270000-TC
Common Work for Telecommunications Systems

Part 1 - General Introduction

A. The work shall consist of the design, provision, termination, testing and documentation of a complete and fully functional structured Category 6 (Cat-6) and optical fiber communications cabling system. The instructions in this section are specific to communications installations and should be read in conjunction with other contract documents as applicable.

B. MAA/OT has communications specifications specific to MAA/OT. Attempts have been made to include MAAOAT specific requirements through this document. If there are questions about this specification, contact MAA for clarification.

Part 2 - Qualifications

A. The telephone and data cabling system design work detailed in this section shall be carried out by a BISCI Certified RCDD.

B. The telephone and data cabling system installation work detailed in this section shall be carried out by a specialist installer company. The installer shall be certified by the system manufacturer (or manufacturers) in the installation and testing of the cabling system, and have a BISCI ITS Technician on site to over see the installation.

C. The installer shall have a proven track record in the field of telephone and data (Category 6 and optical fiber) cabling system installation. The installer shall have completed at least three previous installations of comparable size, complexity and manpower within the last three years. Each installation shall utilize components, installation practices and testing procedure equivalent to those specified in this document.

Part 3 - Definitions

A. Provide: Supply, furnish, deliver, install, pull, fix, dress, terminate, label, test, ground, fire stop, and document the components as per these specifications.

B. Main Distribution Frame (MDF): Location where external cables are to be terminated.

C. Intermediate Distribution Frame (IDF): Secondary wiring closets which are connected to the MDF that serve localized areas.

D. Workstation Outlet: Cable termination(s) to be used by end user equipment.
E. Backbone Cables: Cables linking the MDF and IDFs located through out the complex.
F. Link Cables: Cables linking Distribution Frames directly with one another.
G. Distribution Cables: Cables linking the Communications Rooms to each workstation outlet.
H. External Cables: Cables that link the building to external connection point(s) and/or other building(s). These cables are considered to be Outside Plant (OSP).
I. Station Cables: Cables linking workstation outlet to active equipment.
J. Patch Cables: Cables linking Distribution Frame Patch Panel terminations with active electronics or another Patch Panel termination.

Part 4 - Scope of Work

A. The work shall consist of the furnishing, installation, termination, testing and documentation of a complete and fully functional structured communications cabling system. The work shall include the following (as identified within these documents and associated drawings):

1. Provision of external optical fiber and copper cabling, except as specified by MAA/OT.
2. Splicing external grade cables to internal grade cables.
3. Provision of internal optical fiber and copper backbone, link and distribution cables.
4. Provision of coaxial CATV television system cabling, if required.
5. Termination of each optical fiber element with optical fiber connectors mounted in patch panels, termination frames and/or outlet faceplates.
6. Termination of each copper cable with connectors mounted in patch panels, termination frames and/or outlet faceplates.
7. Provision of equipment cabinets, racks, cable management and all accessories.
8. Provision of patch cords, station cables and cross-connect wires, except as specified by MAA/OT.
9. Full labeling of the entire installation prior to testing.
10. Testing of each optical fiber element and connector with Power Meters and OTDR.
11. Testing of each copper cable and connector with a level IV tester.
12. Documentation of the installation, including test results, cable management records and as-built documents in native, source or raw electronic format.

B. Provide and install all incidental items that belong to the Work described and which are required for a complete system.
C. Entire copper cable plant shall be certified.
D. Entire fiber cable plant shall be certified.

Part 5 - Works not included

A. The work detailed in this section shall not include the following:

1. Provision of active networking equipment (electronics) and computer terminals.
2. Installation and physical connection of active network electronics to cable plant.
3. Provision of telephone equipment and associated services.
4. Installation and physical connection of active telephone equipment to cable plant.
5. Fiber Optic and Copper patch cables.

Part 6 - Manufacturer's Complete Systems

A. The cabling system specified in this document shall be an end to end solution that is sourced from a single manufacturer or partnered manufacturers. Unless explicitly noted within these specifications, this shall include patch panels, connectors, cables, patch cords, faceplates and other associated components.
B. Bidders shall note that all components shall meet or exceed the performance requirements detailed within these specifications.
C. MAA/OT reserves the right to reject any substitution on the grounds of adherence to standards, quality, performance, utility, function and/or appearance.

Part 7 - Job Conditions

A. Prior to bidding, visit the site and determine all existing conditions affecting work. The Bidder shall examine all drawings and specifications to familiarize themselves with the type of construction to be used, and the nature and extent of work provided by other trades.
B. Verify dimensions and the correct location of hardware before proceeding with the installation of hardware, cabling and/or connections.
C. Notify MAA/OT in writing immediately on discovery of dimensional discrepancies and other conditions detrimental to proper performance of the Work.

Part 8 - Clarifications

A. If any ambiguity, conflict, discrepancy, omission or other need for clarification is discovered in the specification, drawings and associated documents, bidders shall immediately notify the Consultant in writing and request modification and/or clarification of the document. Modifications will be made by addenda.

Part 9 - Addenda

A. The specifications, drawings and associated documents may be modified prior to the proposal due date by issuance of an addendum. The addendum will be sent to all bidders.

Part 10 - Personnel

A. The personnel who will be employed on the contract shall be suitably trained in the management of a project of this nature and/or in the installation and maintenance of products of the type being provided so as to be able to carry out all work in a competent manner.

B. The Installer shall provide a site manager BISCI ITS Technician Technician responsible for all site-related issues. This individual shall be the single point of contact for the project team and shall carry a mobile phone so they can be contacted during the working hours of the project or have an alternate POC.

C. The Installer shall have a Registered Communications Distribution Designer (RCDD) as a permanent member of staff. The RCDD shall be in good standing with the Building Industry Consulting Service International (BICSI) and shall have a current registration. The RCDD must be available for weekly meetings or as needed to facilitate system installation and address MAA/OT's needs and concerns.

D. The Installer shall be certified by the component manufacturer(s) in the installation and testing of the cabling system and shall be able to provide a manufacturers' extended performance warranty for the 'end to end' cabling system.

Part 11 - Labeling and Numbering Scheme

A. Label each component of the communications systems with its unique identification number. The labeling scheme shall uniquely identify each outlet for the whole building. The scheme shall contain a reference to the building, outlet type, the Communications Room that

serves the outlet, and the outlet number. Consult with MAA/OT Voice and Data Networks department to establish and approve the labeling scheme.

B. Provide P-touch labels for Riser cables, connectors, cables, outlets, termination frames and patch panels.

C. The lettering on each label shall be as large as is practicable. All labels shall be machine-produced. Hand-written labels will not be acceptable.

D. A standard relative orientation shall be adopted for all labels unless otherwise specified.

E. Labels shall be robust, durable, shall resist abrasion and shall be UV inhibiting, permanent and indelible.

F. Labels shall carry the full complement of characters to designate the unique identification for the item that they identify.

G. Cable Labels

1. Provide laminated, cable-tied labels for interduct. Provide nameplate labels for each. Labels are to be a white and black engraved plastic sandwich material, i.e. black letters on white background. The label shall be punched with holes to allow two cable ties (one at each end) to be used to secure the label to the cable. Distribution / Link Cabling: Label each cable so that the label is within 8" of the end of the cable at the patch frame end and within 6" of the end of the cable at the outlet end.
2. Backbone / External / Innerduct Cabling: Provide nameplate labels for each. Labels are to be a white and black engraved plastic sandwich material, i.e. black letters on white background. The label shall be punched with holes to allow two cable ties (one at each end) to be used to secure the label to the cable.

H. Outlet and Patch Panel Labels

1. Provide Provide P-touch labels
2. Outlet Label: Provide P-touch labels
3. Patch Panel: Provide P-touch labels

Part 12 - Warranty

A. Installer to provide a warranty for one year from Notice of Completion on all materials and workmanship installed or supplied as part of the optical fiber and data system.

B. The Installer shall also supply an extended performance warranty, as offered by the components' manufacturer(s).

C. The Installer shall also supply certificates indicating extended performance warranty, per components' manufacturer(s).

Part 13 - Quality

A. The communications cabling installation work detailed in this section shall be carried out to a high standard and are free of defects.

B. All installation work shall be completed to the standard of the samples approved by MAA/OT during the submittal process. Any products not installed to the quality detailed in these specifications and approved in the submittal process shall be reworked by the Installer to the satisfaction of MAA/OT at no additional cost to the Owner.

Part 14 - Materials Standards

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 Electric Code (NEC)
4. Relevant State Electric and Fire Codes
5. Institute of Electrical and Electronic Engineers (IEEE)
6. Underwriters Laboratories, Inc. (UL)
7. ANSI/EIA/TIA 568A-1995 Commercial Building Telecommunications Wiring Standard
8. ANSI/EIA/TIA 568-B.2-1 Transmission Performance Category 6 Cabling Specifications for 4-Pair 100 Ohm.
9. ANSI/EIA/TIA 569A Commercial Building Standard for Telecommunications Pathways and Spaces
10. ANSI/EIA/TIA 606 The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
11. ANSI/EIA/TIA 607 Commercial Building Grounding and Bonding Requirements for Telecommunications
12. ANSI/EIA/TIA 598 Color Coding of Optical Fiber Cables
13. EIA/TIA TSB 67 Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling Systems
14. Building Industry Consulting Service International (BICSI) publications:
    - Telecommunications Distribution Methods Manual
    - LAN and Internetworking Design Manual
    - Telecommunications Cabling Installation Manual
    - Customer Owned Outside Plant Design Manual
15. Manufacturer’s recommendations and installation guidelines
16. 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.
17. All publications referred to in this document shall be the latest edition thereof together with any amendments and/or addenda current ten days before the date fixed for return of bids.

Part 15 - Cabling System Performance and Requirements

15.1 Copper Data Cabling

A. The copper cabling system shall support data network protocols/services at rates of at least 1 Gbps. It shall support 10/100/1000BaseT, ATM (at OC-3, OC-12 and OC-48) and other network protocols. The cabling system shall also be compatible with RS-232, Voice over IP, other dedicated point-to-point protocols, and in-line power specifications.

B. The channel performance for the Category 6 system provided as a part of this installation shall meet or exceed the frequency support up to 500MHz.

C. Provide listed Cable Category 6 or equivalent cable that will be certified as part of a certified end-to-end cabling system warranty with Blue color jacket for data networking and White color jacket for telephone cable. Each cable shall have four pairs of unshielded twisted-pair 24 AWG solid copper conductors. The cable shall be plenum-rated (CMP). Each cable shall meet or exceed the channel performance specifications in this document when installed as part of the end to end cabling system described in this specification. Cable choices are to be priced and submitted to MAA/OT for approval as part of the bidding process.

D. Category 6 (Cat-6) Copper Jacks. Provide Jack Module – eight position, eight wire jacks (CJ688TP-xx). Colors to be used: Grey (Primary Voice), Black (Secondary Voice), Red (Primary Data), and Yellow (Secondary Data). Each connector shall meet or exceed the channel performance specifications as described in the TIA/EIA Category 6 specification. The pin outs for the jack shall conform to the T568B wiring scheme.

E. Faceplate will be White quad position with label windows.

15.2 Copper Voice Cabling

A. The cabling system shall support telephone services from the PBX. It shall support both digital and analog telephone services and shall be compatible with direct trunk lines (POTS) and ISDN services.

15.3 Fiber Optic Cabling

A. General Requirements

1. The fiber cabling system shall support at least 10Gbps for all runs that are in the 10Gbps cable length spec. Fiber cable runs outside of this distance requirement must support at least 1Gbps. The fiber cabling system must support WDM signaling requirements.

2. Faceplate, jack colors and other aesthetic issues must be approved by MAA/OT prior to installation.

B. Optical Fiber External Cables – To be provided by MAA/OT unless otherwise stated.

1. Provide optical fiber external cables from remote campus wiring centers to MDF.
2. Optical fiber cable to be run through conduit in inner duct to the point of entry to MDF.
3. Terminate each end of each strand of optical fiber elements with optical fiber connectors fitted in an optical fiber rack-mounted patch panel as described in this specification. Label each connector with the feeder cable pair number.
4. Connector type is to be ST for multi mode and SC for single mode.

C. Optical Fiber Riser Cabling

1. Provide optical fiber feeder cables between the MDF and IDF on each floor as shown on the drawings.
2. Run optical fiber cable through inner duct between MDF and IDFs.
3. Terminate each end of each strand of optical fiber elements with optical fiber connectors fitted in an optical fiber rack-mounted patch panel as described in this specification. Label each connector with the feeder cable pair number.
4. Connector type is to be ST for multi mode and SC for single mode.

D. Optical Fiber Patch Panels

1. Provide patch panels fitted in the equipment racks (as shown on the Drawings) to house optical fiber cables terminated on optical fiber connectors.
2. Securely fix all patch panels in place.
3. Provide a sufficient number of patch panels to house all specified optical fiber cables and connectors.
4. Terminate all elements of each optical fiber cable with the specified connectors. Strip back the optical fiber cable jacket, providing a 24" service loop for each optical fiber element. Neatly dress these loops in the patch panel using appropriately sized spiral wrap, so they are protected. A 10’ service loop will be neatly coiled outside the patch panel.
5. Connector type is to be ST for multi mode and SC for single mode.

15.4 Coaxial Cabling

A. Coaxial cable system shall support 5MHz through 1GHz frequency ranges.

B. Faceplate, jack colors and other aesthetic issues must be approved by MAA/OT prior to installation.

Part 16 - Submittals

1. All submittals shall be sent to MAA/OT.

Part 17 - Personnel Training

A. Submit for approval current RCDD registration certification for the RCDD or RCDDs that are part of the Installers staff. This documentation shall clearly show that the registration is current. A currently certified RCDD is required for the duration of the project.

B. Submit for approval records regarding the management, installation and testing personnel. These records shall include resumes, training certificates, previous work experience details (especially on reference projects) and other relevant information.

C. Submit records to confirm that the personnel who will be employed in an installation capacity are suitably trained in the installation and maintenance of equipment and systems of the type being provided.

D. Submit records to confirm that the personnel that will be responsible for testing the system are suitably trained in the operation of the test equipment being used in this project.

Part 18 - Cabling Diagram (required on award of Contract)

A. Submit, for approval, a complete cabling diagram. The diagram shall be based on the single-line drawing included in the Construction Documents. It shall be updated to show quantities and part numbers for all components including patch panels, cable, conduit, cabinets and equipment racks, splices, splice cases and all other associated components.

Part 19 - Test Equipment (required on award of Contract) and Testing

19.1 General Requirement

A. Submit, for approval, details of each item of test equipment to be used to test the optical fiber and copper components. Include patch cords and other specialized components.

19.2 Category 6 Test Equipment

A. Tests performed must meet end to end Category 6 specifications.

B. Provide test leads for the specific cabling system manufacturer as specified in this document.

19.3 Optical Time Domain Reflectometer (OTDR)

A. OTDR is to meet optical fiber manufacturer's requirements for certified end to end optical fiber solution. OTDR must have current certified factory calibration. OTDR must be from the optical fiber manufacturer's approved list of testers.

B. A copy of the emulation software for the OTDR used and the appropriate license shall be passed to the client with the test results.

C. Any launch and drop leads used for optical fiber tests shall be at least 100m longer than the cable under test. They should be sourced from a different manufacturer from the cables under test.

19.4 Power Meter

A. Power meter is to meet optical fiber manufacturer's requirements for certified end to end optical fiber solution. Power meter must have current certified factory calibration. Power meter must be from the optical fiber manufacturer's approved list of testers.

19.5 Microscope

A. Use the Noyes OFS 300-200, portable (battery operated) inspection microscope or equivalent.

B. The microscope shall meet or exceed the following specifications:

1. 200X magnification
2. Fixtures to allow the relevant connectors to be attached to the microscope and inspected in hands-free mode.
3. Built in front illumination

19.6 Testing Requirements Specific to MAA/OT in Addition to Other Requirements in this Document

A. The testing is to show beyond reasonable doubt that there are no errors, damaged or incorrectly installed components, that the installation is correctly labeled and that all the installed components meet or exceed the criteria detailed in these specifications. Any test that does

not show that a component is satisfactorily installed, as per these specifications, shall be repeated. If a test procedure needs to be modified to satisfactorily test some components, the modification shall be submitted for approval of Caltech, prior to the tests being conducted.

B. Following optical fiber and data cable installation, including labeling and termination at both ends, undertake and record tests to ensure that the cabling system will perform satisfactorily in service. In addition to the tests detailed in this specification, the Installer shall carry out any additional tests that the Installer deems necessary to ensure the satisfactory operation of the telephone and data systems. The costs of these additional tests shall be borne by the Installer.

C. All outlets, cables, patch panels and associated components shall be fully assembled and labeled prior to testing. Any testing performed on incomplete systems shall be redone on completion of the work.

D. Provide MAA/OT with the opportunity to witness all testing. On reasonable request, the installer shall demonstrate that the test procedure competently identifies the fault conditions being tested for.

E. Complete all of the tests identified in these specifications.

F. Notify MAA/OT ten working days before the date of commencement of the cable tests. Provide details in writing, on that advance date, of proposed tests, the test schedule, equipment to be used, its certification and calibration and the names and qualifications of test personnel.

G. The Owner and MAA/OT shall be invited, to the first instance of each type of test conducted. In the event of a number of tests being conducted by the Installer prior to this first inspection, MAA/OT reserves the right to reject these tests as non-compliant and to require them to be repeated at the Installer’s cost.

H. Personnel shall be competent in and qualified by experience or training for comprehensive TDR and OTDR operation and troubleshooting, for both copper and optical fiber testing.

I. Include the cost of obtaining, calibrating and maintaining test equipment and the cost of carrying out and recording the tests detailed in this specification, including labor costs, in the bid sum. No extra costs will be entertained.

J. Ensure that all test equipment is in calibration before delivery to site and throughout the testing period. The Installer shall be responsible for ensuring that any necessary tests and rework to maintain equipment's

calibration status is carried out. Any tests performed on un-calibrated test equipment shall be repeated at the Installer's cost.

K. The test documentation shall be available for inspection by MAA/OT during the installation period and copies shall be passed to MAA/OT within five working days of completion of tests on cables in each area. The Installer shall retain a copy to aid preparation of as-built information.

L. Failures detected during the testing shall be noted on the test results schedule, rectified and re-tested. On the fault being rectified, this shall also be noted. These notes shall not be deleted or obliterated.

M. Rectification of all damaged cables shall include replacing damaged cables with new cables in complete runs, replacing damaged connectors or remaking poor terminations. In-line cable joints, splices or distribution points will not be acceptable except where specified in this document. All damaged cables shall be removed from site.

N. If on submittal of the As-Built documentation there are any missing test results or incorrectly named files, the test shall be repeated at the Installer's expense.

Part 20 - Product Literature/Data Sheets (required on award of Contract)

A. Submit for approval manufacturer's product data sheets for each component of the telephone and data cabling systems. Certify that the data sheets depict the components to be provided by the Installer to make up the complete system as described in this specification.

Part 21 - Communications Manholes

A. Provide a 12’-0” service loop for each external cable that passes through a communications manhole. Dress the cable to keep it clear from any water that may be in the bottom of the manholes and to minimize any risk of damage caused by later visits to the manhole.
Provide bushings, grommets and strain-relief for cables terminating at wall-mounted outlets and patch panels to ensure durable and robust connections. The bushings and grommets are intended to protect the cables from any sharp edges that present a risk to the cables. Ensure that all sharp edges are covered to protect the cables from damage.

Part 22 - Installation Practices

22.1 General

A. Installation practices are detailed in order sections of the Telecommunications Specification. This section pertains to MAA/OT specific concerns regarding cable plant installations. If there is a conflict or question regarding which method to apply, contact MAA/OT for clarification.

22.2 Specifics

A. No cables shall be installed in a fashion that contravenes either the minimum installed or the minimum under-load bend radius of the cable.

B. All inner ducts shall run parallel or at right angles to building wall structures. Provide a support system for inner duct running in the ceiling void. Do not allow inner duct to rest on electrical or mechanical equipment. Do not tie inner duct to power or other foreign services. Support inner duct running in the vertical and horizontal direction in place at not more than 12" and 48" centers respectively.

C. No cable is to be pulled through a conduit “L-bend” (condulets). In existing routes with L-bends, the cables are to be pulled to the L-Bend. The cable is then to be carefully pulled through the remainder of the conduit run.

D. Install all cables in complete runs from outlet or patch panel to patch panel. In-line joints, splices, distribution points or other intermediate connections are not permitted unless specifically called out by this specification.

E. At no point shall the communications cables be tied to power cables or other building services or their supports, or run in the same ducts, raceways, conduits or connection boxes as power cabling. Copper data cables

must maintain the specified distance separation from electrical lines and conduits per Industry specification.

F. Use plenum-rated tie wraps in plenum spaces. All tie wraps shall be secured in such a way that it can be rotated around the cable bundle, so as to assure no cables have been cinched too tight.

G. Reinstate all pull-wires in conduits and ducts after use to facilitate future addition of cables.

H. Cables shall not be held so tightly with cable ties that the cable jackets are indented by the cable ties.

I. Individually and properly ground all equipment cabinets, racks and ladder rack. Ground all metallic sheath communications cables entering the building per manufacturer specifications and NEC 770-33, 800-33, 800-40 and EIA/TIA-607 (or newest EIA/TIA code which supersedes these).

J. Ensure that all waste materials are disposed of in a safe manner. Pay particular attention to waste materials produced during the termination of optical fiber cabling. Ensure that all used components and fiber cut-offs are collected in purpose-made containers and disposed of properly.

K. Replace all moisture and fire barrier material in ducts, conduits and other penetrations disturbed during installation of communications cabling. Install barrier material in all fire-rated penetrations that have cabling running through them. The barrier material shall be installed so the final penetration has the same fire rating as the original wall/floor. No mixing of materials when fire stopping.

L. Provide expansion plugs in all ducts/conduits entering the building. Seal all unused ducts/conduits with plugs that allow the pull-string to be tied off on the inside.

M. Use purpose-built pulling grips during cable installation. Do not pull cables by attaching pull wires to cable jackets, elements or reinforcement. Use strain gauges or equivalent measures to ensure that the maximum tensile load rating of the cables is not exceeded during installation.

N. External Cables shall be run in underground ducts. Ducts shall be proven to be clear prior to pulling of cables. Cable pulling tension shall not exceed manufacturer’s limits. The cable pulling tension shall be applied smoothly without jerks and at no time shall it exceed the manufacturer’s limits.

O. The pulling equipment for pulling external cables shall be arranged either to indicate the pulling tension, which shall

be continually monitored during a pull, or shall mechanically, assure that the maximum permissible tension is not exceeded.

P. The number of cables in each conduit shall be controlled to allow for future cable installation and to stay within the manufacturer's maximum allowable cable pulling tension. Conduit fill ratios shall not exceed 40%.

Q. The maximum run length of each distribution cable shall not exceed the 90m limit specified by EIA/TIA 568B horizontal cables. Notify MAA/OT immediately if, due to on-site conditions or other factors, a distribution cable run length exceeds this distance.

R. Provide Hook and Loop (Velcro) strapping for all cable bundles within all Communications Rooms cut to length according to manufacturer's specification for strength is recommended. Straps are to be placed at 3 foot intervals along bundles. On completion of installation, neatly run and re-tie all cable bundles in the Closet and through cable plant.

S. All cable bundles within all Communications Rooms are to be no larger than 48 per.

22.3 Unused Components

A. Any components purchased in accordance with these specifications and unused shall be documented and passed to the Owner on completion of the project.

Part 23 - As-Built Documentation (required on completion of the work)

A. Following completion of the installation, submit the following record drawings, documentation and testing for approval.

B. As-Built Drawings

1. As-built drawings showing locations of telephone, tele/data and data outlets, backbone, distribution, splices for backbone, link and external cable routes, data rack locations, telephone termination board locations and cable identifications.

C. Final Test Results

1. Test results for each cable indicating tests performed, results obtained and values measured.

D. All documentation and drawings shall be provided in an electronic format (AutoCAD for drawings, MS Excel for schedule, etc) and supplied on CD-ROM. PDF or scans of non-electronically sourced materials are not acceptable. If there are questions regarding acceptable electronic formats, contact MAA/OT for clarification.