 Optical Fiber Color Coding Addendum
      m. TIA-606-C Admin for Telecom Infrastructure

n. TIA-607-D Grounding and Bonding
o. TIA-758-B Customer Owned OSP
p. TIA-942-B Data-Centers

8. Building Industry Consulting Service International (BICSI) publications:
   a. Telecommunications Distribution Methods Manual (TDMM), 14th ed.
   b. Outside Plant Design Reference Manual (OSPDRM), 6th ed.
   c. Information Technology Systems Installation Methods Manual (ITSIMM), 7th ed.
   d. Telecommunications Project Management Manual (TPMM), 1st edition
   e. ANSI/BICSI 006, Distributed Antenna System (DAS) Design and Implementation Best Practices
   f. ANSI/BICSI 008, Wireless Local Area Network (WLAN) Systems Design and Implementation Best Practices
   g. ANSI/BICSI 005, Electronic Safety and Security (ESS) System Design and Implementation Best Practices
   h. ANSI/BICSI 007, Information Communication Technology Design and Implementation Practices for Intelligent Buildings and Premises
   i. ANSI/BICSI 001, Information and Communication Technology Systems Design and Implementation Best Practices for Educational Institutions and Facilities
9. Manufacturer's recommendations and installation guidelines
10. All cabling shall comply with all appropriate requirements of NEC Articles 770 and 800 and shall comply with the State Fire Codes as interpreted by the State Fire Marshall's Dept.
11. All publications referred to in this document shall be the latest edition thereof together with any amendments and/or addenda.

1.4 - Submittals

A. As specified in Division 1, submit to the Engineer of Record and Caltech shop drawings, manufacturer's data and certificates for equipment, materials and finish, and pertinent details for each system specified.
B. Obtain approval of the Engineer of Record and Caltech before procurement, fabrication, or delivery of the items to the job site.
C. Partial submittals are not acceptable and will be returned without review.
D. Submittals are required for all items, regardless of whether they are furnished as specified or are substituted.
E. Information to be submitted includes manufacturer's name, trade name, equipment model number, nameplate data, equipment drawings including:
   1. Layout dimensions and capacity
   2. Manufacturer's descriptive literature of cataloged products, diagrams, test data, and performance and characteristic curves as applicable.
   3. Furnish project specification and paragraph reference, applicable Federal, Industry and Technical Society Publication References, and years of satisfactory service of each item required to establish contract compliance.

4. Photographs of existing installations and data submitted in lieu of catalog data are not acceptable and will be returned without approval.

F. If submittal information includes multiple products, items being submitted for approval shall be clearly identified and items not to be used on the project shall be clearly marked out.

G. Organize submittals for equipment and items related to each specification section together as a package.

H. Submit submittal packages shall be in PDF form. Pages of PDF shall retain text and other features and not be digitally flattened to prevent selection of text and images.

I. Certificates of Conformance:
   1. Submit manufacturer's certifications as required on products, materials, finish, and equipment indicated in the technical sections.
   2. Certifications shall be documents prepared specifically for this contract.
   3. Preprinted certifications and copies of previously submitted documents will not be acceptable.
   4. The manufacturer's certifications shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item.
   5. Certification shall not contain statements that imply the item does not meet requirements specified, such as "as good as", "achieve the same end use and results as materials formulated in accordance with the referenced publications;" or "equal or exceed the service and performance of the specified material."
   6. Certifications shall state that the item conforms to the requirements specified.
   7. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official, authorized to sign certificates of conformance.

J. Substitutions:
   1. The equipment included in the Contract Documents is used to establish standards of quality, utility, and appearance. Equipment which in the opinion of the Caltech IMSS is equal in quality, utility, and appearance will be approved as substitutions to that specified:
      a. Products that are specified by manufacturer, trade name or catalog number establish a standard of quality and do not prohibit the use of equal products of other manufacturers provided they are approved by the Caltech IMSS prior to bidding/use.
   2. Substitutions will be accepted for review where there is a reasonable reason for the substitution. Reasonable reasons include:
      a. Cost savings to the owner. Include deductive change order with submittal.
      b. A product with features providing additional benefits to the end user.
      c. Improved finished environment/lay out of the final installation.
      d. Delivery considerations.
      e. Owner's specific requests.
   3. Where items are noted as "or equal", a product of equal design, construction and performance will be considered.

4. Any item proposed as a substitute shall be accompanied by drawings and/or data giving sizes, capacities, all pertinent test data, catalog cut sheets, product information, and all other necessary information required to substantiate that the product is equal or exceeds that specified.
5. Substitutions shall be equal, in the opinion of the Engineer, to the specified equipment. The burden of proof of such shall rest with the Contractor. When the Engineer in writing accepts a substitution, it is with the understanding that the Contractor guaranteed the substituted equipment to be equal to the one specified and dimensioned to fit within the construction. Approved substitutions shall not relieve the Contractor of responsibilities for the proper execution of the work, or from any provisions of the Plans or Specifications.
6. Only one substitution will be considered for each product specified.
7. Alternate manufacturers must be submitted for approval by Caltech 10 days prior to bid date unless noted otherwise in Division 1.
8. The Contractor shall be responsible for all expenses in connection with the substitution materials, process, and equipment, including the effect of his/her substitution on him/her, his/her subcontractor's or other Contractor's work. No substitution shall be permitted without written authorization of the Engineer after written approval by Caltech IMSS. Any assumptions on the acceptability of a proposed substitution prior to acceptance by the Engineer are at the sole risk of the Contractor.

K. Closeout Submittals:
1. Submit final cost information/cost analysis including original bid and any change orders broken down by system, material and labor costs (as applicable):
   a. Telecom System
   b. Data System
   c. Audio/Visual System
   d. Security
2. Furnish Operation and Maintenance Manuals (O & M Manuals) for equipment where manuals are specified in the equipment specifications or are specified in Division 1. O & M Manuals shall include as a minimum:
   a. Copies of equipment supplied on the project.
   b. Instruction manuals including operation instructions and maintenance requirements/recommendations.
   c. List of suppliers for all equipment with addresses and telephone numbers.
   d. List of service support for all equipment with addresses and telephone numbers.
   e. Copies of all test reports required in Division 27 specification sections.
   f. For each piece of equipment, submit a list of recommended spare parts. Include part numbers and the name, address, and telephone number of the supplier.
   g. Other closeout documentation and test results as required under other sections of the specifications.
   h. Provide in a single transmittal.
   i. Warranty for all work, including contractor's general warranty.

j. All warranties begin as per the Contract, Division 1 or final acceptance of the Work by the Owner, Architect, Engineer, and Authority Having Jurisdiction, whichever is later.
   i) Manufacturer's Warrantees and Guarantees that are longer than the base contract/specified amount are to be provided with the manuals.
   ii) The Contractor is responsible for all Warranty and Guarantee work whether or not the Manufacturer also Warrantees and Guarantees the product.

1.5 - Contract Documents

A. Review the Drawings and Specification Divisions of other trades and perform the electrical work that will be required for the installations:
   1. Should there be a need to deviate from the Drawings and Specifications, submit written details and reasons for all changes to the Engineer for favorable review.
   2. All drawings and divisions of these specifications shall be considered as whole. This contractor shall report any apparent discrepancies prior to submitting bids.
   3. Should there be a conflict or discrepancy between the drawings and specifications, the most expensive option shall be required, at the discretion of the Engineer.

B. Drawings:
   1. The Drawings shall govern the general layout of the completed construction.
      a. Locations of equipment, inserts, anchors, panels, pull boxes, manholes, conduits, stub-ups, fittings, outlets, racks, devices and ground connections are approximate unless dimensioned; verify locations with the Engineer prior to installation. Field verify scaled dimensions on Drawings.
      b. The general arrangement and location of existing conduits, piping, apparatus, etc., is shown as existing on drawings or specified. The drawings and specifications are for the assistance and guidance of the contractor, exact locations, distances and elevations are governed by actual field conditions. Extreme accuracy of data given herein and on the drawings is not guaranteed. Minor changes may be necessary to accommodate work. The contractor is responsible for verifying existing conditions. Should it be necessary to deviate from the design due to interference with existing conditions or work in progress, claims for additional compensation shall be limited to those for work required by unforeseen conditions as determined by the Engineer.

1.6 - Coordination

A. Coordinate the communications work with the other trades, code authorities, utilities and the Engineer:
   1. Failure to accomplish this coordination is not a basis for additional cost reimbursement to the Contractor.
   2. Coordinate does not mean to only send a Request for Information (RFI). Coordinate implies that the contractor is to take the lead in bringing all of the necessary organizations together to coordinate the work and to provide for the associated costs.

B. Where connections must be made to existing installations, properly schedule all the required work, including the power or communication system shutdown periods. Schedule and carry out shutdowns so as to cause the least disruption to operation of the Owner's facilities:
   1. Include costs for work during non-normal working hours and temporary facilities as may be required.
   2. Include costs as necessary for sub-contractors as necessary to accomplish the specified work.

C. When two trades join together in an area, make certain that no communications work is omitted. Failure to accomplish this coordination is not a basis for additional cost reimbursement to the Contractor.

D. Operations:
   1. Perform all work in compliance with Division 1.
   2. Keep the number and duration of utility shutdown periods to a minimum.
   3. Show all proposed shutdowns and their expected duration on the construction schedule.
   4. If the construction schedule is created and maintained by others, make sure that the associated information is incorporated.
   5. Failure by the Contractor to properly schedule and plan for such activities is not a basis for additional compensation.
   6. Carry out shutdown only after the Engineer has favorably reviewed the schedule. Submit power/communications interruption schedule 15 days prior to date of interruption. Failure to provide schedule with adequate review time may result in rescheduling of the work at the Contractor's expense.

E. Construction telephone and data services:
   1. See Division 1 Temporary Utilities.

F. Storage:
   1. Provide adequate storage for all equipment and materials which will become part of the completed facility so that it is protected from sun, weather, condensation, dust, water, construction operations or theft.

G. Damaged Products:
   1. Notify the Engineer in writing in the event that any equipment or material is damaged. Obtain approval from the Engineer before making repairs to damaged products.

H. Order material in such a timely manner and after approval of the same so as to ensure that the approved material is available to be installed on site in a timely manner. Additional costs or substitutions necessitated because the Contractor failed to order material in a timely manner are not reimbursable. Costs associated with processing of paperwork by the owner and design consultant resultant of such failures to coordinate the work by the Contractor shall have such costs reimbursed by the Contractor.

1.7 - Locations

A. Use equipment, materials and wiring methods suitable for the types of locations in which they are located:
   1. Dry Locations:
      a. All those indoor areas which do not fall within the definition below for Wet Locations and which are not otherwise designated on the Drawings.
   2. Wet Locations:
      a. All locations exposed to the weather, whether under a roof or not, unless otherwise designated on the Drawings.
      b. All locations exposed to high humidity locations including, but not limited to:
         i) Cage washes.
         ii) Kitchen areas exposed to water, steam or humidity.
         iii) Wet labs where areas are exposed to water, steam or humidity.
         iv) Mechanical spaces subject to water, steam or humidity exposure.
         v) Campus tunnel system.

1.8 - Safety and Indemnity

A. The Contractor is solely and completely responsible for conditions of the job site including safety of all persons and property during performance of the work. This requirement will apply continually and not be limited to normal working hours.
   1. No act, service, drawing review or construction review by the Owner, the Engineer or their Consultants is intended to include reviews of the adequacy of the Contractors safety measures in or near the construction site.
   2. The Contractor performing work under this Division of the Specifications shall hold harmless, indemnify, and defend the Owner, the Engineer, their consultants, and each of their officers, agents and employees from any and all liability claims, losses, or damage arising out of or alleged to arise from bodily injury, sickness, or death of a person or persons and for all damages arising out of injury to or destruction of property arising directly or indirectly out of or in connection with the performance of the work under this Division of the Specifications, and from the Contractor's negligence in the performance of the work described in the construction contract documents, but not including liability that may be due to the sole negligence of the Owner, the engineer, their Consultants or their officers, agents and employees.

Part 2 - Products

2.1 - Standard of Quality

A. Material and Equipment
   1. Provide materials and equipment that are new and are current products of manufacturers regularly engaged in the production of such products. The standard products shall have been in satisfactory commercial or industrial use for two years prior to bid opening. The two-year period includes use of equipment and materials

of similar size under similar circumstances. For uniformity, only one manufacturer will be accepted for each type of product.

B. Service Support
   1. Submit a certified list of qualified permanent service organizations including their addresses and qualification for support of the equipment. These service organizations shall be convenient to the equipment installation and able to render service to the equipment on a regular and emergency basis during the warranty period of the contract.

C. Manufacturer's Recommendations
   1. Where installation procedures are required to be in accordance with manufacturer's recommendations, furnish printed copies of the recommendations prior to installation. Installation of the item shall not proceed until recommendations are received. Failure to furnish recommendation shall be cause for rejection of the equipment or material.

2.2 - Nameplates

A. For each piece of electrical equipment, provide a manufacturer's nameplate showing their name, location, the pertinent ratings, the model designation, and shop order number.

B. Additionally, identify each piece of equipment and related controls with a rigid laminated engraved plastic nameplate. Unless otherwise noted, nameplates shall be melamine plastic 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be 1 by 2.5 inches unless otherwise noted. Where not otherwise specified, lettering shall be a minimum of 0.25-inch-high normal block style. Engrave nameplates with the inscriptions indicated on the Drawings and, if not so indicated, with the equipment name. Securely fasten nameplates in place using two stainless steel screws or, where favorably reviewed by the Engineer, with epoxy cement. Where no inscriptions are indicated on the Drawings, furnish nameplates with appropriate inscriptions furnished by the Engineer upon prior request by the Contractor.

2.3 - Fasteners

A. Fasteners for securing equipment to walls, floors and the like shall be either hot dip galvanized after fabrication or stainless steel.

2.4 - Finish Requirements

A. Equipment
   1. Refer to each electrical equipment section of these Specifications for painting requirements of equipment enclosures. Repair any final paint finish which has been damaged or is otherwise unsatisfactory, to the satisfaction of the Engineer.

B. Conduit, boxes and pathways
   1. In finished areas, paint all exposed conduits, boxes and fittings to match the color of the surface to which they are affixed.

C. Cable
    1. Cables shall not have finishes applied. Factory finishes must be maintained.

Part 3 - Part 3 - Execution

3.1 - Installation

A. Ensure that all equipment and materials fit properly in their installation.
B. Perform any required work to correct improperly fit installation at no additional expense to the owner.
C. Equipment Installation
    1. Provide the required inserts, bolts and anchors, and securely attach all equipment and materials to their supports.
    2. Mount all metal panels or cabinets which are mounted on or abutting concrete walls or any outside walls 1/8 inch from the wall, paint the back sides of the panels with Mobil Hi-Build Bituminous Coating 35-J-10, Kopper Bitumastic Super Tank Solution, or equal. Film thickness shall be 10 mils minimum.
D. Cutting, Drilling and Welding
    1. Provide the required cutting, drilling and/or welding that is required for the construction work. Comply with Division 1 requirements.
    2. Structural members shall not be cut or drilled, except after approval by the Engineer. Use a core drill wherever it is necessary to drill through concrete or masonry.
    3. Provide the required welding for equipment supports. Conduits and fittings shall not be welded to structural steel. Where welding is required, it shall be accomplished by tradesmen certified to do such work. Provide fire and other protection as appropriate.

3.2 - Field Tests

A. Test shall be in accordance with Acceptance Testing recommendations issued by the NIA/TIA for telecommunications equipment and the manufacturers recommendations for equipment other than telephone or data systems.
B. Perform equipment field tests and adjustments.
    1. Properly calibrate, adjust and operationally check all components, and demonstrate as ready for service.
    2. Make additional calibration and adjustments if it is determined later that the initial adjustments are not satisfactory for proper performance.
    3. Perform equipment field test for equipment where equipment field tests are specified in the equipment Specifications.
    4. Give sufficient notice to the Engineer prior to any test so that the tests may be witnessed.
C. Provide instruments, other equipment, temporary facilities as may be necessary, and material required for the tests. These shall be of the type designed for the type of tests to be performed and shall be calibrated by a recognized testing laboratory within three months prior to testing.

D. Operationally test all drops to demonstrate that the circuits and equipment have been properly installed and adjusted and are ready for full-time service. Demonstrate the proper functioning of drops in all modes of operation.

E. Re-testing will be required for all unsatisfactory tests after the equipment or system has been repaired. Re-test all related equipment and systems if required by the Engineer. Repair and re-test equipment and systems which have been satisfactorily tested but later fail, until satisfactory performance is obtained.

F. Perform calibration and adjustment on all equipment. Where the values for adjustment are not shown on the Drawings, obtain the proper values from the Engineer.

G. Maintain records of each test and submit reports in digital form to the Engineer when testing is complete. All tests shall be witnessed by the Engineer. These records shall include:

1. Name of equipment tested.
    a. Date of report.
    b. Date of test.
    c. Description of test setup.
    d. Identification and rating of test equipment.
    e. Test results and data.
    f. Name of person performing test.
    g. Owner or Engineer's initials.
2. Items requiring testing as a minimum
    a. Data system
    b. Telephone system
    c. Audio/Visual system
    d. Security system

3.3 - Painting of Equipment

A. Factory Applied

1. Communication equipment shall have factory applied painting system which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test and the additional requirements specified in the technical section.

B. Field Applied

1. Paint communication equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria.
2. Paint shall be applied in a manner that does not affect operating equipment or finishes on other installed equipment.

3.4 - Signage

A. Nameplate Mounting

1. Provide number, location and letter designation of nameplates as indicated.
2. Fasten nameplates to the device with a minimum of two stainless steel sheet-metal screws or two rivets.

3.5 - Records

A. Maintain one copy of the contract Drawing Sheets on the site of the work for recording the record “as built” condition. After completion of the work, the Contractor shall neatly and carefully mark the work as actually constructed, revising, deleting and adding to the Drawing Sheets as required.
B. Provide the size and type of each cable installed on the project.
C. Where the location of duct lines, adjacent utilities, cable boxes, and manholes are found to be different than shown, carefully mark the correct location on the Drawings. Work shall be dimensioned from existing improvements.
D. At the completion of the Work the Contractor shall provide a set of record “as built” drawings over to the Owner for his use.
E. Record drawings are required to be transmitted no later than 30 days after completion or no less than 30 days prior to occupancy, whichever is sooner.
F. Records are to be transmitted in native electronic format. Scans will not be accepted. PDF generated documents are complimentary and not a substitute for source documents in source formats.
G. Drawings containing layers shall not layers flattened to one layer.
H. Documents and files shall be transmitted digitally to the Owner for review. If errors are discovered, Contractor shall make corrections and issue revised documents at no cost to Owner.
I. Contractor to provide information on their company in the margin of record drawings along with the date of the revisions and the associated revision number.

3.6 - Posted Operating Instructions

A. Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:
   1. Single line diagrams, wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
   2. Start up, proper adjustments, operating and shutdown procedures.
   3. Safety precautions.
   4. The procedure in the event of equipment failure.
   5. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

3.7 - Instruction to Owner's Personnel

A. Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated personnel in the adjustment, operation and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or systems has been accepted and turned over to the Owner for regular

operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual sections. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with equipment or system. When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instructions to acquaint the operating personnel with the changes or modifications.

1. Contractor shall maintain an attendance sheet from each session which contains the following information:
   a. Attendees with associated arrival and departure time and date.
   b. Topics covered.
   c. Information provided.
   d. Signatures of attendees taken at the completion of the session.

3.8 - Clean Up

A. Thoroughly clean all soiled surfaces of installed equipment and materials.
B. Upon completion of work, remove all surplus materials, rubbish, and debris that accumulated during the construction work. Leave the entire area neat, clean, and acceptable to the Engineer.

End Section