EOTSS Defined Standards
Telecommunications Cabling Specifications

Document History

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1.0	Jessica Powers	Initial Document	September 2020

SECTION 271000 - COMMUNICATIONS CABLING SYSTEMS

PART 1 - GENERAL

1.01. GENERAL REQUIREMENTS

A. All Work included in this Section has been configured so as to be issued as a separate "telecommunications" trade. If any duplicates or conflicts with other specification Sections should occur, the item of higher standard shall dictate.

B. General compliance requirements: Telecommunications Contractor shall provide a complete and operable system in compliance with the specifications, referenced standards, all applicable building codes, and all requirements of the AHJ. The scope of this project includes all planning, design, materials, equipment, labor, configuration, programming, testing, startup/commissioning services, and documentation costs for a complete and operable system, meeting all requirements contained in the specifications.

1. Where conflicts exist between applicable documents or standards, the most stringent requirements shall apply.

2. Work includes all items required for a complete system whether or not it is identified in the specification or on the drawings.

3. No exclusion from or limitation in, the symbolism used on the drawings for telecommunications Work or the language used in the specifications for telecommunications Work shall be interpreted as a reason for omitting the appurtenances or accessories necessary to complete any required system or item of equipment.

4. Any telecommunications drawings, elevations, details and riser diagrams shall be considered diagrammatic and therefore the Telecommunication Contractor is responsible for all quantities and sizes in order to provide a fully operational system.

C. Telecommunications Contractor must comply with all contract documents, specifications, drawings, manufacturer's instructions, and requirements of the Commonwealth of Massachusetts and the AHJ.

D. Complete and Usable Work: Telecommunications Contractor shall provide complete and usable work in accordance with the contract documents including all materials and equipment, along with all accessories and additional work required for field conditions, as well as additional work and accessories required for complete, usable, and fully functional construction and systems, even if not explicitly

specified or indicated. Contractor shall provide a complete and operable system in full compliance with all specification requirements, and shall include but not be limited to all required accessories, devices, equipment, wiring, programming, configuration, and work required to provide a complete and operable system complying with all drawing, specification, and performance requirements. If necessary in order to comply with all contract requirements, provide controllers and control panels with greater capabilities and capacities than those indicated.

E. Telecommunications Contractor shall coordinate installation work with all field conditions and the work of other trades. Minimum clearances and work required for compliance with NFPA 70, "National Electrical Code" and the manufacturer's instructions shall be provided. Comply with additional requirements indicated for access and clearances. The Contractor shall verify all field conditions and dimensions that affect the selection and provision of materials and equipment, and shall locate equipment, devices, and wiring as required to comply with all contract requirements.

F. Items and installation methods as described in any drawings and specifications provided for telecommunications Work are to be used only under normal work conditions as hereinafter described unless there are specific notations to the contrary.

G. Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of any telecommunications item in the drawings and specifications for telecommunications Work carries with it the instruction to furnish, install and connect the item as part of the telecommunications Work regardless of whether or not this instruction is explicitly stated.

H. It shall be understood that any specifications and drawings are complementary and are to be taken together for a complete interpretation of the telecommunications Work. Where there are conflicts between the drawings and specifications or within the specifications or drawings themselves, the items of higher standard shall govern.

I. To the extent that they govern the basic Work, the specifications also govern change order Work if any.

J. Any drawings for telecommunications Work utilize symbols and schematic diagrams that have no dimensional significance. The telecommunications Work shall, therefore, be installed to fulfill the diagrammatic intent expressed on telecommunications drawings, but in conformity with the dimensions indicated on the final working drawings, field layouts and shop drawings of all trades.

K. Information as to general construction and architectural features and finishes shall be derived from structural and architectural drawings and specifications only.

L. The use of words in the singular shall not be considered as limiting where other indications denote that more than one item is referred to.

M. Ratings of devices, materials and equipment specified without reference to specific performance criteria shall be understood to be nominal or nameplate ratings established by means of industry standard procedures.

N. The Work called for under this Contract shall be carried on simultaneously with the Work of other trades and Commonwealth of Massachusetts functions in such a manner as to not delay the overall progress of the construction project.

O. When directed by the Commonwealth of Massachusetts' TSS representative, the Telecommunication Contractor shall, without extra charge, make reasonable, minor modifications in the layout of hardware as needed to prevent conflict with Work of the trades, Commonwealth of Massachusetts functions or for proper execution of the Work.

P. The Telecommunication Contractor shall be responsible for providing adequate protection of equipment before and after installation.

Q. The Telecommunication Contractor is responsible for clean up of debris on a daily basis and cost of clean up is the responsibility of the Telecommunication Contractor unless otherwise specified.

1.02. SUBMITTALS

A. Telecommunications Contractor may be asked to provide complete technical and project approach submittals for the following submissions:

1. RFP Submittals: If requested, proposal submittals included with an RFP should contain;
    a. Executive Summary
    b. Compliance Certification
    c. System operation description covering this specific project
    d. Equipment data cut sheets
    e. Recommendations for system modifications to improve performance or functionality
    f. System schematics and wiring diagrams
    g. Proposed project cost, with breakdowns and other related information requested by the Commonwealth of Massachusetts' representative.

2. Approval Submittals: Telecommunications Contractor's submission of contract submittals for review and approval for use on the project. Include

all submittals specified herein and in the respective specification sections for the work specified in this contract.

3. Operations & Maintenance Manuals

B. Submittals shall be presented in a clear and thorough manner and shall include all information required by the applicable specification sections. Submit quantities as directed otherwise by the Commonwealth of Massachusetts.

C. For shop drawings, product data, samples, test reports, or other submittals that require more than two reviews for the same material or equipment, the Commonwealth of Massachusetts reserves the right to obtain compensation from the Telecommunications Contractor to defray the cost of the additional submittal reviews that result from submittal incompleteness, incorrect information, or non-compliance with the contract provisions. The Commonwealth of Massachusetts will notify the Telecommunications Contractor of the hourly rates for the additional submittal reviews, and will issue an invoice to the Contractor for the additional review cost. Payment of the additional submittal review costs by the Contractor is required within 30 days of invoicing. The Commonwealth of Massachusetts reserves the right to deduct additional costs defined herein that are indicated on past due invoices from the contract amount due the contractor.

D. The Contractor shall not be eligible for extensions of contract schedule or additional charges resulting from additional reviews of submittals resulting from incompleteness, incorrect information, or non-compliance with the contract provisions.

E. Refer to paragraph "Substitutions" hereinafter.

F. Approval Submittals: Prior to ordering of materials, beginning work, and prior to the pre-installation meeting specified herein, contractor shall submit the specified documentation in the complete set quantities required by the Commonwealth of Massachusetts's representative, or as specified in the project specification general requirements. Submittals of related systems shall be fully coordinated and submitted for review concurrently. Submit compliance certifications and submissions to the Authority Having Jurisdiction (AHJ) where specified.

G. Operation and Maintenance Manuals: Telecommunications Contractor shall prepare manuals and additional requirements specified in this section or other sections. Include data for each type product, including all features and operating sequences, both automatic and manual. Include recommendations for spare parts to be stocked at the site. Provide the names, addresses, and telephone numbers of service organizations that carry stock of repair parts for the system to be provided. Upon project completion, submit operation and maintenance manuals, consisting of the

following information as a minimum. Additional requirements are specified in the individual specification sections.

1. Index sheet, listing contents in alphabetical order.

2. Description of function, normal operating characteristics and limitations, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.

3. Manufacturer's equipment parts list of all functional components of the system.

4. Auto-CAD disk of system schematics, including wiring diagrams, in format approved by the Commonwealth of Massachusetts' representative.

5. Interconnection wiring diagrams, as installed and tested.

6. Manufacturer's user manuals for operations, administration, installation, and maintenance.

H. Test Reports: Submit results of all required factory and field testing. Submit results of all required startup and commissioning activities.

I. Record Drawings: Prepare manuals in accordance with specifications and maintain a separate hard copy set of drawings, elementary diagrams, and wiring diagrams of the structured cabling systems provided in this contract, to be used for record drawings. This set shall be kept up to date by neatly drawn hand annotations in red ink, reflecting all changes and additions made to the SCS. Copies of the final record drawings shall be provided to the Commonwealth of Massachusetts in .DWG format using the version of AutoCAD directed by the Commonwealth of Massachusetts's representative. Record drawings shall include:

1. SCS and all related infrastructure.

2. Raceway and pathway systems, size and location, for both exterior and interior; locations of all equipment and devices.

3. Equipment locations (exposed and concealed), dimensioned from prominent building lines.

4. Approved substitutions, Contract Modifications, and actual equipment and materials installed.

5. Record the locations and invert elevations of underground installations.

6. Installed cable routes, equipment and outlet locations, and administration labeling information prior to project completion.

1.03. SUBSTITUTIONS

A. Substitution requests will be considered only if submitted to the Commonwealth of Massachusetts's representative not less than 10 working days prior to the project bid date. Acceptance or rejection of the proposed substitution is at the Commonwealth of Massachusetts' representative sole discretion. No exceptions. Requests for substitutions shall be considered "NOT APPROVED" unless approval is issued in writing by the Commonwealth of Massachusetts' representative.

B. For equipment, cabling, wiring, materials, and all other products indicated or specified, the Commonwealth of Massachusetts does not expect nor desire requests for substitutions and alternate products other than those specified, and the Commonwealth of Massachusetts reserves the right for the Commonwealth of Massachusetts ' representative to reject proposed substitution requests and submissions of alternates without review or justification.

1.04. QUALITY ASSURANCE

A. Installer/Provider Qualifications: Comply with any additional requirements specified in this section or other sections. Prior to bidding, obtain and maintain all licenses required for the system installation work required by the local AHJ.

B. Local Requirements: Comply with the applicable building code, local ordinances, and regulations, and the requirements of the authority having jurisdiction (AHJ).

C. Product Listing: Systems and equipment shall be listed and labeled by a nationally recognized testing laboratory (NRTL) for compliance with the referenced standards. All items of the SCS shall be listed as a product of the specified structured cabling system manufacturer under the appropriate category by the NRTL and shall bear the appropriate label.

D. Materials and equipment shall be the catalogued products of manufacturers regularly engaged in production and manufacture of said components or systems and shall be manufacturer's latest standard design that complies with the specification requirements.

1.05. WARRANTY

A. General Requirements: Telecommunications Contractor shall comply with any additional or extended warranties required in other specification Sections. Provide all services, materials and equipment necessary for the successful operation of the

entire SCS system for a period of one year after beneficial use. Scope of warranty includes all equipment, devices, wiring, accessories, software, hardware, installation, programming, and configuration required to maintain a complete and operable system. The contractor shall furnish the Commonwealth of Massachusetts a minimum one (1) year's warranty on materials and workmanship furnished and performed under this contract, plus additional warranties specified in other specification sections of this project, including but not limited to specification sections related to the SCS system. This shall apply to all items except those specifically excluded, or items wherein a longer period of service and warranty is specified or indicated. All warranties shall be effective for one year, minimum, from the date the SCS is accepted by the Commonwealth of Massachusetts. Use of systems provided under this section for temporary services and facilities shall not constitute Final Acceptance of work nor beneficial use by the Commonwealth of Massachusetts and shall not automatically initiate the warranty period. The warranty shall cover repair or replacement of defective materials, equipment, workmanship, and installation that may be incurred during this period. Warranty work is to be done promptly and to the Commonwealth of Massachusetts' satisfaction. In addition, the warranty shall cover correction of damage caused in making necessary repairs and replacements under warranty. Additional warranty responsibilities are:

1. Obtain written equipment and material warranties offered in manufacturer's published data without exclusion or limitation, in Commonwealth of Massachusetts’ designated name.

2. Replace material and equipment that require excessive service during the guarantee period as determined by the Commonwealth of Massachusetts.

3. Provide 24-hour service beginning on the date of Substantial Completion and lasting until the termination of the warranty period. Service shall be at no cost to the Commonwealth of Massachusetts. Service can be provided by installing contractor or by a separate service organization. Choice of service organization shall be subject to Commonwealth of Massachusetts' approval. Submit name and a phone number that will be answered on a 24-hour basis each day of the week, for the duration of the service.

4. Submit copies of equipment and material warranties to Commonwealth of Massachusetts before final acceptance.

5. At end of guarantee period, transfer manufacturers' equipment and material warranties still in force to the Commonwealth of Massachusetts.

6. If warranty work problems cannot be corrected immediately to Commonwealth of Massachusetts' satisfaction, advise Commonwealth of Massachusetts in writing, describing efforts to correct the situation, and provide analysis of cause for the problem. If necessary to resolve the

problem, provide at no cost the services of the manufacturer's engineering and technical staff at the site in a timely manner to analyze the warranty issues, and develop recommendations for correction, for review and approval by the Commonwealth of Massachusetts.

B. This paragraph shall not be interpreted to limit the Commonwealth of Massachusetts' rights under applicable codes and under this Contract.

C. Other Specification Sections may specify warranty requirements that exceed those of this Paragraph.

1.06. COMPLETENESS OF WORK

A. Complete and Usable Work: The Telecommunications Contractor is responsible for providing complete and usable work in accordance with the contract documents. All materials and equipment shall be provided with all accessories and additional work required for field conditions, as well as additional work and accessories required for complete, usable, and fully functional construction and systems, even if not explicitly specified or indicated. The horizontal cabling systems described in this specification shall be provided as complete and operable systems in full compliance with all requirements on the drawings and all specification requirements. If drawings are utilized, they are to be considered as diagrammatic and the specifications as performance-based; the Contractor shall provide all work required to comply with the drawings and specifications, even if not explicitly indicated or specified. The Contractor shall be responsible for coordinating installation of the electrical systems with all field conditions and the work of other trades. Minimum clearances and work required for compliance with NFPA 70, "National Electrical Code" and the manufacturer's instructions shall be provided. Comply with additional requirements indicated for access and clearances. The Telecommunications Contractor shall verify all field conditions and dimensions that affect the selection and provision of materials and equipment, and shall provide any disassembly, reassembly, relocation, demolition, cutting and patching required to provide the work specified or indicated, including relocation and reinstallation of existing wiring and equipment. The Telecommunications Contractor shall protect from damage resulting from the Contractor's operations the existing facility, equipment, and wiring. Extra charges for completion and contract time extension will not be allowed on account of field conditions or additional work required for complete and usable construction and systems.

B. Installation and Coordination: Use judgment and care to install any telecommunications work to function properly and fit within building construction and finishes. Provide electrical conductors, conduit, and components not shown or specified that are required for any device or system to function as a complete and fully operational system. Verify device/equipment-mounting heights as required by project conditions prior to rough-in. Route conduits and wiring associated with new

equipment and systems above ceilings, in existing chases, and concealed within building structure, except where indicated of specified to be exposed. Provide proper number of cables to provide a complete and fully operational system for all work indicated in the contract documents.

C. Drawings and Specifications form complementary requirements; provide work specified and not shown, and work shown and not specified as though explicitly required by both. Except where explicitly modified by a specific notation to the contrary, it shall be understood that the indication or description of any item, in the drawings or specifications or both, carries with it the instruction to furnish and install the item, provided complete.

D. As used in this specification, "provide," means "furnish and install." "Furnish" means "to purchase and deliver to the project site complete with every necessary appurtenance and support," and "install" means "to unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project."

E. Give notices, file plans, obtain permits and licenses, pay fees, and obtain necessary approvals from authorities that have jurisdiction as required to perform work in accordance with all legal requirements and with Specifications, Drawings, Addenda and Change Orders, all of which are part of Contract Documents.

F. Provide supplementary or miscellaneous items, appurtenances, devices and materials necessary for a sound, secure and complete installation. Examine Drawings and other Sections of the Specifications for requirements that affect work of this section. Completely coordinate work of this Section with work of other Sections and provide a complete and fully functional installation. Refer to all other Drawings and other Specifications Sections that indicate types of construction in which work shall be installed and work of other Sections with which work of this Section must be coordinated.

G. Items referred to in singular number in Contract Documents shall be provided in quantities necessary to complete the work.

1.07. PROJECT CONDITIONS

A. Field Verification: The Telecommunications Contractor shall carefully verify the location, use and status of all material, equipment, and utilities that are specified, indicated, or deemed necessary for removal. Verify that all materials, equipment, and utilities to be removed are completely inactive and will not be required or in use after completion of the project. Replace with equivalent any material, equipment and utilities that were removed by the Contractor that are required to be left in place.

B. Existing Cabling System: Do not interrupt any existing SCS-serving facilities occupied by Commonwealth of Massachusetts or others unless permitted under the

following conditions and then only after arranging to provide a temporary SCS according to requirements indicated:

1. Notify Commonwealth of Massachusetts in writing at least 14 days in advance of proposed interruptions.

2. Do not proceed with interruptions without Commonwealth of Massachusetts' written permission.

3. Installation:

    a. Determine suitable path for new SCS and consider project conditions.

    b. Verify clearance requirements and locate equipment to meet installation tolerances.

    c. Revise locations and elevations from those indicated to those required to suit Project.

1.08. DELIVERY, STORAGE, AND HANDLING

A. Store and protect products in accordance with manufacturer's instructions.

1.09. PERMITS

A. The contractor shall secure and pay for all licenses, permits, and inspection fees required by local agencies and/or other agencies having jurisdiction. The contractor, by submitting his bid, agrees to furnish any additional labor or material required in order to comply with all local and other agencies having jurisdiction at no additional cost. The contractor shall obtain any required certificates of inspection and approval from all authorities having jurisdiction, and forward copies of same to the Commonwealth of Massachusetts' representative prior to request for project acceptance inspections, final completion inspections, substantial completion inspections, and acceptance testing/demonstrations.

1.10. EXAMINATION

A. Prior to submitting a proposal, the Telecommunications Contractor shall examine the site, review the contract drawings and specifications, and determine the exact extent of the work required. Contractor shall include in their proposals all materials, labor, and equipment required to complete the work indicated and required. Work that is necessary to obtain the complete and usable project as specified herein shall be included in the contractor's proposal, even if not indicated or specified.

B. Should the bidders have any questions as to the intent of the drawings and/or specifications, quality of materials to be used, and work to be performed, questions shall be submitted in writing to the Commonwealth of Massachusetts' representative in the manner dictated by the Commonwealth of Massachusetts' representative. All answers and clarifications to the drawings and specifications will be issued in writing.

C. Claims for extra payment will not be allowed due to unfamiliarity with the work to be performed by other trades, existing conditions at the job site, local or state laws and codes and alterations due to field conditions.

1.11. ADDITIONAL COSTS INCURRED BY COMMONWEALTH OF MASSACHUSETTS FOR TESTING AND PROJECT ACCEPTANCE INSPECTIONS

A. Project acceptance inspections, final completion inspections, substantial completion inspections, and acceptance testing/demonstrations shall be conducted after verification of system operation and completeness by the Contractor.

B. For project acceptance inspections, final completion inspections, substantial completion inspections, and testing/demonstrations that require more than one site visit by the Commonwealth of Massachusetts' representative to verify contract compliance for the same material or equipment, the Commonwealth of MA reserves the right to obtain compensation from the Contractor to defray the cost of the additional site visits that result from project construction or testing deficiencies/incompleteness, incorrect information, or non-compliance with the contract provisions. The Commonwealth of Massachusetts' representative will notify the Contractor of the hourly rates and travel expenses for the additional site visits, and will issue an invoice to the Contractor for the additional site visits. Payment of the additional site visit costs by the Telecommunications Contractor is required within 30 days of invoicing. The Commonwealth of Massachusetts reserves the right to deduct additional costs defined herein that are indicated on past due invoices from the contract amount due the contractor.

C. The Telecommunications Contractor shall not be eligible for extensions of contract schedule or additional charges resulting from additional site visits that result from project construction or testing deficiencies/incompleteness, incorrect information, or non-compliance with the contract provisions.

2.01. SUMMARY

A. Section Includes:

1. Pathways.

2. UTP cabling.
3. Coaxial cable.
4. Fiber Optic cable
5. Cable connecting hardware, patch panels, and cross-connects.
6. Telecommunications outlet/connectors.
7. Backbone Cabling Systems
8. Cabling system identification products.
9. Field Quality Control

B. This document shall be used (in conjunction with telecommunications drawings, if available) to obtain a competitive bid for the telecommunications cabling systems associated with the project.

C. This document shall be distributed for the planning of the supporting infrastructure (pathways and spaces) for the telecommunications systems.

2.02. DEFINITIONS

A. As used in the drawings and specifications for telecommunications Work, certain non-technical words shall be understood to have specific meanings as follows regardless of indications to the contrary in the general conditions or other documents governing the telecommunications Work.

Furnish" -- Purchase and deliver to the project site complete with every necessary appurtenance and support, all as part of the telecommunications Work. Purchasing shall include payment of all sales taxes and other surcharges as may be required to assure that purchased items are free of all liens, claims or encumbrances. Payment of sales taxes is, however, specifically excluded.

"Install" -- Unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project, all as part of the telecommunications Work.

"Provide" – means to "furnish" and "install."

"New" -- Manufactured within the past two years, equal to the current version or revision number, and never before used.

B. Regardless of their usage in codes or other industry standards, certain words as used in the drawings or specifications for the telecommunications, Work shall be understood to have the specific meanings ascribed to them in the following list:-

"Accessible Corridor" - A common horizontal pathway which can be approached or entered easily in which telecommunications cables are run until they branch out to individual workstation terminations.

"Assembly" A defined set of elements of telecommunications Work.

“Category 3” -- Cables/connectivity with transmission characteristics rated for 16 MHz as defined in TIA-568.C.2 and all related addendums or bulletins.

“Category 6” -- Cables/connectivity with transmission characteristics rated for 250 MHz as defined in TIA-568.C.2 and all related addendums or bulletins.

“Augmented Category 6 or Category 6A” -- Cables/connectivity with transmission characteristics rated for 500 MHz as defined in TIA -568.C.2 and all related addendums or bulletins.

"Circuit" -- An electrical or optical path used for communications between two devices.

“Communications Plenum cable (CMP)” -- Cable listed as being suitable for use in ducts, plenums, and other air-handling spaces.

“Communications Riser cable (CMR)” -- Cable listed as being suitable for use in a vertical shaft or from floor to floor.

"Telecommunications Room” (TR) -- An enclosed area or space specifically designated for the routing, termination and/or cross-connecting of telecommunications cable (i.e., riser cable) to other telecommunications cable and/or equipment (i.e., workstation cables or concentrators). This may also be referred to as the telephone or communications closet.

"Telecommunications Infrastructure" -- Any telecommunications Work which consists of wires, cables, raceways, and/or specialty wiring method assemblies taken all together complete with associated junction boxes, pull boxes, outlet boxes, joints, couplings, splices and connections except where limited to a lesser meaning by specific description.

"Telecommunications Work" -- All telecommunications Work as defined by the telecommunications drawings and specifications.

"Electromagnetic Interference (EMI)” – An undesirable effect on electronic equipment or signals, created by radiated or conducted electromagnetic energy.

"Entrance Point" -- Point at which telecommunications cabling enters the building. Where cable enters in conduit that is buried in a concrete floor, the point at which the conduit emerges from the floor is considered the entrance point.

“Horizontal Cross-connect (HC) -- A floor or area-serving group of connectors that allows backbone and horizontal cabling, equipment, systems and subsystems to be cross-connected or interconnected using patch cords or jumpers.

“Horizontal Cabling”-- Distribution media that connects the telecommunications outlet or connector in the work area to a consolidation point or horizontal connection point or to the first piece of connecting equipment in the horizontal cross-connect.

“Intermediate Cross-connect (IC) -- A group of connectors between the first and second level backbone that allows equipment, systems and subsystems to be cross-connected.

“Insulation displacement connector (IDC) – Wire termination where the insulation around a conductor is displaced at the point of connection.

"Intermediate Distribution Frame (IC)” – See Horizontal Cross-connect and Intermediate Cross-connect.

"Local area network (LAN)” – A computer network that encompasses a relatively small area, floor, group of floors, building or campus.

"Low Voltage" – 1. Circuits less than 50 volts (NEC Article 720) 2. Voltage 0-150 AC/DC (Article 725)

"Main Distribution Frame (MDF)” -- See Main Cross-Connect.

Main Cross-connect (MC) -- A group of connectors, normally located in the (main) equipment room, that allows the cross-connection and interconnection of entrance cabling, first-level backbone, horizontal cabling, equipment, systems and subsystems.

"Patch Panel" -- A system of terminal blocks, patch cords, and backboards that facilitates administration of cross-connect fields for moves and rearrangements.

“Plenum” -- A building space that forms part of the air distribution system for heating, ventilation or air conditioning.

Polyvinyl chloride (PVC) -- A general purpose, water-resistant thermoplastic use as a jacketing and insulation material for wire and cable.

"Raceway" -- Any pipe, duct, extended enclosure, or conduit (as specified for a particular system) which is used to contain wires or cables.

"Riser" -- 1. The space used for cable to pass from floor-to-floor. 2. Vertical sections of cable.

"Station Cable" -- See Horizontal Cabling.

"Shielded Twisted-Pair (STP) -- Multiple twisted copper pair cable with an additional metallic shield covering each individual pair.

Structured Cabling System (SCS) – A complete collection of telecommunications cabling and associated hardware in a given location.

“Telecommunications Outlet/Connector (TO)” -- A connecting device in the work area upon which horizontal cabling terminates and into which the work area cable (cord) is connected.

"Unshielded Twisted-Pair (UTP) -- One or more pairs of twisted copper conductors with no metallic shielding.

“Voice over Internet Protocol (VoIP)” -- Hardware or software that enables the Internet to be used as the transmission medium for telephone calls by sending voice data in packets using IP rather than by traditional circuit transmissions of the public switched telephone network.

"Work Area” or “Work Station” -- The location where end users interact with telecommunications or network equipment.

C. Reference to "U.L. (Materials Construction) Standards" shall mean the "Standards for Safety," published by Underwriters Laboratories, Inc., 333 Pfingsten Road, Northbrook, Illinois 60062.

D. Reference to "NEMA Standards" shall mean the "Approved Standards" published by the National Electrical Manufacturers Association, 2101 "L" Street, N.W., Washington, D.C. 20037.

E. Reference to "ANSI Standards" shall mean the standards published by the American National Standards Institute, 1819 L Street, NW, Suite 600, Washington, DC 20036.

F. Reference to "TIA Standards" shall mean the standards published by the Telecommunications Industry Association,1320 North Courthouse Road, Suite 200 Arlington, VA 22201

G. Reference to "IEEE Standards" shall mean the standards published by the Institute of Electrical and Electronics Engineers, 3 Park Avenue, 17th Floor, New York, N.Y. 10016.

H. Reference to "BICSI Standards" shall mean the guidelines and methods described in the Telecommunications Distribution Methods Manual (TDMM), 14th Edition,

(2020) published by the Building Industries Consulting Service International (BICSI), 8610 Hidden River Pkwy., Tampa, FL 33637.

I. Reference to "RUS Standards" shall mean the standards published by the Rural Utilities Services, 1400 Independence Ave., SW, Rm. 5151, Washington, DC 20250.

J. Reference to "Bell Standards" shall mean the standards published by Telcordia Technologies, formerly Bell Communications Research, Incorporated (Bellcore), One Telcordia Drive, RRC 1B-180, Piscataway, NJ 08854.

K. Reference to “NRTL” shall mean any of the laboratories listed in OSHA’s Nationally Recognized Testing Laboratory program, N3653, Frances Perkins Building, 200 Constitution Ave. NW, Washington, DC 20210.

L. Reference to “BICSI ITSIM” shall mean the Information Transport Systems Installation Manual (ITSIM), 7th Edition, published by the Building Industries Consulting Service International (BICSI), 8610 Hidden River Pkwy., Tampa, FL 33637.

2.03. HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.

1. TIA-568-C.1 defines the minimum requirement for telecommunication outlets for each work area.
2. Horizontal cabling shall contain no more that one transition point, consolidation point or horizontal connection point between the horizontal cross-connect and the telecommunications outlet/connector. Bridged taps and splices shall not be installed in the horizontal cabling, except as permitted in TIA-862, Building Automation Systems Cabling Standard for Commercial Buildings.
3. Splitters shall not be installed as part of the optical fiber cabling.

B. A work area is approximately 100 sq. ft. (9.3 sq. m), and includes the components that extend from the telecommunications outlet/connectors to the station equipment.

C. The maximum allowable length of the horizontal link is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment. The maximum allowable length does not

include an allowance for the length of 16 feet (4.9 m) in the horizontal cross-connect.

2.04. BACKBONE CABLING DESCRIPTION

A. Backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, Intermediate and Main Cross-connects mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

2.05. PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal and Backbone cabling system(s) shall comply with transmission standards in TIA-568-C, when tested according to test procedures of this standard.

B. Manufacturer Seismic Qualification Certification (if applicable): Submit certification that distribution racks and their components will withstand seismic forces: Include the following:

1. Basis for Certification: Base certification on the maximum number of components capable of being mounted in each rack type. Identify components on which certification is based. Indicate whether withstand certification is based on actual test of assembled components or on calculation.
    a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
    b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity of each rack-mounted component and of each assembled rack type, and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

2.06. QUALITY ASSURANCE

A. Installer Qualifications:

1. System installer must have on staff a Registered Communication Distribution Designer (RCDD) certified by Building Industry Consulting Service International (BICSI).

2. The Telecommunication Contractor selected must be authorized to certify and warranty their cable and connectivity solution. Provide a resume of qualifications for the Telecommunication Contractor's Project Manager and on-site supervisors and technicians that will be assigned to the project.

3. The Telecommunication Contractor selected must provide a list of training and certification for their solution. Telecommunication Contractor's personnel that will install any materials for the project. The list will be subject to review and approval by the Commonwealth of Massachusetts' TSS representative.

4. The Telecommunication Contractor shall have at least five (5) years experience installing and servicing telecommunication systems.

5. The Telecommunication Contractor shall be Authorized and be able to provide a twenty (20) year manufacturer warranty on their solution.

6. The Telecommunication Contractor shall be approved by the Commonwealth of Massachusetts and an active participant of ITC68 contract.

B. Verification Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

C. Source Limitations: Obtain all SCS products including twisted-pair and fiber-optic cables through one source from a single manufacturer, e.g. CommScope, Inc.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NFPA 70.

F. All equipment and materials for permanent installation shall be the products of recognized manufacturers and shall be new.

G. New equipment and materials shall:

1. Be Underwriters Laboratories, Inc. (U.L.) labeled and/or listed where specifically called for or where normally subject to such U.L. labeling and/or listing services.

2. Be clearly labeled identifying the transmission parameters specified (specifically with reference to Category 5E and Category 6 or higher ratings).

3. Be without blemish or defect.

4. Be in accordance with the latest applicable standards.

5. Be products that meet with the acceptance of the agency inspecting the telecommunications Work.

H. Manufacturer's Recommendations: Where installation procedures of any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

I. Telecommunications Pathways and Spaces: Comply with TIA-569-B.1.

J. Grounding: Comply with ANSI-J-STD-607-A.

2.07. CODES, PERMITS AND INSPECTIONS

A. All telecommunications Work shall meet or exceed the latest requirements of all national, state, county, municipal, and other authorities exercising jurisdiction over the telecommunications Work and the project.

B. All required permits and inspection certificates shall be obtained, paid for, and made available at the completion of the telecommunications Work. In the event that no official authority exists which will issue a certificate attesting to the safety of the electrical installations, such a certificate shall be acquired from an independent agency selected by the Commonwealth of Massachusetts. Inspection and certification fees levied by this agency shall be paid for as part of the telecommunications Work.

C. Any portion of the telecommunications Work which is not subject to the requirements of an electric code published by a specific authority having jurisdiction (AHJ) shall be governed by the National Electrical Code and other applicable Sections of the National Fire Code, as published by the National Fire Protection Association.

D. In the event the authority having jurisdiction does not require a permit for this scope of Work, Telecommunication Contractor must obtain that information, in writing, from the AHJ and provide to Commonwealth of Massachusetts, prior to the start of the Work.

E. Installation procedures, methods and conditions shall comply with the latest requirements of the Federal Occupational Safety and Health Administration (OSHA).

2.08. GUARANTEES AND CERTIFICATIONS

A. All telecommunications Work shall be guaranteed to be free from defects. Any defective materials or workmanship, as well as damage to the telecommunications Work of all trades resulting from same, shall be replaced or repaired as directed for the duration of stipulated guarantee periods.

B. The duration of guarantee periods following the date of acceptance of the telecommunications Work shall be:

1. For Work not otherwise specified -- one year.

C. The date of acceptance shall be the date of the final payment for the telecommunications Work or the date of a formal notice of acceptance, whichever is earlier.

D. Non-durable items shall be replaced up to the date of acceptance, such that they shall have had no use prior to this date.

E. Certification shall be submitted attesting to the fact that specified performance and other criteria are met by all items of telecommunications Work for which such certification is required.

F. The Telecommunication Contractor must possess the required certifications to install and offer manufacturer’s warranties for the specified cabling system and other components or systems. Proof of such certifications must be included with the bid response.

2.09. COORDINATION

A. Coordinate layout and installation of voice and data communication cabling with Commonwealth of Massachusetts' telecommunications and LAN equipment suppliers. Coordinate service entrance arrangement with local exchange carrier.

B. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Commonwealth of Massachusetts to exchange information and agree on details of equipment arrangements and installation interfaces.

C. Record agreements reached in meetings and distribute to other participants.

D. Adjust arrangements and locations of cross-connect and patch panels in equipment rooms and wiring closets to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.

E. The Telecommunication Contractor is responsible for reviewing coordination drawings produced by other trades to make sure proper clearances are maintained and cable routing and space layouts are coordinated. Any problems shall be brought to the attention of the engineer.

F. The Telecommunication Contractor is responsible for coordinating the exact location of the telecommunications outlets along with their associated power receptacle(s) with the Commonwealth of Massachusetts' TSS representative.

G. The Telecommunication Contractor is responsible for the coordination of all trades that impact any of the telecommunication rooms. Any alteration within or around the telecommunication rooms that effects the protection of the telecommunication cables and equipment shall be brought to the attention of the Commonwealth of Massachusetts' TSS representative.

2.10. SEPARATION OF WORK BETWEEN TRADES

A. The specifications for the overall construction delineate various items of Work under separate trade headings. The list below sets forth this delineation to the extent that it affects the telecommunications Work.

B. In the absence of more detailed information, the list shall be taken as a specific instruction to the Telecommunications Trade to include the telecommunications Work assigned to it.

C. Indications that any trade is to perform an item of Work means that it is to perform the telecommunications Work for its own accommodation only, except as specifically noted otherwise.

D. Include in the telecommunications Work all necessary supervision and the issuing of all coordination information to any other trades who are supplying Work to accommodate the telecommunications installations.

E. For items of equipment which are to be installed but not purchased as part of the telecommunications Work, the telecommunications Work shall include:-

1. The coordination of their delivery.

2. Their unloading from delivery trucks driven in to any point on the property line at grade level.

3. Their safe handling and field storage up to the time of permanent placement in the project.

4. The correction of any damage, defacement or corrosion to which they may have been subjected.

5. Their field make-up as may be necessary for their proper operation.

6. Their mounting in place including the purchase and installation of all dunnage, supporting members, and fastenings necessary to adapt them to architectural and structural conditions.

7. Included shall be the purchase and installation of any substitute lugs or other wiring terminations as may be necessary to adapt their terminals to the wiring as called for and to the connection methods set forth in these specifications.

F. Items of equipment which are to be installed but not purchased as part of the telecommunications Work shall be carefully examined upon delivery to the project. Claims that any of these items have been received in such condition that their installation will require procedures beyond the reasonable scope of the telecommunications Work will be considered only if presented in writing within one week of the date of delivery to the project of the items in question. The telecommunications Work includes all procedures, regardless of how extensive, necessary to put into satisfactory operation, all items for which no claims have been submitted as outlined above.

G. Where materials are specified to be provided by the Commonwealth of Massachusetts or their representative, the following shall be performed:

1. Prior to ordering of the cabling, the Telecommunication Contractor shall identify the types, quantities, colors, etc. required and provide them to the Commonwealth of Massachusetts to be ordered.

2. The Telecommunication Contractor shall ensure that the information is complete and accurate. Any errors or omissions in the ordering information will be the Telecommunication Contractor's responsibility.

3. At the beginning of the Work, the Telecommunication Contractor shall coordinate lead times of all material with the Commonwealth of Massachusetts' TSS representative. The Telecommunication Contractor shall bear all responsibility for this coordination or lack thereof.

4. The Commonwealth of Massachusetts' ordering deadline shall be based on the lead times agreed upon. The Telecommunication Contractor shall be informed of any changes in material lead time as the Work progresses.

5. The Telecommunication Contractor shall bear the responsibility of any delays in the Work if requests for materials are not placed with the Commonwealth of Massachusetts in writing at least one business day in advance of the Commonwealth of Massachusetts' ordering deadline, taking the agreed upon lead times into account.

2.11. UNIT PRICE QUOTATIONS

A. The Commonwealth of Massachusetts reserves the right to request unit pricing. When requested, the following guidelines will be utilized.

1. Telecommunications Contractor shall submit separate unit price quotations for each of the various components and assemblies. Unit prices shall include overhead, profit, insurance and taxes.

2. Unit price quotations shall be suitable both for additions and deductions.

3. Except where specific exceptions are indicated, it shall be understood that equipment, materials, installation methods, etc., required for unit quotation items are to be identical to those called for under the base bid.

4. Unit price quotations shall, in each case, be for complete Work, furnished and installed, unless otherwise noted.

B. In addition, the Commonwealth of Massachusetts may request the Telecommunications Contractor to provide unit quotations to cover authorized additional telecommunications Work performed on a "Time and Material" basis as follows:

Labor---------- per man hour.

Regular Working -------- for one man working one Hour's Labor hour during the stipulated time.

Overtime Labor---------- for one man working one hour during the stipulated time.

Material---------- percentage to be applied to actual cost.

1. Unit prices for labor shall include all supervision, insurance, overhead and profit.

2. Quotations for labor shall be accompanied by a schedule denoting the times for which the various indicated rates are applicable.

2.12. RECORD DRAWINGS

A. As part of the required telecommunications Work, a complete set of "as-built" or record telecommunications drawings shall be made up and delivered to the Commonwealth of Massachusetts' TSS representative.

B. The drawings shall show:

1. All telecommunications Work installed exactly in accordance with the original design and/or specification.

2. All telecommunications Work installed as a modification or addition to the original design and/or specification.

3. The dimensional information necessary to delineate the exact location of all circuitry and wiring runs which are concealed as to be untraceable by inspection through the regular means of access established for inspection and maintenance.

4. The numbering information necessary to correlate all telecommunications items (or outlets for same) to the patch panel, end user or head end device to which they are connected.

C. The as-built drawings shall be produced using AutoCAD 2000 (or later version) design package.

1. Another CAD program (Visio preferred) may be utilized as the as-built drawing package of choice subject to review and approval by the Commonwealth of Massachusetts' TSS representative as to the specific software and version, etc., to be used.

2. Prior to developing any "as-built" drawings, the Telecommunication Contractor shall coordinate with the Commonwealth of Massachusetts TSS representative the layering structure, colors, etc., of CAD drawings.

D. The quantity of design drawings which are made available represents the minimum number of drawings to be included in the record drawing set and shall in no way be interpreted as setting a maximum limit to the number of drawings necessary to show the required "as-built" information.

E. Any and all costs for document conversion (if necessary), printing, etc., are the responsibility of the Telecommunication Contractor.

F. Design drawings will be made available in Visio, for the exclusive purpose of producing "as-built" drawings. These documents remain the property of the Commonwealth of Massachusetts and shall be used for no other purpose without expressed, written consent. The Telecommunication Contractor shall assume all liabilities resulting from unauthorized modifications to the drawings.

G. "As-built" information submitted to the Engineer and/or Commonwealth of Massachusetts' TSS representative for approval shall contain the following:

1. CAD (or Visio with prior approval) drawing file on CD-Rom or other approved electronic media.

2. Two (2) sets of printed ANSI E sized drawings.

H. The Telecommunication Contractor shall establish cable records during the installation. Cable records will be maintained on Microsoft Excel. These records shall correlate the workstation ID number, distribution cable number, punch down block or rack assignments, conduit or duct path and station location. These records shall be updated as the project progresses to reflect any required changes made either in the field or as a result of design changes. As-built Records/Drawings will be furnished as specified after the completion of installation and acceptance of the space by the Commonwealth of Massachusetts TSS representative. The database format (i.e., field and record descriptions) shall be submitted to the Commonwealth of Massachusetts' TSS representative for approval prior to beginning Work.

PART 2 - PRODUCTS

2.01. PATHWAYS

A. General Requirements: Comply with TIA-569-B.1.

B. Cable Support: NRTL labeled for support of Category 6/6a cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

1. Support brackets with cable tie slots for fastening cable ties to brackets.
2. Lacing bars, spools, J-hooks, and D-rings.
3. Straps and other devices.

C. Cable Trays:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or equivalent:

    a. Chatsworth
    b. Cooper B-Line, Inc.

2. Cable Tray Materials: Metal, suitable for indoors, and protected against corrosion by electroplated zinc galvanizing, complying with ASTM B 633, Type 1, not less than 0.000472 inch hick [hot-dip galvanizing, complying with ASTM A 123/A 123M, Grade 0.55, not less than 0.002165 inch thick .

    a. Ladder Cable Trays: Nominally 12inches wide (minimum), and a rung spacing of 12 inches.
    b. Ladder rack shall be run within the main corridors for fit out space equal or greater to 10,000sq ft. For projects under 10,000 sq ft, cables shall be supported via J-Hooks.
    c. Refer to any plans and drawings for additional information.

    NOTE: Telecommunication Contractor is responsible for all associated parts and supports products for a complete installation.

D. Conduit and Boxes: (Flexible metal conduit shall not be used.)

1. Outlet boxes shall be a double gang box with a single gang reducer bracket, unless otherwise noted.

2. Each telecommunication outlet shall have a 1" conduit stubbed up with pull string to the nearest accessible ceiling and/or cable tray.

E. Innerduct

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or equivalent:

    a. Carlon
    b. Endot

2. Flexible, fire retardant, plenum rated, 1 inch inner duct

3. The color of the inner duct shall be orange.

2.02. SYSTEM REQUIREMENTS

A. General: Coordinate the features of materials and equipment so they form an integrated system. For optimum performance, the entire cable infrastructure system shall have the same performance (transmission speeds) for all components. The Telecommunication Contractor shall provide all of the necessary components to install a completely operational cabling system (regardless if they are shown on the drawings or listed in this specification).

B. Expansion Capability: Unless otherwise indicated, provide spare conductor pairs in riser cables, positions in riser and horizontal cross-connect and patch panels, and terminal strips to accommodate 20 percent future increase.

2.03. BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches.

B. On one of the walls (where intended to mount 110 termination blocks), the backboard shall be mounted to 2" x 4" studs at 24" on center, unless otherwise noted.

C. Backboards shall be AC grade with the “A” side (smooth) facing out.

2.04. UTP CABLE (HORIZONTAL)

A. Manufacturers: Subject to compliance with requirements, provide products by the following manufacturer or equivalent:

1. SYSTIMAX Solutions; a CommScope, Inc. brand.

B. Description: 100-ohm, 4-pair UTP.

1. Comply with ANSI/ICEA S-90-661-2002 for mechanical properties.

2. Comply with TIA-568-C.1 for performance specifications.

3. Comply with TIA-568-C.2, Category 6 or Category 6A.

4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

a. Communications, Plenum Rated: Type CMP, complying with NFPA 262.

b. Communications, Riser Rated: Type CMR, complying with UL 1666.

   i The horizontal cable's fire rating shall meet that of the ceiling space to where the cables are intended to be routed.

c. The horizontal cable utilized for the distribution of data shall be 4-pair, plenum rated (unless less otherwise requested), Category 6, manufactured by SYSTIMAX 2071 series cable or approved equal.

   i The horizontal cable, running to/from each data port #1, shall be blue.

d. The horizontal cable utilized for the distribution of voice port shall be 4-pair, plenum rated (unless less otherwise requested), Category 6, manufactured by SYSTIMAX 2071 series cable or approved equal.

   i The horizontal cable, running to/from each voice port #1 (terminated on 110 blocks), shall be white in color.
   ii The horizontal cable, running to/from each voice port #2 (terminated on patch panels-VoIP), shall be yellow in color.

e. The horizontal cable utilized for the distribution of WiFi access points shall be 4-pair, plenum rated (unless less otherwise requested), Category 6A.
   i Coordinate exact color and termination method with Commonwealth of Massachusetts' TSS representative.

f. The horizontal cable utilized for the distribution of miscellaneous (voice/data/other) shall be 4-pair, plenum rated (unless less otherwise requested), Category 6.

   i For the fourth cable (miscellaneous), coordinate exact color and termination method with Commonwealth of Massachusetts' TSS representative.

2.05. UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers or equivalent:

   1. SYSTIMAX Solutions; a CommScope, Inc. brand.

B. General Requirements for Cable Connecting Hardware: Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

C. Connecting Blocks: 110-style IDC for Category 6 Provide blocks for the number of cables terminated on the block, plus 20 percent spare. Connecting blocks shall include all associated hardware (i.e. connecting clips: C-4/C-5, labels, and, label holders).

1. 100-pair filed terminated blocks, 110 type shall be manufactured by SYSTIMAX, P/N: 110AB2-100FT or equivalent.

    a. Telecommunication Contractor is responsible for all associated support products in order to install a complete solution.
    b. 300 pair termination blocks may be utilized for projects requiring larger backbone configurations or more than 24 voice users (i.e. 300 pair copper backbone). (SYSTIMAX P/N: 110AB2-300FT) or equivalent.

D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.

1. Coordinate the number of pairs to be cross connected with Commonwealth of Massachusetts' TSS representative

E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables. All patch panels shall include rear strain relief bars.

1. 24/48 port patch panel shall be Category 6, manufactured by SYSTIMAX, P/N: 1100-U-GS3-24 (Cat 6, 24 port) and 1100-U-GS3-48 (Cat 6, 48 port). Or 1100-U-GS6-24 (Cat 6A, 24 port) and 1100-U-GS6-48 (Cat 6A, 48 port) or equivalent.

    Note: Telecommunication Contractor to confirm with Commonwealth of Massachusetts TSS representative if VoIP is to be implemented for voice connectivity. If yes, coordinate exact termination method with Commonwealth of Massachusetts' TSS representative (i.e. utilize same patch panels intended for data or separate patch panels).

F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

G. Patch Cords: Factory-made, four-pair, stranded cables in 36-inch, 48-inch, 60-inch, and 84-inch lengths; terminated with eight-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.

2. Patch cords shall be color-coded for circuit identification

3. Field terminated patch cords are not acceptable.

4. 7’ patch cords shall be utilized at the workstation end. The patch cords for the Telecommunications Room shall be coordinated with Commonwealth of Massachusetts’ TSS representative (length, quantity, and color).

2.06. COAXIAL CABLE

A. Manufacturer: Subject to compliance with requirements, provide products by the following manufacturer or equivalent.:

1. CommScope, Inc.

B. Cable Characteristics: Broadband type, recommended by cable manufacturer specifically for broadband data transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 dB maximum from 7 to 806 MHz.

C. RG-11/U: NFPA 70, Type CATV.

1. Solid, copper-covered steel conductor.
2. Gas-injected, foam-PE insulation.
3. Quad shielded with 100 percent aluminum polyester tape and 60 percent aluminum braid.
4. Jacketed with sunlight-resistant, black PVC or PE.
5. Suitable for outdoor installations in ambient temperatures ranging from minus 40 to plus 85 deg C.

D. RG-6/U: NFPA 70, Type CATV or CM.

1. Solid, copper-covered steel conductor; gas-injected, foam-PE insulation.
2. Quad shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid.
3. Jacketed with black PVC or PE.
4. Suitable for indoor installations.

E. NFPA and UL compliance listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1655 and with NFPA 70 "Radio and Television Equipment" and "Community Antenna Television and Radio Distribution" Articles. Types are as follows:

1. CATV Cable: Type CATV or **CATVP or CATVR**.
2. CATV Plenum Rated: Type CATVP, complying with NFPA 262.

3. CATV Riser Rated: Type CATVR **or CATVP, CATVR, or CATV**, complying with UL 1666.

F. Coaxial cable for horizontal video distribution shall be RG6, quad shield, plenum rated (for cable runs less than 150'), manufactured by CommScope, Inc. or equivalent.

G. Coaxial cable for horizontal video distribution shall be RG11, quad shield, plenum rated (for cable runs greater than 150'), manufactured by CommScope, Inc. or equivalent.

2.07. COAXIAL CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by the following manufacturer or equivalent.

1. CommScope, Inc.

B. Coaxial-Cable Connectors: F-type compression style connectors.

1. Female/female f-type modular insert shall match faceplate and patch panel manufacturer.

C. Modular coaxial patch panels shall be manufactured by SYSTIMAX Solutions or equivalent and shall be capable of accepting the M81 series of coaxial adapters.

2.08. CONSOLIDATION POINTS

A. Manufacturers: Subject to compliance with requirements, provide products by the following manufacturer or equivalent.:

1. SYSTIMAX Solutions

B. Description: Consolidation points shall comply with requirements for cable connecting hardware.

1. Number of terminals per field, connectors per field and mounting locations shall be coordinated with the Engineer or Commonwealth of Massachusetts' TSS representative.

2. NRTL listed as complying with UL 50 and UL 1863.

3. When installed in plenums used for environmental air, NRTL listed as complying with UL 2043.

2.09. TELECOMMUNICATIONS OUTLET/CONNECTORS

A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA-568-C.1.

1. Work station outlets shall match the category rating of the associated cable (i.e. Category 6)

2. Minimum number of ports per workstation shall be two (2), consisting of one Cat 6 data (color blue) and one Cat 6 voice (color white). If a third outlet is used (VoIP), provide a Cat 6 voice #2 (color yellow). If a fourth outlet is used, coordinate the Cat 6 color and termination method with Commonwealth of Massachusetts' TSS representative.

3. Each voice and data cable shall terminate on individual RJ-45 jacks following the T568B wiring scheme.

4. All voice cables shall be terminated on 110-type termination blocks in the MC/IC, unless designated for VoIP in which they would be terminated on patch panels. All data cables shall be terminated on modular Category 6 jacks (or a data patch panel) in the MC/IC.

5. All jacks shall be terminated on a faceplate. Blank modules and jack icons shall be installed and the faceplate shall be labeled as described elsewhere.

6. A Standard Voice/Data Workstation (minimum requirement) shall consist of the following:

    a. One (1) individual 4-pair Category 6 cable for voice.
    b. One (1) individual 4-pair Category 6 cable for data.

7. Each cable in a standard workstation shall be identified with the same cable ID and a separate description identifying the particular cable (i.e., voice, data, etc.).

8. Cabling to wall mounted workstation outlets shall terminate in a double-gang plaster ring with a single gang reducer plate provided by the Telecommunication Contractor. The Telecommunication Contractor shall provide the necessary connectors (as described elsewhere) under a single-gang faceplate. The type of faceplate to be used shall be coordinated with the Architect or Commonwealth of Massachusetts' TSS representative for color, finish, etc.

9. All twisted pair voice & data cables shall be terminated in 8-position/8-conductor RJ45 type jack conforming to the TIA T568B wiring standard. This wiring scheme shall be maintained throughout the installation (i.e., workstation outlets, patch panels, etc.).

10. All twisted pair cables shall terminate in vapor tight, insulating displacement type connectors (IDC). The Telecommunication Contractor shall confirm that sufficient space exists within the outlet box/raceway to maintain recommended bend radius and that strain relief is provided for all cable terminations.

11. The copper cabling system components shall comply with the TIA-568-C.2 Standard. All twisted pair cables shall terminate in vapor tight, insulating displacement type connectors (IDC). The Telecommunication Contractor shall confirm that sufficient space exists within the outlet box/raceway and that strain relief is provided for all cable terminations.

B. Workstation Outlets: Two, three or four port connector mounted in single gang faceplate.

1. Plastic Faceplate: High-impact plastic. Coordinate color with architect and/or Commonwealth of Massachusetts' TSS representative.

2. Metal Faceplate: Stainless steel / brass,

3. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.

a. Flush mounting jacks, positioning the cord at a 90-degree angle.

4. Legend: Factory labeled by silk-screening or engraving for stainless steel/brass faceplates.

5. Legend: Machine printed, in the field, using adhesive-tape label.

6. Legend: Snap-in, clear-label covers and machine-printed paper inserts.

7. Refer to outlet configuration details in the attachment section for additional information.

2.10. BACKBONE CABLING SYSTEMS

A. UTP CABLE (BACKBONE)

1. Manufacturer: Subject to compliance with requirements, provide products by the following manufacturer or equivalent.

a. SYSTIMAX Solutions

B. Description: 100-ohm, 100-pair UTP, formed into 25-pair binder groups covered with a gray thermoplastic jacket.

1. Comply with ANSI/ICEA S-90-661-2002 for mechanical properties.

2. Comply with TIA-568-C.1 for performance specifications.

3. Comply with TIA-568-C.2, Category 3 for voice backbone Category 6 for data backbone.

4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

    a. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
    b. Communications, Riser Rated: Type CMR complying with UL 1666.

C. Data Backbone Cable

1. Data Backbone cable shall be 2071 4-pair, plenum rated, Category 6, manufactured by SYSTIMAX Solutions or equivalent.

    a. A minimum, of two (2) Cat 6 data cables shall be installed between the MC and each IC, terminated on a separate 24 port patch panel.
    b. Coordinate exact quantity of Cat 6 data backbone cables with Commonwealth of Massachusetts' TSS representative.

2. Voice Backbone Cable

    a. Voice Backbone cable shall be 100-pair (minimum, unless otherwise noted), 24 gauge, plenum rated, Category 3, manufactured by SYSTIMAX Solutions P/N: 2010B WH 100/24 R1000. or equivalent.
    b. Voice backbone cable shall be terminated on wall mounted 110 blocks with C-5 clips and all associated hardware.
    c. Telecommunication Contractor to leave 20' of cable slack coiled within each telecomm room.
    d. Voice copper backbone shall be sized based on 1 ½ pairs per user for large installation (beyond 100 pair minimum).

2.11. OPTICAL FIBER CABLE

A. Manufacturer: Subject to compliance with requirements, provide products by the following manufacturer or equivalent.

1. SYSTIMAX Solutions.

B. Description: Multimode, 50/125] micrometer, 12-strand (minimum), laser optimized tight buffer, optical fiber cable. Comply with ICEA S-83-596 for mechanical

properties:

1. Comply with TIA-568-C.3 for performance specifications.

2. Comply with ANSI/TIA-598-C, and ANSI/TIA-604.2-A, FOCIS 2 for detailed specifications.

3. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
    a. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
    b. Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.
    c. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.

4. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

C. Jacket

1. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-C.
2. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

D. Building Backbone System Cables

1. Multi-Mode fiber - for data backbone system infrastructure shall consist of 12-strand (minimum, unless other wise noted), multi-mode 50/125 micron, laser optimized, riser rated, manufactured by SYSTIMAX, P/N R-012-DS-5M-FSUAQ (OM3, non-armored). R-012-DS-5K-FSUAQ (OM4, non-armored) (R-012-DZ-5M-FSUAQ, OM3 armored) (R-012-DZ-5K-FSUAQ, OM4 armored) or equivalent.
    a. 50/125 multimode fiber shall be terminated with LC style connectors.

2. Single-mode Fiber – for data backbone system infrastructure single-mode shall consist of 12-strand (minimum unless otherwise noted), single-mode 8.3/125 micron, zero water peak, OS2 fiber, manufactured by SYSTIMAX, P/N R-012-DS-8W-FSUYL or R-012-DZ-8W-FSUYL (armored) or equivalent.

    a. 8.3/125 single-mode fiber shall be terminated with LC style connectors.

2.12. OPTICAL FIBER CABLE HARDWARE

A. Manufacturer: Subject to compliance with requirements, provide products by the following manufacturer or equivalent.:

1. SYSTIMAX Solutions

B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
   1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

C. Patch Cords: Factory-made, dual-fiber cables in 36-inch (900-mm) lengths.

D. Cable Connecting Hardware:

   1. Comply with Optical Fiber Connector Intermateablility Standards (FOCIS) specifications of ANSI/TIA-604.2-A, FOCIS 2. Comply with TIA-568-C.3.
   2. Quick-connect, simplex and duplex, Type LC connectors. Insertion loss not more than 0.75 dB.
   3. 48/96 port fiber patch panel shall be rack mounted, manufactured by SYSTIMAX Solutions or approved equal.

      a. Install 48 port fiber panel within the IC and 96 port fiber panel in the MC. SYSTIMAX P/N: HD-1U (holds 4 adapter panels/cassettes), HD-2U (holds 8 adapter panels), HD-4U (holds 16 Adapter Panels) or equivalent.
      b. Adapter panels shall be 12 port, LC-type, manufactured by SYSTIMAX Solutions, P/N: 360DP-12LC-LS (6 port, OM3/OM4), or 360DPis-24LC-LS (12 port, OM3/OM4), 360DP-12LC-SM (6 port, single-mode), or 360DPis-24LC-SM (12 port, single-mode) or equivalent.
      c. The fiber optic panels shall be mounted at the top of each equipment rack.

2.13. EQUIPMENT RACKS/CABINETS

A. Free standing frames (racks) may be used for the termination of back of house data cabling in the Main Cross-connect/Equipment Room. Racks shall be 19" wide, 6" deep and 84" high unless specified otherwise. They shall be provided with a standard top angle and self-supporting base. Side rails shall be pre-drilled and tapped in accordance with the EIA 19" mounting standard.

B. Double-sided vertical wire management troughs shall be provided between racks and on the ends of frame line as indicated on the drawings if they are not provided with the equipment racks by the Commonwealth of Massachusetts.

C. Cable runs to racks and frames which terminate at the rear of patch panels and other devices shall be run at the rear of the double-sided vertical wire management trough. Patch cords and other cable runs which terminate on the front of the frame shall run at the front of the double-sided vertical wire management trough and be secured with

color-coded Velcro cable ties. Cable distribution shall be routed evenly along both rails to the maximum extent possible.

D. For free-standing frames, a 3 ft clear work space shall be maintained in front and back of the frame and at one end of the frame line-up. Where space permits, a space of 3 ft shall be maintained at both ends of the frame line-up.

E. Free standing frames shall be securely bolted in place. Where frames are installed on raised floor, proper support shall be provided below the floor.

F. Cabling for connection to frame mounted patch panels and equipment shall be dressed such that the labeling of patch panels and/or other equipment is readily visible and access to said items is not obstructed. Where accessories for managing cable in the rear of the patch panel are available, they shall be provided whether or not explicitly stated.

G. Where access to free standing frames is provided from cable tray mounted above, Kindorf extensions shall be provided from the frame side members to the cable tray for supporting cable runs (where necessary). A 6" clearance shall be maintained between the top the equipment rack(s) and the bottom of the cable tray.

H. Each frame shall be provided with an equipment ground assembly. The Telecommunication Contractor shall provide one (1) #6 AWG wire from the ground assembly to the nearest telecommunications grounding busbar (TGB).

I. Horizontal wire management panels shall be provided above and below each patch panel to ensure a neatly dressed installation.

J. Double sided, 6" wide (minimum) vertical wire managers shall be provided on both sides of each equipment rack (unless otherwise noted) to ensure a neatly dressed installation.

K. All racks shall be provided with (2) 30 amp plug strips with outlets 6" on center. The plug strips shall be no more than six feet high and shall be mounted to the side or rear of the rails using stand-off brackets to maximize space for routing communications cabling.

2.14. GROUNDING

A. Comply with ANSI-J-STD-607-A.

B. Conductors utilized for grounding and bonding shall not be less than #6 AWG and shall have type “TW” or better insulation, color coded green.

C. All ground wire connections to ground bars, racks, ladder racks, etc. shall be made using a crimp-style, 2 bolt, and UL listed grounding lugs.

2.15. IDENTIFICATION PRODUCTS

A. Comply with TIA-606 and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.16. SOURCE QUALITY CONTROL

A. Factory test UTP and optical fiber cables on reels according to TIA-568-C.1.

B. Factory test UTP cables according to TIA-568-C.2.

C. Factory test multimode optical fiber cables according to TIA-526-7 and TIA-568-C.3.

D. Factory-sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.

E. Cable will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

PART 3 - EXECUTION

3.01 SCS WORK - GENERAL REQUIREMENTS

A. General: Sequence, coordinate, and integrate the various elements of the SCS systems, materials, and equipment. Comply with the following requirements as a minimum:

1. Coordinate systems, equipment, and materials installation with other building components.
2. Verify all dimensions by field measurements.
3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for wiring, cabling, and equipment installations.
4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
5. Sequence, coordinate, and integrate installations of materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.

6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom and access for service and maintenance as possible.
7. Coordinate connection of materials, equipment, and systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, request direction in writing from the Commonwealth of Massachusetts' representative.
9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
10. Install cabling, wiring, and equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
11. Provide access panel or doors where units are concealed behind finished surfaces.
12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
13. Comply with all requirements and work indicated on the drawings (if applicable).
14. Avoid interference with structure and with work or other trades, preserving adequate headroom and clearing doors and passageways to satisfaction of the Commonwealth of MA and in accordance with code requirements.
15. Install equipment and cabling/wiring so as to properly distribute equipment loads on building structural members provided for equipment support under other Sections. Roof-mounted equipment shall be installed and supported on structural steel or roof curbs as appropriate.
16. Provide suspended platforms, strap hangers, brackets, shelves, stands or legs as necessary for floor, wall and ceiling mounting of equipment as required.
17. Provide steel supports and hardware for proper installation of hangers, anchors, guides, and other support hardware.
18. Obtain and analyze catalog data, weights, and other pertinent data required for proper coordination of equipment support provisions and installation.
19. Structural steel and hardware shall conform to Standard Specifications of ASTM; use of steel and hardware shall conform to requirements of Section Five of Code of Practice of American Institute of Steel Construction.

20. Verify site conditions and dimensions of equipment to ensure access for proper installation of equipment without disassembly that would void the warranty.

3.02 EQUIPMENT INSTALLATION

A. General: Install equipment in locations as indicated, according to manufacturer's written instructions. Install equipment level and plumb. Install wiring and cabling between equipment and all related devices.

B. Mounting: For equipment at walls, bolt units to wall or mount on structural steel channel strut bolted to the wall. For equipment not at walls, provide freestanding racks fabricated of structural steel members and slotted structural steel channel strut. Use feet consisting of 0.25-inch thick steel plates, 6-inch square, bolted to the floor. Use feet for welded attachment of vertical posts not over 3 feet on center. Connect the posts with horizontal U channel steel strut and bolt the control equipment to the channels.

C. Cleaning: Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean devices internally using methods and materials as recommended by manufacturer.

D. Connections: Tighten wiring connectors, terminals, bus joints, and mountings, including lugs, screws and bolts according to equipment manufacturer's published torque tightening values for equipment connectors. Where the manufacturer does not publish connection or terminal torque values, comply with the torque values specified in UL 486A and UL 486B.

3.03 CUTTING AND PATCHING

A. General: Perform cutting and patching in accordance with the following requirements apply:

1. Perform cutting, fitting, and patching of telecommunications equipment and materials required to uncover Work to provide for installation of ill timed Work.
2. Remove and replace defective Work.
3. Remove and replace Work not conforming to requirements of the Contract Documents.
4. Remove samples of installed Work as specified for testing.
5. Install equipment and materials in existing structures.

B. Demolition and Removal: Cut, remove, and legally dispose of selected equipment, components, and materials as indicated, including but not limited to removal of material, equipment, devices, and other items indicated to be removed and items made obsolete by the new Work.

C. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

D. Protection of Work: Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed. During cutting and patching operations, protect adjacent installations. Patch finished surfaces and building components using new materials specified for the original installation and experienced Installers.

3.04 PENETRATIONS AND SLEEVES

A. General: Coordinate work with other Sections. Set sleeves in forms before concrete is poured. Provide core drilling as necessary if walls are poured or otherwise constructed, without sleeves and a wall penetration is required. Do not penetrate structural members. Provide sleeves and packing materials at all penetrations of foundations, walls, slabs (except on-grade), partitions, and floors. Sleeves shall meet requirements of the pertinent specifications. Lay out penetration and sleeve openings in advance, to permit provision in work. Set sleeves and conduit in forms before concrete is poured. Provide remedial work where sleeves and conduits are omitted or improperly placed.

B. Sleeve Fill: Sleeves that penetrate outside walls, basement slabs, footings, and beams shall be waterproof. Fill slots, sleeves and other openings in floors or walls if not used. Fill spaces in openings after installation of conduit or cable. Fill for floor penetrations shall prevent passage of water, smoke, fire, and fumes. Fill shall be fire resistant in fire floors and walls, and shall prevent passage of air, smoke and fumes. Sleeves through floors shall be watertight and shall extend 2 inches above floor surface. Where raceways passing through openings are exposed in finished rooms, finishes of filling materials shall match and be flush with adjoining floor, ceiling, and wall finishes.

C. Conduit Sleeves:

1. Annular space between conduit and sleeve shall be at least 1/4 inch.
2. Sleeves shall not be provided for slabs-on-grade unless specified or indicated otherwise.
3. For sleeves through rated fire walls and smoke partitions, comply with requirements for firestopping specified in section "Firestopping".

D. Supports: Do not support piping risers or conduit on sleeves.

E. Future Use: Identify unused sleeves and slots for future installation.

3.05 CORE DRILLING

A. Core drilling shall be avoided where possible. Where core drilling is unavoidable locate all required openings prior to coring. Coordinate openings with other trades and utilities, and prevent damage to structural reinforcement. Thoroughly investigate existing conditions in vicinity of required opening prior to coring. Set sleeves prior to installation of structure for passage of pipes, conduit, ducts, etc. Protect all areas from damage.

3.06 CLEANING

A. Cleaning shall be performed prior to commissioning. After completion of project, clean the exterior surface of all equipment, including concrete residue, dirt, paint residue, etc.

3.07 ACCESS AND ACCESS PANELS

A. Where Required: Provide access to materials and equipment that require inspection, replacement, repair or service. Provide access panels and/or doors as required to allow service of all equipment components. Provide access panels where items installed require access and are concealed in floor, wall, furred space or above ceiling. Ceilings consisting of lay-in or removable splined tiles do not require access panels. Locations of equipment requiring access shall be noted on record drawings. Access panels shall have same fire rating classification as surface penetrated.

B. Coordination: Coordinate and prepare a location, size, and function schedule of access panels required to fully service equipment and deliver to the Commonwealth of Massachusetts.

C. Construction: Panels shall be at least 12 inches by 12 inches, and located to provide optimum access to equipment for maintenance and servicing. Verify access panel locations and construction with Commonwealth of Massachusetts' representative.

3.08 STARTUP AND OPERATIONAL TESTING OF EQUIPMENT AND SYSTEMS

A. General: The Commonwealth of Massachusetts maintains the right to have access to the entire project site to develop operational procedures. Completion of start up and field testing shall be accomplished as a prerequisite for substantial completion. All guarantees and warranties shall not begin until final acceptance of the systems and equipment by the Commonwealth of Massachusetts. Acceptance requires, at a minimum, complete systems startup and testing.

B. Requirements:

1. Provide installation testing of equipment where required by manufacturer's installation instructions.
2. All guarantees and warranties shall not begin until final acceptance of the systems and equipment by the Commonwealth of Massachusetts. Acceptance requires, at a minimum, complete systems startup and testing.

3.09 SPECIAL RESPONSIBILITIES AND INFORMATION

A. Coordination of Information: Cooperate and coordinate with work of other Sections in executing work of this Section. Perform work such that progress of entire project including work of other Sections shall not be interfered with or delayed. Provide information as requested on items furnished under this Section which shall be installed under other Sections. Obtain detailed installation information from manufacturers of equipment provided under this Section.

B. Obtain final roughing dimensions or other information as needed for complete installation of items furnished under other Sections or by the Commonwealth of

Massachusetts. Keep fully informed as to shape, size and position of openings required for material or equipment to be provided under this and other Sections. Give full information so that openings required by work of this Section may be coordinated with other work and other openings and may be provided for in advance. In case of failure to provide sufficient information in proper time, provide cutting and patching or have same done, at no expense to the Commonwealth of Massachusetts.

C. Housekeeping Pads: Provide information as requested as to sizes, number and locations of concrete housekeeping pads necessary for floor mounted equipment.

D. Use of premises: Use of premises shall be restricted as directed by the Commonwealth of Massachusetts' representative and as required below:

1. Cleaning and Rubbish Removal: Remove and dispose of dirt and debris, and keep premises clean. During progress of work, remove equipment and unused material. Put building and premises in neat and clean condition, and do cleaning and washing required to provide acceptable appearance and operation of equipment, to satisfaction of the Commonwealth of Massachusetts' representative.
2. Storage: Store materials in a manner that will maintain an orderly, clean appearance. If stored on site in open or unprotected areas, all equipment and material shall be kept off the ground by means of pallets or racks, and covered with tarpaulins.

E. Protection of Fireproofing:

1. Clips, hangers, clamps, supports and other attachments to surfaces to be fireproofed shall be installed, insofar as possible, prior to start of spray fire proofing work.
2. Conduits and other items, which would interfere with proper application of fireproofing, shall be installed after completion of spray fire proofing work.
3. Patching and repairing of fireproofing due to cutting or damaging to fireproofing during course of work specified under this Section shall be performed by installer of fireproofing and paid for by the Section responsible for damage and shall not constitute grounds for an extra to the Commonwealth of Massachusetts.

F. Movement of Materials: Unload materials and equipment delivered to site. Pay costs for rigging, hoisting, lowering and moving equipment on and around site, in building or on roof.

3.10 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.11 WIRING METHODS

B. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, in attics, and in

gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.

C. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

D. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.12 INSTALLATION OF PATHWAYS

A. Cable Trays: Comply with NEMA VE 2 and TIA-569-B-1.

B. Comply with TIA-569-B-1for pull-box sizing and length of conduit and number of bends between pull points.

1. Pull boxes are required every 100' or 180 degrees of conduit bends.

2. All conduits shall be bushed and reamed and free of any sharp edges that can cause damage to the cables.

C. Install manufactured conduit sweeps and long-radius elbows whenever possible.

D. Pathway Installation in Communications Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
2. Install cable trays to route cables if conduits cannot be located in these positions.
3. Secure conduits to backboard when entering room from overhead.
4. Extend conduits 3-4 inches above finished floor.
5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

E. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

F. Refer to Attachment “Conduit Sizing Chart” for additional information.

3.13 SUPPORTS

A. Support Work in accordance with best industry practice and the following.

B. Include supporting cabinets to floor in telecommunications closets and main equipment room.

C. Supporting cables with Kindorf, cable hangers and threaded rod are the responsibility of the Telecommunication Contractor.

D. Nothing (including outlet, pull and junction boxes and fittings) shall depend on conduits, raceways or cables for support.

E. Nothing shall rest on, or depend for support on, suspended ceiling media (tiles, lath, plaster, as well as splines, runners, bars and the like in the plane of the ceiling). Vertical members which suspend the ceiling (together with their horizontal bracing which occurs above the ceiling), however, may be used for support.

F. As a minimum procedure, in suspended ceilings support small runs of circuitry from ceiling suspension members as defined above. Support larger runs of circuitry directly from structural slabs, decks or framing members.

G. Where support members must of necessity penetrate air ducts, include, in accordance with instructions issued in the field, airtight sealing provisions which allow for a relative movement between the support members and the duct walls.

H. Include in the telecommunications Work channel sills or skids for leveling and support of all floor mounted telecommunications equipment.

I. Where permitted loading is exceeded by direct application of telecommunications equipment to a slab or deck, include in the telecommunications Work proper dunnage as required to distribute the weight in a safe manner.

J. Fire-resistant Velcro cable ties shall be used for securing riser cables. The cable ties shall be laced through the strands of the messenger and secured to the cable to be supported.

K. All cable ties used to support telecommunications cabling shall be of the fire-resistant Velcro type. The support rating of the cable ties used shall be a minimum of twice that of the weight per unit of the cable(s) to be supported. Nylon cable ties shall not be used during any part of the installation of the cabling system, even during the pulling of cabling.

3.14 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA-568-C.1.

2. Comply with BICSI ITSIM, “Cable Termination Practices."

3. Comply with SYSTIMAX or equivalent Solutions GigaSPEED XL Design & Installation Guideline Documentation.

4. Install 110-style IDC termination hardware unless otherwise indicated.

5. A Multi-User Telecommunications Outlet Assembly (MUTOA) shall not be used as a cross-connect point.

6. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:

    a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
    b. Locate consolidation points for UTP at least 49 feet (15 m) from communications equipment room.
    c. Note: This requirement does not apply to Horizontal Connection Points deployed as part of a building automation system (BAS) as defined in TIA-862.

7. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.

8. Cables may not be spliced.

9. Secure and support cables at intervals not exceeding 60 inches (1.5 m) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

10. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

11. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" chapter. Install lacing bars and distribution spools.

12. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.

13. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.

14. In the communications equipment room, install a 10-foot- (3-m-) long service loop at the telecom room and 12" service loop at the workstation end, located at the nearest accessible ceiling.

15. Pulling Cable: Comply with BICSI ITSIM, "Pulling Cable." Monitor cable pull tensions. Telecommunication Contractor to follow manufacturer's recommendation for pulling tension.

16. All telecommunication cables shall be carry a fire rating (i.e. plenum-CMP) to match the environment of that space.

C. UTP Cable Installation:

1. Comply with TIA-568-C.2.

2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Optical Fiber Cable Installation:

1. Comply with TIA-568-C.3.

2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

E. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 4-5' apart.

3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

F. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.

2. Install cabling after the flooring system has been installed in raised floor areas.

3. Coil cable 6 feet (1800 mm) long not less than 12 inches (300 mm) in diameter below each feed point.

G. Group connecting hardware for cables into separate logical fields.

H. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-B-1 for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.

2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).

6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

I. MOUNTING HEIGHTS

1. Heights of all wall mounted outlets shall be in accordance with the following list. (Dimensions are above finished floor unless noted.)

    a. Telecommunications outlet in field constructed wall, partition or column unless otherwise specified below -- 18" to centerline.
    b. Telecommunications outlet in factory fabricated wall or partition, unless otherwise specified below -- Dimension determined by wall or partition construction.
    c. Telecommunications outlet in telecommunications closets, mechanical spaces, electric switchboard rooms, electric closets -- 5'-0" to centerline.

2. Heights of all wall mounted outlets shall be in accordance with the architectural drawings and details. Equipment mounting heights shall be in accordance with telecommunications details. Any discrepancies shall be brought to the engineer's attention.

3. Architectural drawings and field instructions issued by the Architect take precedence over the above list and shall be adhered to.

3.15 FIRESTOPPING

A. Comply with TIA-569-B-1, Annex A, "Firestopping."

B. Comply with BICSI TDMM, Chapter 7, "Firestopping Systems".

C. Firestopping shall be provided for all penetrations of conduit, wireways, bus ducts, cable trays, etc., through fire-rated walls and floors and other fire-rated separations as follows:

1. Excess space in framed openings through structural floors between conduits and concrete shall be grouted in with concrete to a depth of at least the thickness of the slab plus 2" minimum above the slab.

2. Conduit penetration through poured concrete or masonry walls shall be grouted in with concrete and provided with tight fitting escutcheon plates on both sides.

3. Conduit penetrations through fire-rated dry walls shall be with sleeves through the wall fitted with escutcheon plates on both sides with excess openings filled with fire stop material specifically manufactured for the purpose.

4. Excess space within conduit sleeves or stubs through floor slabs or walls where low voltage/telecommunications cables pass through shall be filled with firestopping material specifically manufactured for the purpose.

5. Utilize fire-rated fittings, as specified elsewhere for penetrations through floor slabs for supplying floor outlets.

D. All conduits/sleeves used for vertical cable passage shall be sealed utilizing suitable material after the installation of cables as follows:

1. The material shall be non-corrosive to the cable jacket or insulation that it applies to.

2. The material shall provide for a minimum of three (3) hour fire rating.

3. The material shall be non-shrinking, waterproof and smoke tight.

4. The material shall remain flexible and non-hardening.

5. The material shall be of the type that when installed will not slip through the openings, will stick to the surfaces of the openings and the cable and will not require any pressure to be applied to the cable in order to keep it in place.

6. The material shall be installed in a neat and workmanlike manner and the final installation shall be smooth finished to the top of the sleeve or conduit.

7. The material shall be easily removable without damaging the cables after being set or cured for at least one week.

E. All horizontal cable penetrations through rated walls shall be sealed in a manner that will provide a fire rating equal to the wall construction.

F. All materials used for firestopping shall be approved for the purpose and the rating of the wall or floor and all methods employed shall meet with the approval of the local authorities.

G. Refer to architectural drawings and specifications for all locations of fire rated walls and floors.

3.16 GROUNDING

A. Install grounding according to BICSI TDMM, Chapter 8: “Bonding and Grounding (Earthing)”

B. Comply with ANSI-J-STD-607-A.

C. Telecommunications Grounding Busbar(s) to be provided by the Telecommunication Contractor.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

E. Ground all systems and equipment in accordance with best industry practice and the following:

1. The Telecommunication Contractor shall furnish and install ground connections in the Main Cross-connect/Equipment Room and each IC room from every cabinet, rack, conduit, sleeve, cable shield, etc. to the ground bars provided for that purpose.

2. All metal panels, enclosures, boxes, racks, raceways, conduits, ladder rack etc. in computer rooms, telecommunications equipment rooms and closets shall be grounded with an individual ground wire back to bus bar. No “daisy-chaining” will be permitted.

3. All ground wire connections to ground bars, racks, ladder rack, etc. shall be made using crimp-style, 2 bolt, UL-listed grounding lugs.

3.17 IDENTIFICATION

A. Identify individually:

1. Each and every telecommunications cable.

2. Each outlet (and each port).

3. Each termination block and patch panel (and each termination).

4. Each equipment termination frame and cabinet.

5. Each junction box used for telecommunications wiring.

6. Each system (i.e., voice, LAN, etc.).

7. Other items as directed by the Commonwealth of Massachusetts.

B. The nomenclature used to identify cables, blocks, equipment, etc. shall be as specified on the drawings or elsewhere in this specification. Missing or unclear nomenclature criteria for the items specified above shall not be construed as a reason not to identify the items and shall be brought to the Engineers attention.

C. All materials required for labeling shall be provided by the Telecommunication Contractor. All labels shall be permanently adhered, easily visible and shall be smudge-proof. All text shall be electronically printed (not handwritten). All cables shall be labeled at both ends minimum.

D. Identification for the wires and cables shall be by means of wrap around type labels at both ends (Brady or similar).

E. Labels for risers, cables, wires, faceplates, cover plates, etc., shall be provided with textual descriptions.

F. Identify each outlet box, junction box, and cabinet used in conjunction with empty raceway for wires of a future system by means of indelible markings on the inside denoting the system.

G. Prior to installing identifying tags and nameplates, submit their nomenclature for approval. Conform to any revisions issued by the Commonwealth of Massachusetts TSS representative.

H. Junction boxes used for telecommunications wiring and located in unfinished spaces (i.e., hung ceilings, equipment rooms, etc.) shall be clearly identified on the outside as "COMM."

I. All identification products and methods shall comply with TIA-606.

J. Refer to attachment details for additional information.

3.18 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.

2. Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.

3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

    a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

5. Optical Fiber Cable Tests:
    a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
    b. Link End-to-End Attenuation Tests:

        i Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA-526-14-A, Method B, One Reference Jumper.
        ii Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA-568-C.1.

6. UTP Performance Tests:

    a. Test for each outlet. Perform the following tests according to TIA-568-C.1 and TIA-568-C.2:
        i Wire map.
        ii Length (physical vs. electrical, and length requirements).
        iii Insertion loss (attenuation).
        iv Near-end crosstalk (NEXT) loss.
        v Power sum near-end crosstalk (PSNEXT) loss.
        vi Equal-level far-end crosstalk (ELFEXT).
        vii Power sum equal-level far-end crosstalk (PSELFEXT).
        viii Return loss.
        ix Propagation delay.
        x Delay skew.

7. Optical Fiber Cable Performance Tests: Perform optical fiber end-to-end link tests according to TIA-568-C.1 and TIA-568-C.3.

8. Coaxial Cable Tests:
    a. continuity
    b. isolated conductors
    c. no shorts to ground

B. End-to-end cabling will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports as directed by the Commonwealth of MA TSS representative.

3.19 RECORD OF TEST RESULTS

A. A record of all required tests shall be provided to the Commonwealth of Massachusetts TSS representative. The information shall be maintained as permanent record for the purposes of maintenance and restoration.

B. A brief description outlining the test equipment used and a single line diagram indicating the test setup shall be provided to the Engineer and/or the Commonwealth of Massachusetts TSS representative for their review. The level of description should be sufficient enough to allow an individual who is not familiar with the specific test equipment to recreate any portion of the test.

C. Test results to be provided shall contain the following minimum information:

1. For all similar cable runs include:

    a. Project name
    b. Description of test (i.e., voice riser, workstation cable, etc.)
    c. Cable origin
    d. Cable destination
    e. Cable ID
    f. Cable pair/strand
    g. Test date
    h. Tester (individual responsible for conduct of the test)
    i. Page of _

2. For copper cables:
    a. No shorts, no crosses, no breaks
    b. For the indicated pairs of the cables include:
        i Wire Map
        ii Length
        iii Insertion Loss
        iv NEXT Loss, Pair-to-pair
        v PSNEXT Loss

vi ELFEXT Loss, Pair-to-pair
vii PSELFEXT Loss
viii Return Loss
ix ACR
x PSACR
xi Propagation Delay
xii Delay Skew
xiii Test equipment settings.

D. Submitted test results shall be direct output from the tester. The Telecommunication Contractor shall provide a copy of the required viewing software for the Commonwealth of Massachusetts to review the results.

E. The Telecommunication Contractor shall provide a summary sheet indicating the cables tested and summary results.

F. All test results shall be provided in the following formats:

1. Printed (1 bound copy)

2. Disk (CD Rom or other approved electronic media).

G. A copy of the test results in both electronic and printed formats shall be provided to the Engineer and/or Commonwealth of Massachusetts TSS representative for review and for their records.

H. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

3.20 EQUIPMENT INSTALLATION AND TESTING

A. The Telecommunication Contractor shall be available during equipment installation and testing to help isolate faults which may exist in the cabling or LAN system installation.

B. The Telecommunication Contractor shall coordinate with other vendors where necessary to resolve any discrepancies between the cabling system and the vendors cabling or equipment

3.21 CORRECTIVE ACTION

A. Any defects or deficiencies discovered in any of the telecommunications Work shall be indicated on the test report and be corrected.

B. Upon completion of testing and problem resolution, all connections tested are to be 100% error free.

C. Any connections determined to be not correctable shall be indicated at each end of the termination as "bad" (in red).

3.22 CLEANING

D. The Telecommunication Contractor shall clean all equipment prior to acceptance and turn over the installation clean and dust-free.

PART 4 – ATTACHMENTS

4.01. SUMMARY:

1. The purpose of this section is to establish requirements for the infrastructure that is required to support the distribution of voice, data and video services for this project. The support infrastructure includes the following:
    a. Architectural Requirements - Main Telecommunications Room and Distribution Rooms
    b. Electrical Power Requirements
    c. HVAC Requirements
    d. Pathway Requirements to connect the various telecommunications spaces
    e. Grounding System Requirements
    f. Typicals
    g. Approved Materials Schedule
    h.
2. This document should be distributed to the architect, MEP/FP engineers, consultants and others to be used to planning the supporting infrastructure (pathways and spaces) for the telecommunications systems.

4.02. ARCHITECTURAL REQUIREMENTS FOR TELECOMMUNICATIONS SPACES

A. The Main Cross-connect (MC) shall be located on the first basement level below grade, if possible. This will aid the distribution of serviced entrance conduits run from the foundation walls to the Main Telecommunications Room. The service entrance conduits typically enter 24-36” below grade. If the building does not have a basement level, the Main Telecommunications Room shall be located on the First Level. The Main Telecommunications Room shall be a minimum of 12’ x 15’.

B. Each telecommunications room (TR) shall be located such that the total length of twisted pair and coaxial cabling that serves each workstation outlet does not exceed

250 feet. It is recommended that these spaces are located on each floor and are stacked vertically. Each TR shall be a minimum of 8’ x 10’.

C. Each TR shall not have a finished ceiling. The structure above shall be sealed and painted in a light color to promote lighting and minimize dust.

D. Each TR shall have a floor that is sealed or finished with low static linoleum tiles.

E. Each TR shall have each wall covered from the floor to 8’-0” AFF with ¾” fire-retardant plywood backboard. The wall that contains the voice cable terminations shall be built out by 2”x4” wood studs.

1. Each TR shall be provided with a minimum equivalent of 500 Lux (50 footcandles) measured 3 ft above the finished floor. The lighting fixtures shall be located at a minimum of 8.5 ft above the finished floor. A minimum of ½ of the lights shall be on emergency power and the fixtures shall not be on dimmer switches or occupancy sensors.

2. The access door shall be fitted with a lock and shall be minimum 36 in. wide and 84 in. high.

4.03. ELECTRICAL POWER REQUIREMENTS

A. Each TR shall be furnished with its own dedicated electrical panel. The panel for each room shall be wired to a panel that is fed from a UPS system that is connected to the emergency generator for the building. Any transformers that are required to feed the service panels shall NOT be located inside of the TR.

B. A minimum of four dedicated, non-switchable, 30 Amp, 208 Volt alternating current nominal twist-lock receptacles, each on separate branch circuit, shall be provided for equipment power. In addition, each space shall have a minimum of (2) non-switchable, 20 Amp, 120 Volt alternating current nominal quad receptacles.

C. For the Main Cross-connect/Equipment Room, (2) additional 30 Amp, 208 Volts alternating current nominal twist-lock receptacles shall be required for service entrance equipment (if required).

D. The anticipated load for each telecommunications distribution room is 10,000 Watts and for the Main Cross-connect/Equipment Room is 15,000 Watts.

4.04. HVAC REQUIREMENTS

A. Each telecommunications space must have a separate 24x7 HVAC unit that serves the space only. The unit must be located outside of the room and have supply and return ducts that feed the room. The units must be sized to accommodate the following:

Factor	Requirements
Temperature	10 ºC to 35 ºC (50 ºF to 95 ºF)
Relative Humidity	Below 85%
Heat Dissipation	Max of 25,000 BTU per hour

4.05. PATHWAY REQUIREMENTS

A. All feeds to the base of each riser closet stack shall be run in 4” conduits. A total of four (4) 4” conduits shall be provided from the Main Equipment Room (MER) to the base of each riser closet stack.

B. A minimum of (3) 4” bushed conduit sleeves shall be installed as a means of distribution within the riser closet stack. The number of sleeves/ conduits shall be adjusted in accordance with the area that each closet serves. The number of sleeves/ conduits shall be reserved for the following use (approximately):

Number of 4” Sleeves Reserved	Sleeve Designation
1	Copper Riser (Voice)
1	Fiber Optic Cabling
1	Spare

C. All conduits and sleeves for telecommunications cabling shall be fitted with bushed endings and pull strings. All conduits and sleeves shall be grounded to the telecommunications grounding system.

D. The bend radius for the telecommunications conduits shall be 10 to 15 times the conduit radius. A pull box shall be provided where the sum of conduit bends exceeds 180º or 100 feet in conduit length.

E. Conduit Sizing chart:

Conduit Sizing Chart

Cable Type	Cable OD (in inches)	Conduit Diameter (in Inches)									
		1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	
Horizontal Cabling											
4-Pair Cat 5e (Non-Plenum)	0.2	2	5	10	15	22	40	62	90	160	
4-Pair Cat 5e (Plenum)	0.19	2	6	11	17	24	44	69	99	177	
4-Pair Cat 6 (Non-Plenum)	0.23	1	4	7	11	17	30	47	68	120	
4-Pair Cat 6 (Plenum)	0.206	2	5	9	14	21	37	58	84	150	
Quad-Shielded RG-6 (Non-Plenum)	0.3	1	2	4	6	10	17	27	40	71	
Quad-Shielded RG-6 (Plenum)	0.264	1	3	5	8	12	22	35	51	91	
Quad-Shielded RG-11 (Non-Plenum)	0.405	0	1	2	3	5	9	15	21	39	
Quad-Shielded RG-11 (Plenum)	0.372	0	1	2	4	6	11	18	26	46	
2-Strand MM/2-Strand SM (Armored - Plenum)	0.52	0	0	1	2	3	5	9	13	23	
		1/2	**3/4**	**1**	**1 1/4**	**1 1/2**	**2**	**2 1/2**	**3**	**4**	
Riser Cabling											
25-Pair CMR	0.33	0	2	3	5	8	14	22	33	58	
50-Pair CMR	0.47	0	1	1	2	4	7	11	16	28	
100-Pair CMR	0.64	0	0	0	1	2	3	6	8	15	
200-Pair CMR	1.09	0	0	0	0	0	1	2	3	5	
300-Pair CMR	1.32	0	0	0	0	0	0	1	2	3	
400-Pair CMR	1.51	0	0	0	0	0	0	1	1	2	
12-Strand MM/12-Strand SM (Armored - Riser)	0.8	0	0	0	0	1	2	3	5	10	
24-Strand MM/24-Strand SM (Armored - Riser)	1.02	0	0	0	0	0	1	2	3	6	
1" Innerduct	1.2	0	0	0	0	0	1	1	2	4	
1-1/4" Innerduct	1.4	0	0	0	0	0	0	1	1	3	

Assumptions

1. OD for 4-pair cables obtained from Amp product manual.
2. OD for CMR cables obtained from Superior Essex product manual.
3. OD for fiber cables obtained from Corning product manual.
4. OD for coaxial cables obtained from Commscope product manual.

4.06. GROUNDING SYSTEM REQUIREMENTS

A. A separate grounding system shall be established for the telecommunications systems to connect to.

B. The Main Telecommunications Grounding Bus Bar (MTGBB) shall be located in the MER. The MTGBB shall be connected via a #4 AWG, minimum, insulated ground wire to the main cold water service entrance pipe or to the same reference ground as the main electrical switchgear.

C. Each distribution closet shall have a Telecommunications Grounding Bus Bar (TGBB). Each TGBB shall be connected to a grounding riser, #4 AWG, minimum, insulated ground wire, via a compression-type connector or an exothermic weld.

D. The Telecommunication Contractor shall provide the grounding system. The communications cabling contractor shall be responsible for grounding the system components to the grounding system.

4.07. PLUMBING

A. All Telecommunication Rooms (MC/IC) shall be free of any water or drain piping and shall be routed outside of the telecommunication spaces. If any plumbing pipes are routed in the MC/IC, Telecommunications Contractor shall notify the Engineer and/or Commonwealth of Massachusetts TSS representative.

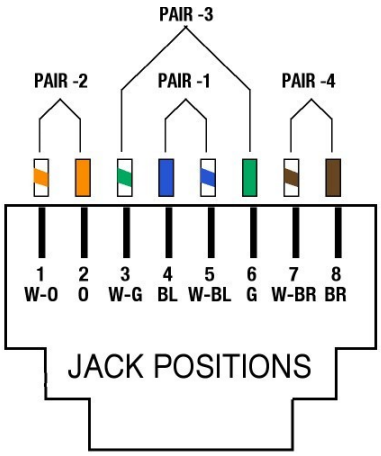
B. All sprinkler heads located with the MC/IC's shall be turned up and protected with a cage.

4.08. TELECOMMUNICATION OUTLET, FACEPLATE, & LABELING CONFIGURATIONS

NOTE: The TSS labeling scheme shall be the following unless otherwise noted:

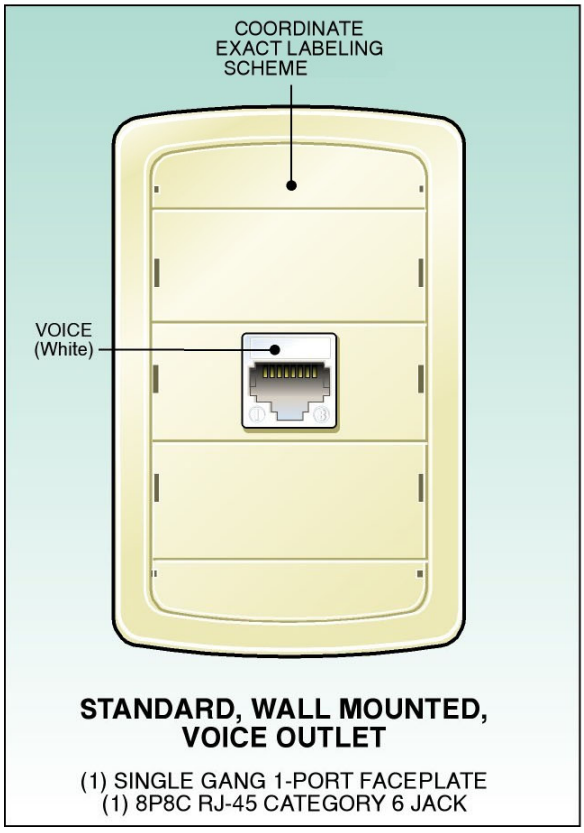
- FLOOR #, CLOSET #, RACK #, PATCH PANEL #, PORT #

(i.e. 2B20248: 2nd floor, B closet, 2nd rack, 2nd patch panel, 48th port)



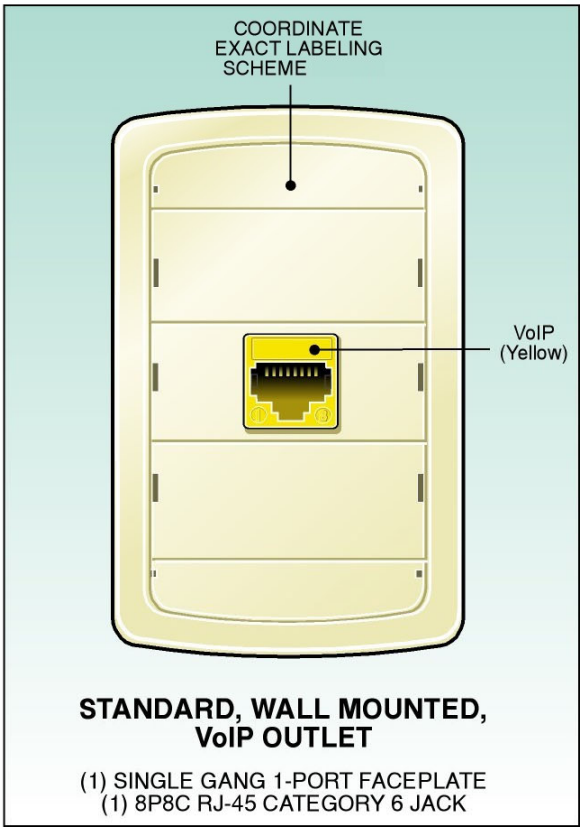
This illustration is a front view of the connector. The colors indicated are associated with the station distribution cable.

8 POSITION JACK PIN/PAIR ASSIGNMENTS
(DESIGNATION T568B)



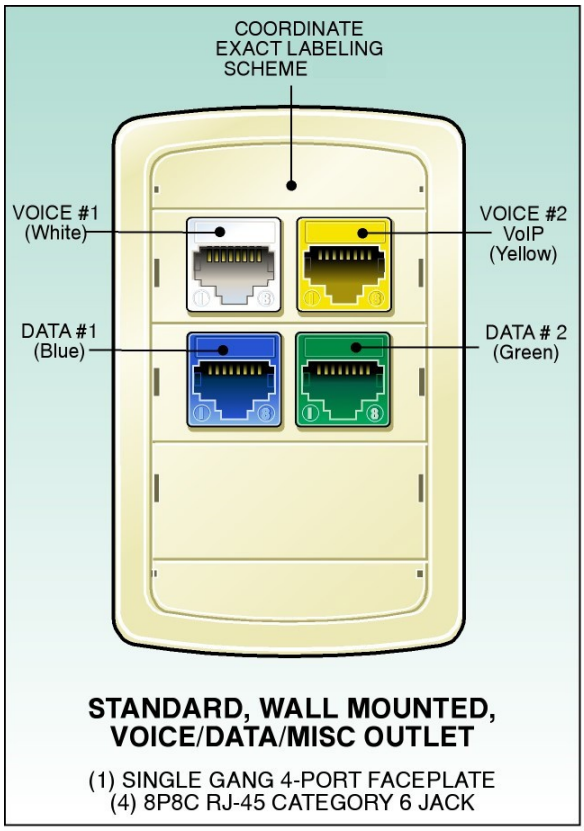
STANDARD, WALL MOUNTED, VOICE OUTLET

(1) SINGLE GANG 1-PORT FACEPLATE
(1) 8P8C RJ-45 CATEGORY 6 JACK



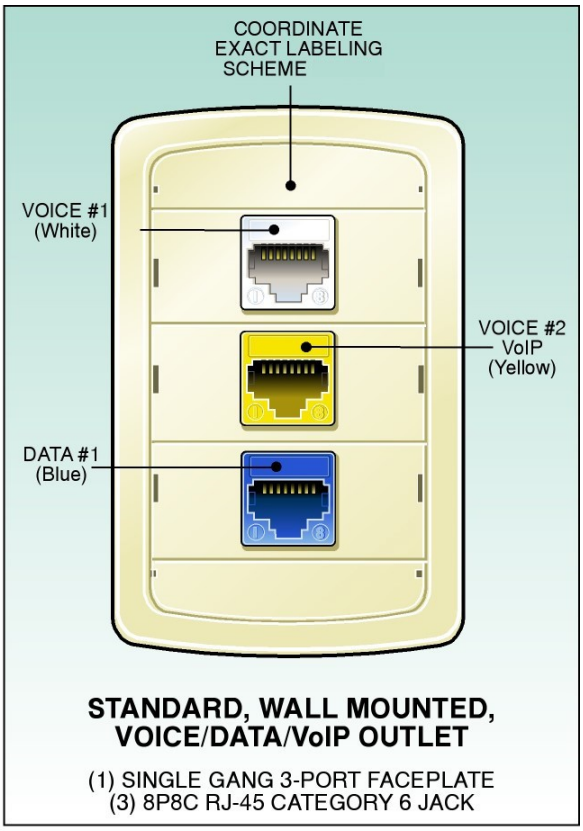
STANDARD, WALL MOUNTED, VoIP OUTLET

(1) SINGLE GANG 1-PORT FACEPLATE
(1) 8P8C RJ-45 CATEGORY 6 JACK



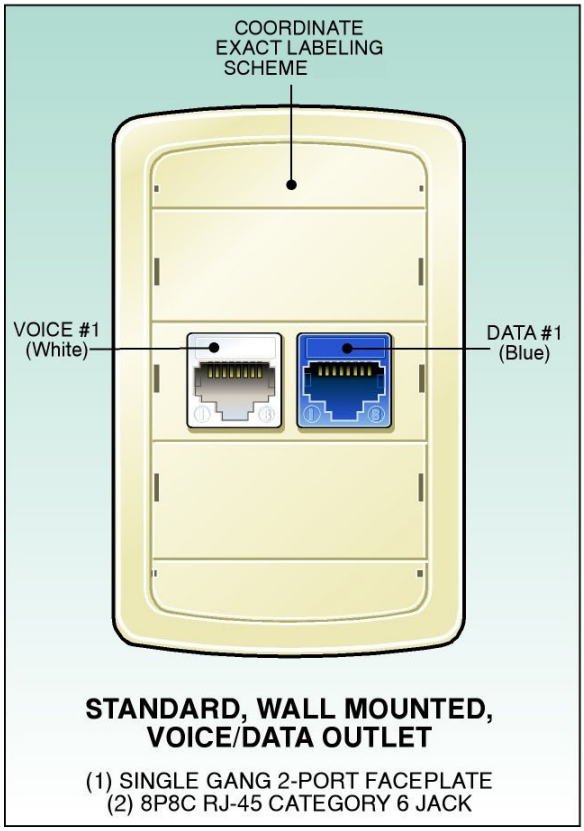
**STANDARD, WALL MOUNTED,
VOICE/DATA/MISC OUTLET**

(1) SINGLE GANG 4-PORT FACEPLATE
(4) 8P8C RJ-45 CATEGORY 6 JACK



**STANDARD, WALL MOUNTED,
VOICE/DATA/VoIP OUTLET**

(1) SINGLE GANG 3-PORT FACEPLATE
(3) 8P8C RJ-45 CATEGORY 6 JACK



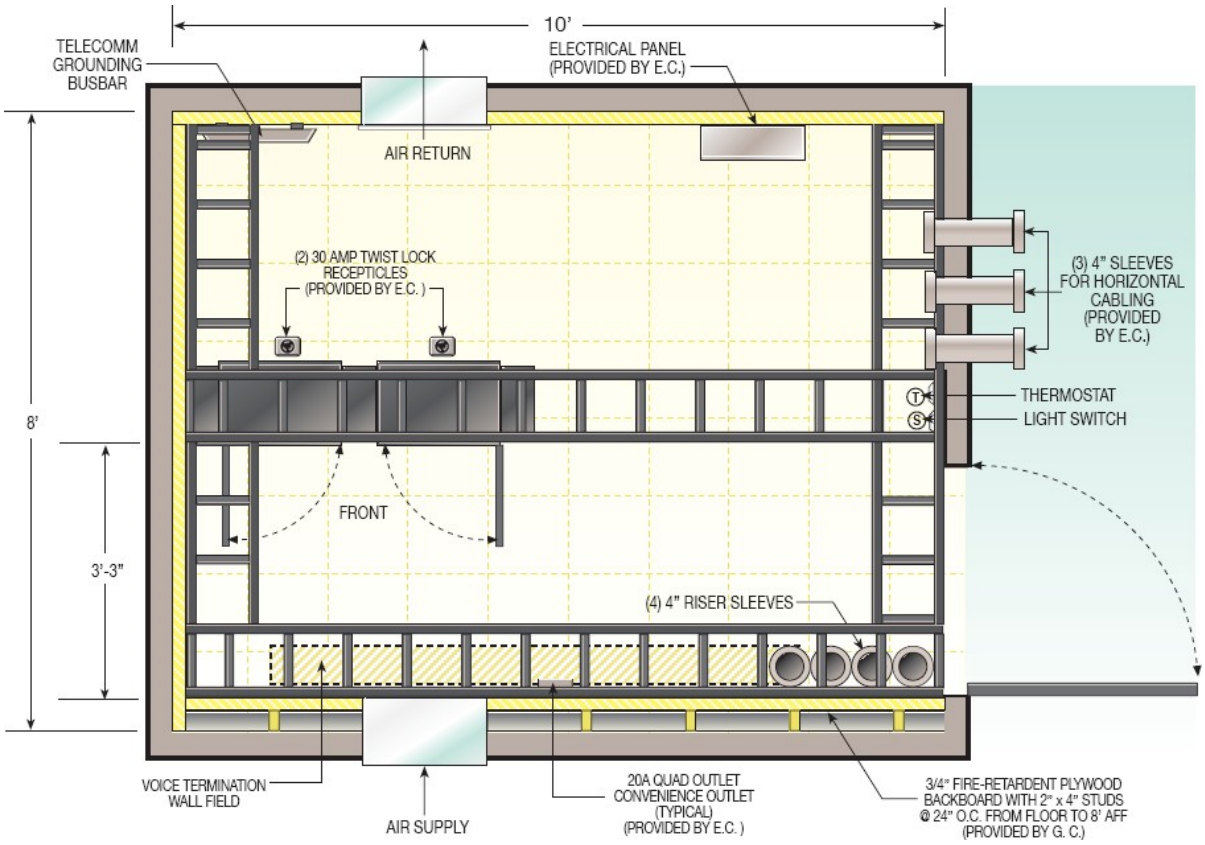
**STANDARD, WALL MOUNTED,
VOICE/DATA OUTLET**

(1) SINGLE GANG 2-PORT FACEPLATE
(2) 8P8C RJ-45 CATEGORY 6 JACK

**STANDARD, WALL MOUNTED,
WALL PHONE OUTLET**

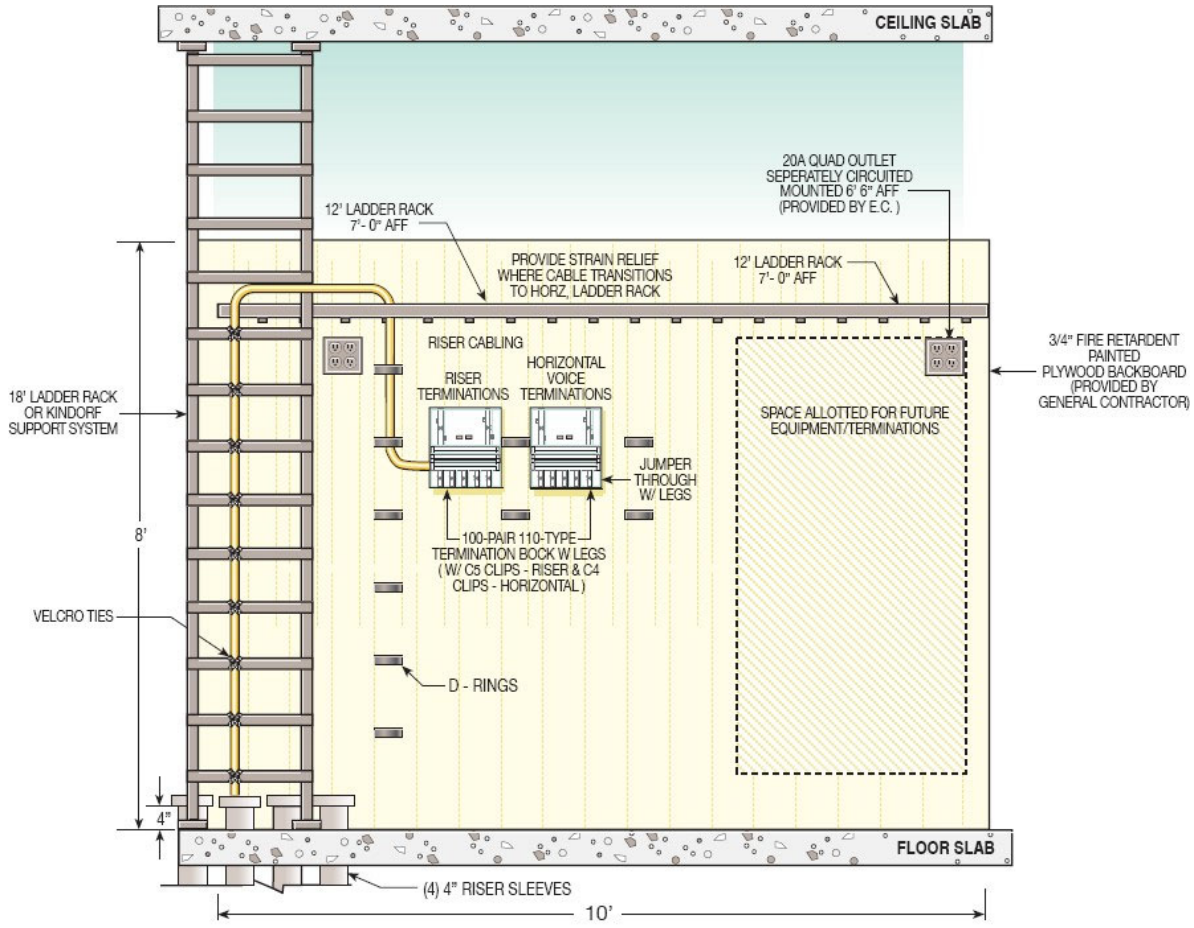
(1) SINGLE GANG 1-PORT WALL PHONE FACEPLATE
(1) 8P8C RJ-45 CATEGORY 6 JACK

4.09 TYPICAL INTERMEDIATE CROSS-CONNECT (IC) ROOM.



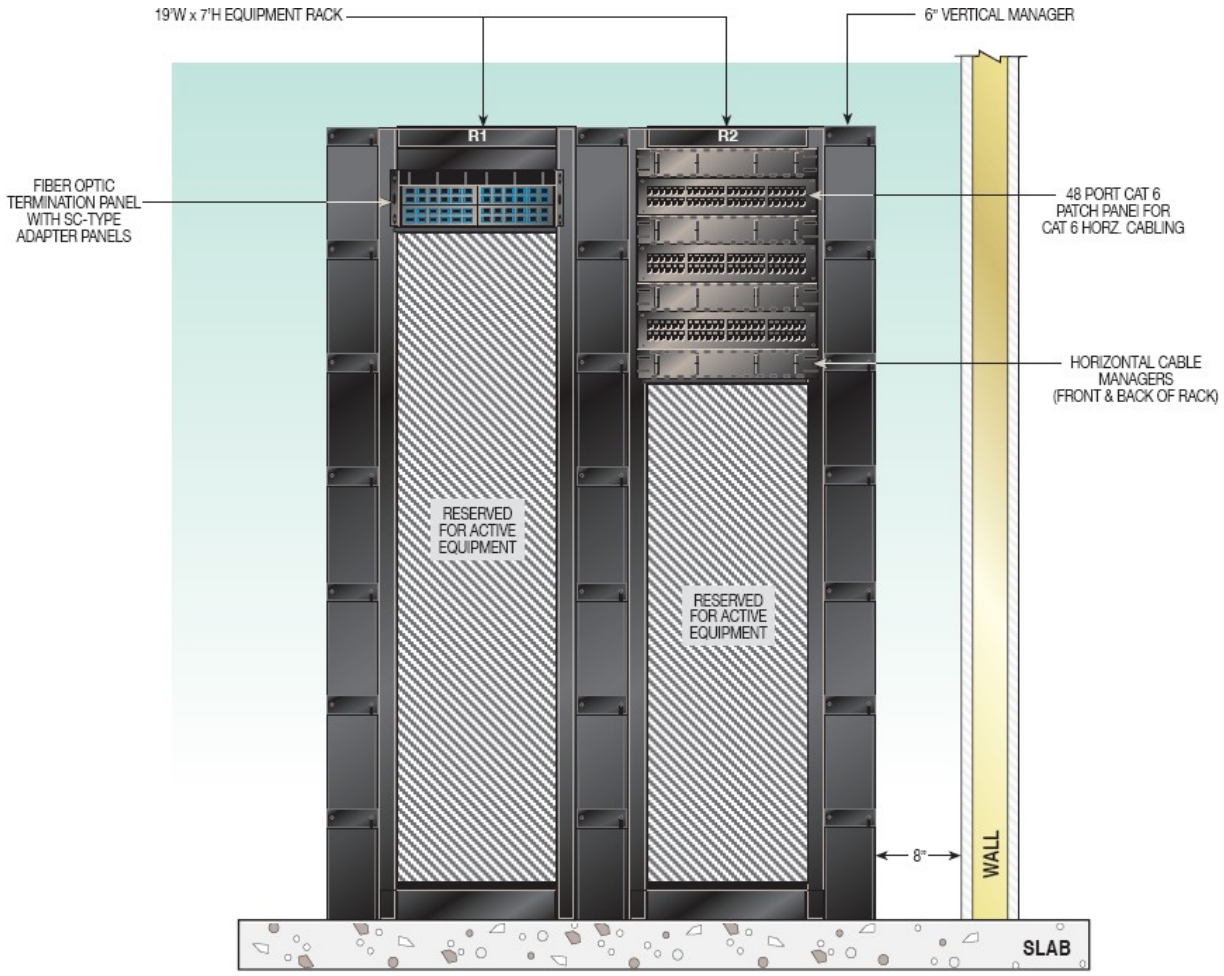
PLAN VIEW

4.09. TYPICAL WALLFIELD



MC/IC WALLFIELD ELEVATION

4.10. TYPICAL RACK ELEVATION



MC/IC EQUIPMENT RACK ELEVATION

REFERENCE DOCUMENTS

A. Telecommunications Industry Association (TIA)

1. ANSI X3T9.5, Requirements for UTP at 100 Mbps
2. TIA TSB-125, Guidelines for Maintaining Optical Fiber Polarity Through Reverse-Pair Positioning, 2001
3. TIA TSB-140, Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems (2004)
4. TIA-526-7, Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant – OFSTP-7
5. T-526-14-A, Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant – SFSTP-14
6. TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises, 2009
7. TIA-568-C.1, Commercial Building Telecommunications Cabling Standard Part 1: General Requirements, 2009
8. TIA-568-C.2 , Commercial Building Telecommunications Cabling Standard—Part 2: Balanced Twisted Pair Cabling Components, 2008
9. TIA-568-C..3, Optical Fiber Cabling Components Standard, 2008
10. TIA-569-B, Commercial Building Standards for Telecommunications Pathways and Spaces, 2004
11. TIA-569-B-1, Commercial Building Standard for Telecommunications Pathways and Space – Addendum 1 – Temperature and Humidity Requirements for Telecommunications Spaces, 2009
12. ANSI/TIA-598-C, Optical Fiber Cable Color Coding, 2005
13. ANSI/TIA-604.2-A, FOCIS 2—Fiber Optic Connector Intermateablility Standard, 2003
14. TIA-606, Administration Standard for Commercial Telecommunications Infrastructures, 2008
15. ANSI J-STD-607-A, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications, 2002
16. ANSI/TIA-758-A, Customer-owned Outside Plant Telecommunications Infrastructure Standard, 2005
17. ANSI/TIA-854, A Full Duplex Ethernet Specification for 1000 Mb/s (1000BASE-TX) Operating over Category 6 Balanced Twisted-Pair Cabling, 2001
18. TIA-862, Building Automation Systems Cabling for Commercial Buildings, 2002
19. TIA-942, Telecommunications Infrastructure Standard for Data Centers, 2005
20. ANSI/NECA/BICSI 568-2006, Standard for Installing Telecommunications Systems, 2006
21. Category TSB-155, Guidelines for the Assessment and Mitigation of Installed 6 Cabling to Support 10GBASE-T, 2007

B. Other Reference Materials

1. ANSI/NECA/GICSI-568-2006, Standard, Installing Commercial Building Telecommunications Cabling
2. BICSI Outside Plant Design Reference Manual (COOSP), current edition.
3. BICSI Electronic Safety and Security Reference Manual (ESSDRM), current edition
4. BICSI Information Transport Systems Installation Methods Manual (ITSIM), current edition
5. BICSI Network Design Reference Manual (NDRM), current edition
6. BICSI Telecommunications Distribution Methods Manual (TDMM), current edition
7. BICSI Wireless Design Reference Manual (WDRM), current edition
8. Institute of Electrical and Electronic Engineers (IEEE)
9. National Electrical Manufacturers Association (NEMA)
10. Underwriters Laboratories (UL) Cable Certification and Follow Up Program