

# Appendix B - General Specifications for all Conference Rooms

## DIVISION 26 - ELECTRICAL

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## DIVISION 27 - COMMUNICATIONS

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SECTION 26 27 26  
WIRING DEVICES

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. Base Bid: The work under this section includes poke-through service fittings.

**1.02 SECTION INCLUDES**

- A. Poke-Through Assemblies

**1.03 RELATED WORK**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this section.

**1.04 SUBMITTALS**

- A. Provide product data showing model numbers, configurations, finishes, dimensions, and manufacturer's instructions.
- B. For occupancy sensor shop drawings, the manufacturer's actual layout of occupancy sensors and the wiring diagrams shall be provided.
- C. Test Reports

**1.05 OPERATION AND MAINTENANCE DATA**

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

**PART 2 – PRODUCTS**

**2.01 POKE-THROUGH ASSEMBLIES**

- A. Description: Assembly comprising service fitting, poke- through component, firestops and smoke barriers, and junction box for conduit termination.
- B. Fire Rating: 2 hours.
- C. Service Fitting:
- D. Type: Flush.
- E. Device Plate: Painted black
- F. Configuration: one 3/4" trade size conduit and one 1 1/2" trade size conduit.
- G. Basis of design: Legrand #RC9AM2TCBK 2" trade size (turnkey solution) or approved equal. Provide furniture whip in accordance with manufacturers recommendations.

- H. Spacing is limited to 2 feet on center and no more than one hole per each 65 sq. ft. [6 sq. m] of floor area in each span.
- I. Refer to manufacturer's installation instructions for further information.

## **PART 3 – EXECUTION**

### **3.01 INSTALLATION**

- A. Drill opening for poke-through fitting installation in accordance with manufacturer's instructions.
- B. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface-mounted outlets.
- C. Install devices and flush and level.
- D. Receptacles shall have a bonding conductor from grounding terminal to the metal conduit system. Self-grounding receptacles using mounting screws as bonding means are not approved.
- E. Coordination with Other Trades:
  - 1. Take steps to ensure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
  - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
- F. Conductors:
  - 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
  - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
  - 3. The length of free conductors at outlets for devices shall meet provisions of NPFA 70, Article 300, without pigtails.
  - 4. Existing Conductors:
    - a. Cut back and pigtail or replace all damaged conductors.
    - b. Straighten conductors that remain and remove corrosion and foreign matter.
    - c. Pigtailing existing conductors is permitted provided the outlet box is large enough.
- G. Device Installation:
  - 1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
  - 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
  - 3. Do not remove surface protection, such as plastic film and smudg4e covers, until the last possible moment.
  - 4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
  - 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductors tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
  - 6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
  - 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
  - 8. Tighten unused terminal screws on the device.

9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

### **3.02 FIELD QUALITY CONTROL**

- A. Inspect each wiring device for defects.
- B. Operate each wall switch and sensor with circuit energized and verify proper operation.
- C. Verify that each receptacle device is energized.
- D. Test each receptacle device for proper polarity.
- E. Test each GFCI receptacle device for proper operation.
- F. The Engineer and Owner's personnel reserve the right to be present at all tests.

### **3.03 ADJUSTING**

- A. Adjust devices and wall plates to be flush and level.
- B. Mark all conductors with the panel and circuit number serving the device with a machine generated label, at the device, and on the back of the device cover.

END OF SECTION

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SECTION 27 05 00  
COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS

PART 1 – GENERAL

**1.01 SCOPE OF WORK**

- A. Base Bid: It is the intent of these specifications to provide complete and workable systems – including all parts lists, operating instructions and wiring diagrams, as shown on the accompanying plans and as specified herein except such parts as are specifically exempted herein. Provide all necessary supervision, coordination, labor, materials, equipment, fixtures, drayage, hoisting, tools, transportation, plant services and facilities, machinery and connections to utilities for the installation of complete and operable telecommunications systems. If details or special conditions are required in addition to those shown on drawings, provide all material and equipment usually furnished with such systems or required to complete their installation, whether noted in plans and specification or not.
- B. Materials and labor shall be new (unless noted otherwise), first class and workmanlike and shall be subject at all times to the A/E's inspections, tests and approval from the commencement until the acceptance of the completed work.
- C. The layout shown on the drawings is diagrammatic and shall be followed as closely as other work will permit. The drawings provide design intent. The Contractor shall verify all dimensions at the site and be responsible for their accuracy.
- D. Because of the scale of the Drawings, certain basic items, such as, pipe fittings, duct fittings, access panels, and sleeves, may not be shown. Where such items are required by Code or by other Sections, or where required for proper installation of the Work, such items shall be included, whether shown or not.
- E. In the event of any inconsistencies between the specifications, drawings, contract documents, applicable laws, statutes, ordinances, building codes, rules and regulations, the contractor shall provide the better quality or greater quantity of work and comply with or conform its work to the most stringent legal or contractual requirements.
- F. Changes from these drawings required to make this work conform to the building construction shall be made only with prior written approval of the Architect/Engineer. All proposed changes shall be shown on shop drawings. All measurements shall be verified by actual observation and all work shall fit in place meeting the approval of the Architect/Engineer.
- G. Equipment Specification may not deal individually with minute items required, such as, components, parts, controls, and devices which may be required to produce the equipment performance specified or as required to meet the equipment warranties. Where such items are required to make the system operational, they shall be included by the supplier of the equipment at no additional cost, whether or not specifically called for.
- H. Equipment, materials and accessories for systems as shown and noted on the drawings including but not limited to the following:
  - 1. A complete raceway system including conduit, outlet box, pull boxes, junction boxes, sleeves and hangers. This work may be separated out for completion by the Division 26 contractor. Usually the General Prime Contractor (GPC) will assign this work to Div. 26 contractor. Div. 27 contractor shall confirm this arrangement prior to bidding.
  - 2. Complete structured cabling system including all riser and horizontal cables.

3. Communications distribution equipment including patch panels, innerduct, terminations, racks and cabinets.
4. Maintaining of all communications and other low voltage connections outside of or passing through the work area to other areas.
5. All cutting and patching to accomplish wiring tasks.
6. All conduit penetrations through walls and floors and complete fire stopping of penetrations per standards of a national testing laboratory.
7. Creation of new cable pathways through areas where no pathway currently exists.
8. Wiring devices, jacks and cover plates.
9. Complete testing, certification and creation of as-builts for all jack locations.

## **1.02 SECTION INCLUDES**

- A. This section includes information common to two or more technical communications specification sections or items that are of a general nature, not conveniently fitting into other technical sections.

1. Submittals
2. Construction Verification Checklists
3. Functional Performance Tests
4. Reference Standards
5. Quality Assurance
6. Guarantee
7. Work by Owner
8. Equipment Furnished by Others
9. Provisions for Future
10. Operation and Maintenance Instructions
11. Record Documents
12. Continuity of Existing Services
13. Protection of Finished Surfaces
14. Sealing and Firestopping
15. Off Site Storage
16. Regulatory Requirements
17. Certificates and Inspections
18. Coordination
19. Sleeves and Openings
20. Definitions
21. Project/Site Conditions
22. Work Sequence and Scheduling
23. Salvage Materials
24. Performance Testing
25. Description
26. Dimensions and Define Locations
27. Training
28. Access Panels and Doors
29. Identification
30. Demolition
31. Cutting and Patching
32. Building Access
33. Equipment Access
34. Housekeeping and Clean Up
35. Cable Installation
36. Testing
37. Systems Checklist

### **1.03 RELATED WORK**

- A. This section applies to all items in 1.03 - C, D, and E.
- B. Section 27 05 53 – Identification for Communications Systems
- C. Section 27 15 10 – Horizontal Copper Cable and Equipment
- D. Section 27 40 00 – Audio-Visual Systems
- E. This work is also subject to all requirements of Division 26 of these specifications and NFPA 70 and the National Electric Code wherever applicable to work under this section.

### **1.04 SUBMITTALS**

- A. Submit shop drawings for equipment under each section per requirements listed in that section.
- B. Submit for all equipment and systems as indicated in the respective specification sections, marking each submittal with that specification section number. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and/or number, as indicated in the contract documents. Failure to do this may result in the submittal(s) being returned to the Contractor for correction and resubmission. Do not submit hard copies of web pages. Failing to follow these instructions does not relieve the Contractor from the requirement of meeting the project schedule.
- C. On request from the A/E, the contractor shall furnish additional drawings, illustrations, catalog data, performance characteristics, etc.
- D. Submittals shall be grouped to include complete submittals of related systems, products, and accessories in a single submittal. Mark dimensions and values in units to match those specified. Include wiring diagrams of electrically powered equipment.
- E. The submittals must be approved before fabrication is authorized.
- F. Provide electronic copies of all submittals for review.

### **1.05 CONSTRUCTION VERIFICATION CHECKLISTS**

- A. Contractor is responsible for utilizing the construction verification checklists supplied under these specifications in accordance with the procedures defined for construction verification checklists in Section.

### **1.06 FUNCTIONAL PERFORMANCE TESTS**

- A. Contractor is responsible for utilizing the functional performance test procedures supplied under these specifications in accordance with the procedures defined for functional performance test procedures in Section.

### **1.07 REFERENCE STANDARDS**

- A. Abbreviations of standards organizations referenced in this and other sections are as follows:
  - 1. ANSI American National Standards Institute

2. ASTM American Society for Testing and Materials
3. EPA Environmental Protection Agency
4. ETL Electrical Testing Laboratories, Inc.
5. IEEE Institute of Electrical and Electronics Engineers
6. IES Illuminating Engineering Society
7. ISA Instrument Society of America
8. NBS National Bureau of Standards
9. NEC National Electric Code
10. NEMA National Electrical Manufacturers Association
11. NESC National Electrical Safety Code
12. NFPA National Fire Protection Association
13. UL Underwriters Laboratories Inc.

## **1.08 QUALITY ASSURANCE**

- A. Substitution of Materials:
1. Where materials or equipment are specified by name the proposed material or equipment must be identical to the specified material or equipment in all characteristics of quality, function and serviceability, regardless of application in the Project and, in addition, when the Architect/Engineer deems that aesthetic significance is important, the equal material or equipment must be identical in all characteristics of visual appearance, design, color and texture. Any proposed equal shall be submitted to Architect/Engineer for prior approval, which Architect/Engineer may approve or disapprove in its sole discretion. Work performed or constructed with unapproved equals is at Contractor's risk and any required correction of work incorporating unapproved equals shall be at Contractor's sole cost and expense.
  2. In all instances, Contractor shall assume full responsibility for proof of equality of the statute to the equipment hereinafter specified. All data and information necessary for proof of equality, function and space requirements shall be prepared and accompany the submittal of the substitution to the Architect/Engineer. Approval by the Architect/Engineer of equipment other than the specified does NOT relieve Contractor of this responsibility.
- B. All products and materials used are to be new, undamaged, clean and in good condition. Existing products and materials are not to be reused unless specifically indicated.
- C. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the contract documents, the contractor is responsible for all costs involved in integrating the equipment or accessories into the system, including, but not limited to, coordination with other trades and any required changes by other trades and for obtaining the intended performance from the system into which these items are placed.
- D. General:
1. Cable and Equipment Manufacturer(s) shall be a company specializing in communications cable, accessories and/or equipment with minimum of 5 years documented experience in producing cable, accessories and/or equipment similar to those specified herein.
- E. Contractor Qualifications:
1. Qualified personnel utilizing state-of-the-art equipment and techniques shall complete all cable and equipment installation and termination.
  2. Contractor shall have been in this business for minimum of 5 years and completed 4 projects of magnitude specified in the following sections.
  3. Contractor shall be certified by the cabling/connectivity manufacturer to install the products provided.
  4. See Appendix A for complete qualifications.

F. Cable Systems:

1. Cable and connection hardware (copper) shall be qualified by Contractor and Manufacturer(s) as certified cabling system. Refer to manufacturers' recommendations for appropriate component types. Contractor shall install and test cable to meet all performance criteria and complete all documentation required by manufacturer in order to obtain cabling system warranty (performance warranty certification). Contractor shall obtain warranty from manufacturer within 30 days of substantial completion and provide a copy of approved warranty to the engineer, the original to the owner.
2. Provide as-built jack label documentation indicating actual locations and labels of all station jacks, changes in cable schedules and changes in rack mounted equipment. See specifications for other labeling requirements.

**1.09 GUARANTEE**

- A. In entering into a contract covering this work, the contractor accepts the specifications and guarantees that the work will be carried out in accordance with the requirements of this specification or such modifications as may be made under the contract documents.
- B. Contractor further guarantees that the workmanship and material will be of the best procurable and that none but experienced workmen familiar with each particular class of work will be employed.
- C. Contractor further guarantees to replace and make good at its own expense, including travel time, all defects, which may develop within 1 year after final payment and acceptance by the Architect/Engineer, due to faulty workmanship or material, upon, receipt of written notification from the Owner.
- D. Manufacturer(s) of cabling and connectivity system shall warranty materials, equipment, and performance etc. for minimum of 20 years from date of substantial completion of work. Warranty shall include labor, material and travel time.

**1.10 WORK BY OWNER**

- A. Owner will provide active electronics (Micro PC and conference phone in Room 321) for interface with building voice (VOIP) and data network.
- B. Owner will provide connections (service activation) from phone and data equipment to Contractor provided cabling and equipment and cross connects from Backbone Voice Cables to Voice Station Cables.

**1.11 OPERATION AND MAINTENANCE INSTRUCTIONS**

- A. In addition to the general content specified under general conditions supply the following additional documentation:
  1. Copies of all approved submittals along with approval letters
  2. Certificates
  3. Warranties
  4. Operation manual documents to assist the Owner to maintain all systems.
  5. Records of test performed to certify compliance with system and manufacturer requirements.
  6. Full equipment cut sheets including brands, makes, models, supplier (retailer) and manufacturer information (name, phone, e-mail, website, contact name), one-line diagrams, cable connections, system architecture.
  7. Contractor information (name, phone, e-mail, website, contact name)

8. Systems checklist (refer to Part 3 below)

## **1.12 RECORD DOCUMENTS**

- A. In addition to the general content specified under Division 27 specifications, follow the following procedures.
  1. During the progress of the work, Contractor shall maintain a current (daily) record set of the drawings and specifications, indicating thereon all work installed at variance with such Contract Documents including, without limitation, work covered by Addenda, Field Work Orders, Change Orders and Engineers additional instructions, interpretations and clarification. All changes or deviations from the original layout of the work and all critical dimensions of buried or concealed work shall be recorded. It shall be Contractor's responsibility to assure that said record sets are complete, accurate and up-to-date, Engineer shall have the right to inspect and review such record sets.
  2. At the completion of the work, Contractor shall indicate on record sets all record changes and such additional details necessary or appropriate to provide a complete reference document for use by Engineer. If variations and details cannot be shown clearly thereon, the Contractor shall prepare supplemental drawings adequate to impart the information. The foregoing drawings collectively shall constitute the "Record" drawings for the work.
  3. All indication on "Record" drawings shall be executed in a legible manner at Contractor's cost, using methods and legend presentations compatible with the overall scheme of the record drawings with respect to scale, drawing sheet sizes and sequential indexing. All changes shall be marked clearly in red and clouded.
  4. Architect/Engineer may review Contractor's "Record" drawings and notify Contractor of observed discrepancies or deviations. Contractor shall promptly correct discrepancies, deviations or illegible markups at Contractor's expense and resubmit revised drawings for Architect/Engineer review.
  5. Contractor shall provide final electronic record drawings to the Owner through the Engineer.
  6. Architect/Engineer will provide final electronic record drawings to the Owner based on Contractor's markups.

## **1.13 CONTINUITY OF EXISTING SERVICES**

- A. Do not interrupt or change existing services without prior written approval from the Owner's Project Representative. When interruption is required, coordinate scheduling of down-time with the Owner to minimize disruption to their activities. Unless specifically stated, all work involved in interrupting or changing existing services is to be done during normal working hours.
- B. Each Contractor shall thoroughly familiarize themselves with existing systems which will affect and be affected by relocation of existing equipment and installation of new lines and equipment. They shall plan installation of their work so that interruptions of services to any building or portion thereof will be a minimum and such interruptions shall occur only when system is not required, if possible. If not possible, each Contractor shall ensure the operation of services by whatever means possible, such as, installing bypasses, capping of services or providing temporary service. Each interruption shall be for as short a duration as possible.
- C. Bypasses or temporary services may add cost. If required, show bypasses or temporary services on phasing plans or floor plans.
- D. No extra costs will be paid to the Contractor for such outages which must occur outside of regular weekly working hours.

- E. This Contractor shall restore any circuit interruption as a result of this work to proper operation as soon as possible. Note that institutional operations are on a seven-day week schedule.

#### **1.14 PROTECTION OF FINISHED SURFACES**

- A. Furnish one can of touch-up paint for each different color factory finish furnished by the Contractor. Deliver touch-up paint with other "loose and detachable parts".

#### **1.15 SEALING AND FIRESTOPPING**

- A. Sealing and firestopping of sleeves/openings between conduits, cable trays, wireways, troughs, cablebus, busduct, etc. and the structural or partition opening shall be the responsibility of the contractor whose work penetrates the opening. The contractor responsible shall employ individuals skilled in such work to do the sealing and firestopping. These individuals shall normally and routinely be employed in the sealing and fireproofing occupation.

#### **1.16 REGULATORY REQUIREMENTS**

- A. Comply with requirements of the referenced codes and local Authority Having Jurisdiction (AHJ) regarding materials and installation.

#### **1.17 COORDINATION**

- A. The General Contractor shall have final decision on all space priority conflicts among Contractors. All space priority conflicts shall be brought to the attention of the Architect/Engineer and Owner's Representative.
- B. Each Contractor shall thoroughly familiarize themselves with existing systems which will affect and be affected by relocation of existing equipment and installation of new lines and equipment. They shall plan installation of their work so that interruptions of services to any building or portion thereof will be a minimum, and such interruptions shall occur only when system is not required, if possible. If not possible, each Contractor shall ensure the operation of services by whatever means possible, such as, installing bypasses, capping of services, or providing temporary service. Each interruption shall be for as short a duration as possible.
- C. Cooperation among all Contractors shall be required. Any Work that is installed without cooperating or coordinating with other Contractors and is in conflict shall be removed and reinstalled at that particular Contractor's cost. No cost additions to the Project will be considered due to a Contractor's lack of participation in the cooperation and coordination process. The following list of work items shall be the priority of order for all Contractors:
  - 1. Structure
  - 2. Recessed light fixtures
  - 3. Gravity-flow systems for sanitary and storm piping
  - 4. Ductwork and appurtenances
  - 5. Electrical and low voltage cable tray
  - 6. Plumbing vent piping
  - 7. Fire protection (sprinkler system)
  - 8. HVAC piping
  - 9. Gas piping and domestic water
  - 10. Electrical conduit and low voltage conduit
  - 11. Conduit

- D. The above list, in descending order, is the precedence assigned to the work items for space priority. Gravity-flow systems have first priority.
- E. In the case of interconnection of the work of two or more contractors, verify at the site or on shop drawings all dimensions relating to such work. All errors due to the failure to so verify any such dimensions shall be promptly rectified.
- F. Any installed work that is not coordinated and interferes with another contractor's work shall be removed or relocated at the installing contractor's expense.
- G. Prior to start of Construction, the Prime Contractor shall schedule a meeting with all of the Contractors responsible for the work items listed above. The purpose of the meeting is to introduce the coordination program and to determine its implementation in relation to the progress schedule.
- H. In the event a Contractor fails to cooperate in the Coordination Program, they shall be held responsible for all costs incurred for adjustments to the work of others made necessary to accommodate the uncooperative Contractor's installations.

#### **1.18 SLEEVES AND OPENINGS**

- A. Openings required in new or existing construction that may be necessary for the installation of work shall be provided by the respective contractor and all patching and repairing shall be done by workmen competent in the trade required.

#### **1.19 DEFINITIONS**

- A. Backbone Cabling - Cables connecting TRs from lower level to upper level or between TRs. Term also applies to outside plant cabling between buildings.
- B. BEF - Building Entrance facility – Voice, data and video services are brought from the street into building in this room.
- C. Cable - Assembly of one or more conductors or optical fibers within enveloping sheath, constructed so as to permit use of conductors singly or in groups.
- D. Cable Link - Includes SIO, station cable and termination hardware in TR.
- E. Cable Channel - Same as Cable Link, plus patch cords at SIO and in TR.
- F. Consolidation Point – Also known as zone distribution box (ZDB). Intermediate point having multiple terminations between SIO and TR to simplify moves, adds and changes, bringing final terminations closer to SIOs.
- G. Cross-Connect - Group of connection points, wall or rack mounted, used to mechanically terminate and administer building wiring.
- H. Entrance Room (ER) – A combination of BEF and MDF in one room. All building voice, data and video services are distributed to TRs on all levels from this room. Cables to all outlying campus buildings are terminated and distributed from the ER. ERs are on floor 2 and floor 3.
- I. Faceplate – a covering placed over a recessed back box that contains one or more openings to house individual jacks.
- J. Horizontal Cabling - Cables connecting SIOs to TRs.

- K. Jack – a single outlet consisting of a single connector attached to a single cable assembly. Multiple jacks may be installed into a single faceplate.
- L. MDF - Main Distribution Frame – Same as BEF or ER.
- M. OFCI – Owner furnished; contractor installed.
- N. OFOI – Owner furnished; owner installed.
- O. CFCI – Contractor furnished; contractor installed.
- P. OSP – Outside Plant (refers to equipment, conduit and installation contractor provided under separate contract to provide equipment beyond five feet from B2 building foundation).
- Q. The term “provide” includes such labor, methods, materials, equipment and transportation or other facilities required to complete the Contract and the performance of all duties thereby upon the Contractor.
- R. RU - Rack Unit - Each RU is 1.75" high.
- S. SIO - Standard Information Outlet - A device assembly located in work area on which horizontal cabling terminates and which can receive modular connectors. Depending on the immediate context, an SIO may refer to either a faceplate configuration (i.e., an SIO having two standard data jacks – SIO = faceplate) or in other cases may refer to a single jack (i.e. SIO = one jack). In some cases, as in item T below, the distinction is irrelevant.
- T. Telecommunications - Any transmission, emission, or reception of signs, signals, writings, images, sounds or information of any nature by wire, radio, visual, optical or other electromagnetic systems.
- U. TR – Telecommunications Room – Room used to cross connect backbone cable to horizontal station cable out to SIOs. May house network electronics. Also houses equipment for other systems such as CCTV and Access Control. Interchangeable with term IDF (Intermediate Distribution Facility). Usually one per floor to accommodate SIOs on that same floor.
- V. MTR – Main Telecommunications Room – Same as IDF but usually larger and located on a lower floor to consolidate riser cables from multiple TRs. May also function as a building entrance facility to receive cables from outside service providers. Interchangeable with term MDF (Main Distribution Facility).
- W. UTP – Unshielded Twisted Pair Cabling

## **1.20 PROJECT/SITE CONDITIONS**

- A. Install Work in locations shown on Drawings, unless prevented by Project conditions.
- B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of A/E before proceeding.
- C. Tools, materials and equipment shall be confined to areas designated by the Owner’s project representative.

## **1.21 WORK SEQUENCE AND SCHEDULING**

- A. Install work in phases to accommodate Owner's occupancy requirements. During the construction period coordinate schedule and operations with Owner's Construction Representatives.

#### **1.22 PERFORMANCE TESTING**

- A. Each system included in project scope shall be tested to verify performance.
- B. Systems that require a performance warranty (such as data cable) shall be tested to comply with manufacturer's requirements in order to obtain the system warranty.
- C. Some systems have specific testing procedures.
- D. Systems not having specific testing criteria shall utilize the Systems Checklist described in Part 3 below.

#### **1.23 DESCRIPTION**

- A. Structured cabling system is a complete collective configuration of cabling and associated hardware on a premises which, when installed, provides a comprehensive telecommunications infrastructure. Systems shall include backbone and station data, voice, and video as indicated on drawings.
- B. Cables and equipment shall be provided, tested, and terminated, including proper grounding and bonding.
- C. Telecommunication distribution consists of Telecommunications Rooms (TR), fiber optic backbone, category 6 copper data station cable, wall and floor box outlets, cable tray and conduit.
- D. TRs are located throughout facility.
- E. No UTP station cable link shall be longer than 90 meters.
- F. Cabling system is intended to be a "universal" system with no distinction between voice and data.
- G. Cabling to be plenum rated where noted and where environment dictates plenum rated cabling.
- H. Systems shall be delivered in complete functioning condition.
- I. Coordinate with owner as required to obtain owner furnished items.

#### **1.24 DIMENSIONS AND DEFINITE LOCATIONS**

- A. The Drawings depicting Work show approximate locations. The exact location of equipment and devices shall be established in the field in accordance with instructions from the Owner. Consideration shall be given to construction features, equipment of other trades, and requirements of the equipment proper.
- B. The Contractor shall refer to Shop Drawings and submittal drawings for all equipment requiring electrical connections to verify rough-in and connection locations.
- C. Unless specifically stated to the contrary, no Drawing by scale shall be used as a dimension to Work by. Dimensions noted on the Drawings are subject, in each case, to measurements of adjacent or previously completed Work and all such measurements necessary shall be taken before undertaking any Work dependent upon them.

## 1.25 TRAINING

- A. The contractor shall have the following responsibilities:
1. Provide a training plan sixty days before the planned training covering the following elements:
    - a. Equipment
    - b. Intended audience
    - c. Location of training
    - d. Objectives
    - e. Subjects covered (description, duration of discussion, special methods, etc.)
    - f. Duration of training on each subject
    - g. Instructor for each subject
    - h. Methods (classroom lecture, manufacturer's quality video, site walk-through, actual operational demonstrations, written handouts, etc.).
  2. Provide designated owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of equipment that makes up the system.
  3. Training shall normally start with classroom sessions followed by hands-on demonstration/training on each piece of equipment.
  4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system shall be repaired or adjusted as necessary and the demonstration repeated at another scheduled time, if necessary.
  5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.
  6. The controls contractor shall attend sessions other than the controls training, as specified, to discuss the interaction of the controls system as it relates to the equipment being discussed.
  7. Training sessions shall follow the outline in the table of contents of the operation and maintenance manual and illustrate whenever possible the use of O&M manuals for reference.
  8. Training shall include:
    - a. Use of the printed installation, operation and maintenance instruction material included in the O&M manuals.
    - b. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include startup, operation in all modes possible, shutdown, seasonal changeover and any emergency procedures.
    - c. Discussion of relevant health and safety issues and concerns.
    - d. Discussion of warranties and guarantees.
    - e. Common troubleshooting problems and solutions.
    - f. Explanatory information included in the O&M manuals.
    - g. Discussion of any peculiarities of equipment installation or operation.
    - h. Classroom sessions shall include the use of overhead projections, slides, video/audio-taped material as might be appropriate.
    - i. Hands-on training shall include startup, operation in all modes possible, and preventative maintenance for all pieces of equipment.
  9. The contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls not controlled by the central control system.

- B. Video recording of the training sessions will be provided by the contractor and added to the O&M manuals. In addition, factory training videos identifying key troubleshooting, repair, service and/or replacement techniques shall be provided and reviewed with the owner.
- C. Provide additional training as specified in other specification sections for specific equipment.

## PART 2 – PRODUCTS

### 2.01 IDENTIFICATION

- A. Refer to Section 27 05 53 – Identification for Communication Systems.

### 2.02 SEALING AND FIRESTOPPING

- A. Fire and/or Smoke Rated Penetrations:

- 1. Manufacturers:

- a. 3M, STI/SpecSeal, Tremco, Hilti
- b. All firestopping systems shall be by the same manufacturer.

- 2. Submittals:

- a. Contractor shall submit product data for each firestop system. Submittals shall include product characteristics, performance and limitation criteria, test data, MSDS sheets, installation details and procedures for each method of installation applicable to this project. For non-standard conditions where no UL tested system exists, submit manufacturer's drawings for UL system with known performance for which an engineering judgment can be based upon.

- 3. Product:

- a. Firestop systems shall be UL listed or tested by an independent testing laboratory approved by the Owner and the Authority Having Jurisdiction (AHJ).
- b. Use a product that has a rating not less than the rating of wall or floor being penetrated. Reference architectural drawings for identification of fire and/or smoke rated walls and floors.
- c. Contractor shall use firestop putty, caulk sealant, intumescent wrapstrips, intumescent firestop collars, firestop mortar or a combination of these products to provide a UL listed system for each application required for this project. Provide mineral wool backing where specified in manufacturer's application detail.

- B. Non-Rated Penetrations:

- 1. Conduit Penetrations Through Below Grade Walls:

- a. In exterior wall openings below grade, use a modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill annular space between the uninsulated conduit and the cored opening or a water-stop type wall sleeve.

2. Conduit and Cable Tray Penetrations:

- a. At conduit and cable tray penetrations of non-rated interior partitions, floors and exterior walls above grade, use urethane caulk in annular space between conduit and sleeve, or the core drilled opening.

**PART 3 – EXECUTION**

**3.01 DEMOLITION**

- A. Perform all demolition as indicated on the drawings to accomplish the work. Where demolition work is to be performed adjacent to existing work that remains in an occupied area, construct temporary dust partition to minimize the amount of contamination of the occupied space. Where pipe is removed and not reconnected with new work, cap ends of existing services as if they were new work. Coordinate work with the Owner to minimize disruption to the existing building occupants.
- B. All pipe, fixtures, equipment, wiring and associated conduit, insulation and similar items demolished, abandoned, or deactivated are to be removed from the site by the Contractor except as specifically noted otherwise. All designated equipment is to be turned over to the owner for their use at a place and time so designated. Maintain the condition of material and/or equipment that is indicated to be reused equal to that existing before work began.
- C. All contractors requiring the personnel/ material hoist at times other than outlined in the temporary facilities specifications will make arrangements directly with the general contractor. The general contractor is responsible for all coordination and scheduling of the use of any hoisting equipment so the flow of the project is smoothly maintained and all workers have access to the work areas to perform their work and deliver material to the areas needed according to the project schedule.
- D. If any contractor's work requires the removal and replacement of any finished materials including but not limited to such materials as ceiling tiles, wall finishes, cabinets, doors, flooring, windows, etc. after those items are installed, each contractor will be responsible, at no additional cost to the owner, to replace any damaged, soiled or lost materials with new materials to match the existing materials and those materials damaged.

**3.02 CUTTING AND PATCHING**

- A. Each Contractor shall furnish to the Prime Contractor the accurate locations and sizes for required openings in the work, but this shall not relieve each Contractor of the responsibility of checking to assure that properly sized openings are provided. When additional patching is required due to the Contractor's failure to inspect this work, then the Contractor shall make arrangements for the patching required to properly close the openings to include patch painting, and the Contractor shall pay any additional cost incurred in this respect.
- B. If cutting and patching of the structure is made necessary due to the Contractor's failure to install piping, ducts, sleeves, or equipment on schedule, or due to the Contractor's failure to furnish on schedule the information required for the leaving of openings, then it shall be the Contractor's responsibility to make arrangements and obtain approval from the General Contractor and Architect/Engineer for this cutting and patching, and the Contractor shall pay any additional cost incurred in this respect. The Contractor shall also reimburse the Owner for any additional costs incurred to the Architect/Engineer for additional services caused by the Contractor in this respect.

- C. The Contractor shall provide cutting and patching and patch painting in the existing structure as required for the installation of their Work and shall furnish lintels and supports as required for openings. Cutting of structural support members will not be permitted without prior approval of the Architect/Engineer. Extent of cutting shall be minimized; use core drills, power saws, or other machines which will provide neat, minimum openings. Patching shall match adjacent materials and surfaces and shall be performed by craftsmen skilled in the respective craft required.

### **3.03 EQUIPMENT ACCESS**

- A. Install all conduit and accessories to permit access to equipment for maintenance. Coordinate the exact location of wall and ceiling access panels and doors with the General Contractor, making sure that access is available for all equipment and specialties. Where access is required in plaster or drywall walls or ceilings, furnish the access doors to the General Contractor and reimburse the General Contractor for installation of those access doors.

### **3.04 COORDINATION**

- A. The Contractor shall cooperate with other trades in locating work in a proper manner. Should it be necessary to raise or lower or move longitudinally any part of the electrical work to better fit the general installation, such work shall be done at no extra cost to the Owner, provided such decision is reached prior to actual installation. The Contractor shall check location of electrical outlets with respect to other installations before installing.
- B. The Contractor shall verify that all devices are compatible for the surfaces on which they will be used. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls and other structural components as they are constructed.
- C. Coordinate all work with other contractors prior to installation. Any installed work that is not coordinated and that interferes with other contractor's work shall be removed or relocated at the installing contractor's expense.
- D. Coordinate with Division 27 contractors and equipment vendors for proper location, quantity and capacity of all required conduits, back boxes, device rings and power supplies required to support systems specified.

### **3.05 SEALING AND FIRESTOPPING**

- A. Fire and/or Smoke Penetrations:
  - 1. Install approved product in accordance with the manufacturer's instructions where a pipe (i.e. cable tray, bus, cable bus, conduit, wireway, trough, etc.) penetrates a fire rated surface.
  - 2. Where firestop mortar is used to infill large fire-rated floor openings that could be required to support weight, provide permanent structural forming. Firestop mortar alone is not adequate to support any substantial weight.
- B. Non-Rated Surfaces:
  - 1. When the opening is through a non-fire rated wall, floor, ceiling or roof the opening must be sealed using an approved type of material.
  - 2. Install escutcheons or floor/ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces for this paragraph include only those rooms with finished ceilings and the penetration occurs below the ceiling.

3. In exterior wall openings below grade, assemble rubber links of mechanical seal to the proper size for the conduit and tighten in place, in accordance with the manufacturer's instructions. Install so that the bolts used to tighten the seal are accessible from the interior of the building or vault.
4. At interior partitions, conduit penetrations are required to be sealed for all clean rooms, laboratories, computer rooms, tele/data/com rooms and similar spaces where the room pressure or odor transmission must be controlled. Apply sealant to both sides of the penetration in such a manner that the annular space between the conduit sleeve and the conduit is completely filled.

### **3.06 HOUSEKEEPING AND CLEAN UP**

- A. The Contractor shall clean up and remove from the premises, on a daily basis, all debris and rubbish resulting from its work and shall repair all damage to new and existing equipment resulting from its work. When job is complete, this Contractor shall remove all tools, excess material and equipment, etc., from the site.

### **3.07 CABLE INSTALLATION**

- A. Furnish all required installation tools to facilitate cable pulling without damage to cable jacket.
- B. During pulling operation adequate number of workers shall be present to allow cable observation at all points of raceway entry and exit, as well as to feed cable and operate pulling machinery.
- C. Pull cables in accordance with cable manufacturer's recommendations and ANSI/EEE C2 Standards.
- D. Recommended pulling tensions and bending radii shall not be exceeded.
- E. Any cables bent or kinked to radius less than recommended dimension are not allowed and shall be replaced at no expense to Owner.
- F. Pull all cable by hand unless installation conditions require mechanical assistance.
- G. Where mechanical assistance is used, ensure that maximum tensile load for cable is not exceeded. This may be in the form of continuous monitoring of pulling tension, use of "break-away" or other approved method.
- H. Install cable in conduit, in J-hooks, or metal raceway system (cable tray or equivalent) in public areas and as designated on plans. Certain routes may require cable to be run outside of cable tray.
- I. All routing shall be kept clear of other trades work and supported utilizing j-hooks.
- J. J-hook cable supports shall be installed in accordance with manufacturers' installation requirements.
- K. Provision of j-hooks is not indicated on drawings. Contractor is responsible to provide j-hooks along any route where cable tray or conduit is not available. Change orders for j-hooks will not be accepted even if cable routes must change due to lack of cable tray, avoidance of structures or other utilities or route changes due to cable length problems. All jack symbols shall assume provision of cable support including j-hooks, cable tray or conduit.
- L. Change orders for additional j-hooks, conduits or cable tray will not be accepted for route changes or changes in cable length unless pre-authorized by engineer.

- M. Cable should be provided within cable tray wherever possible and practical. Cable tray may be indicated on project documents along major routes only. Some cable may need to take alternate routes outside of cable tray to reach destination in order to stay within the cable length limit. Where installed cable does not follow cable tray, contractor shall plan for all required j-hooks and sleeves to accommodate alternate routes. Example: during bidding contractor assumes certain cables will follow cable tray route. But during installation it is discovered that route causes cable to be over the length limit, forcing another route. The alternate route requires additional J-hooks and sleeves that were not planned during bidding. Since neither the owner nor Architect/Engineer provide explicit directions for routing of every cable, and since the project scope or jack quantity did not change, the contractor shall take responsibility for measuring and planning of all cable routes and provision of all support and sleeve devices as required without incurring additional charges to the project.
- N. Spacing of J-hook cable supports shall be minimum every 4 ft. or in accordance with cable manufacturers' specifications, whichever distance is shorter. Under raised floor provide every 2 ft. or on every vertical support.
- O. J-hook fill capacities shall be:
1. 1" diameter, 16 UTP 4 pair cables.
  2. 2" diameter, 50 UTP 4 pair cables.
  3. 4" diameter, 80 UTP 4 pair cables.
- P. Cable in MDF/TR shall be routed and supported utilizing "D-type" mounting rings, J-hooks and overhead cable runway.
- Q. Use of circular bridle rings made of round stock is not acceptable for cable support. Any support device must have a flat bottom (such as j-hooks) to adequately support cable without deforming cable at point of support.
- R. Repair damage to interior spaces caused by installation of cable, raceway or other hardware, Repairs must match preexisting color and finish of walls, floors and ceilings.
- S. Replace contractor-damaged ceiling tiles to match color, size, style and texture.
- T. Avoid abrasion and other damage to cables during installation. Any cable having visible abrasions that have worn through the outer sheath shall be replaced at contractor's expense, whether the cable passes the certification test, or not.
- U. Provide plastic bushings on the end of every conduit or sleeve that is utilized for cable. Use of conduits or sleeves WITHOUT the provision of plastic bushings to protect the end of the conduit may be cause for removal and replacement of all cables utilizing that conduit or sleeve.
- V. Pulling lubricant may be used and shall:
1. Be non-injurious to cable jacket and other materials used.
  2. Not harden or become adhesive with age.
- W. Pull cord (200 lb. minimum) shall be installed with cable installed in conduit and innerduct.
- X. Provide to Engineer, prior to installation, drawings showing proposed installation for approval.
- Y. Install cables splice-free unless otherwise specified.
- Z. Cabling shall be neatly laced, dressed and supported.

### **3.08 TESTING**

- A. Contractor shall:
  - 1. Submit schedule for acceptance testing. Representatives of Owner and/or Architect/Engineer may witness test procedures.
  - 2. Notify Owner and Architect/Engineer a minimum of 2 days in advance to allow for such participation.
  - 3. Conduct tests during course of construction when identifiable portion of installation is complete. Alternatively, testing can be conducted after entire installation is complete if this does not delay the project schedule.
  - 4. Describe test procedures prior to testing and submit sample test form to Engineer. Submit 3 record copies, and one electronic copy in CSV format, of results of tests to Architect/Engineer for approval.
  - 5. Alternatively, Contractor may submit proprietary electronic format test results, including software to access and print results. Software shall be Windows™ compatible.
- B. Testing shall be completed and accepted by Owner and Architect/Engineer before Owner furnished equipment and cross connects are installed.
- C. Test results shall be provided to manufacturer in order to obtain complete cable system warranty within 30 days of project completion. Provide original warranty certificate to owner and one copy to Architect/Engineer.
- D. Provide as-built jack plans and other as-built documentation as determined by field labeling or other changes to project documents.
- E. The contractor is responsible to assure that all individual components and integrated systems (especially electronic systems) are fully functioning and in good working order before notifying Architect/Engineer or Owner for acceptance testing, inspection or final punch list completion.

### **3.09 SYSTEMS CHECKLIST**

- A. For all systems having an electronic equipment component (active electronics) a system checklist shall be developed and utilized by the contractor.
- B. The systems checklist shall make note of all major electronic components and systems.
- C. It shall utilize a simple method to make notations of the equipment, that they
  - 1. Function individually as designed.
  - 2. Have been calibrated or adjusted.
  - 3. Function as an integrated system with other components
- D. The checklist shall be utilized in the field by the contractor and filled out appropriately prior to contracting owner or Architect/Engineer to witness tests, provide inspections or complete final punch list.
- E. The checklist shall have a signature line for three entities: Contractor/supervisor, owner and engineer.
- F. A completed, signed checklist (by Contractor) shall be presented to the Architect/Engineer prior to performing the punch list and prior to final owner sign-off or project completion.

- G. Examples of systems that might require a checklist: Access Control, Closed Circuit TV system (security cameras), Audio-Visual systems, and other system that utilizes active electronics.
- H. It is the responsibility of the Contractor, not the Architect/Engineer or Owner, to assure that all systems function according to the design intent of the project documents and according to all manufacturer's recommendations prior to project completion. The Systems Checklist shall be utilized by the Contractor and presented to the Engineer or Owner as verification that all systems have been tested, adjusted and are in good working order.
- I. The Systems Checklist shall be included as part of the Operations and Maintenance manual to be submitted at project completion.

END 27 05 00

## APPENDIX A

### COMMUNICATION QUALIFICATION REQUIREMENTS

#### TABLE OF ARTICLES

1. GENERAL
2. TECHNICIAN/INSTALLER QUALIFICATIONS
3. CONTRACTOR QUALIFICATION REQUIREMENTS

#### COMMUNICATIONS QUALIFICATION REQUIREMENTS

##### ARTICLE 1 - GENERAL

###### 1.1 GENERAL

- 1.1 This document specifies the minimum technical qualifications required of Communications Subcontractors and Technicians participating in the construction this project.
- 1.2. This document is part of the Contract Documents. The Communications subcontractor acknowledges that all Technicians performing communications work on the Project meet the technical qualifications specified herein. This document will serve as a metric to evaluate quality control and quality of work throughout the Project, including workmanship, code and standards compliance, methods, practices, accuracy of work, efficiency, and other trade related work items.
- 1.3 The Communication Subcontractor must be able to demonstrate the capacity to satisfy all sections of this qualification document. The Owner reserves the right to require supporting documentation from the Communications subcontractor to verify that all qualification requirements specified herein for participation on the Project have been met.

###### 1.2 CONTRACTORS AND SUBCONTRACTORS

- 1.2.1 The minimum work anticipated for the Project includes Communications cable installation, termination, documentation, labeling and testing.

###### 1.3 SCOPE OF WORK

- 1.3.1 In brief the Project requires:
  - .1 Communications cabling work may include any combination of the following: copper cable throughout the facility; horizontal cabling to work area outlets; and termination, labeling, and testing of new communication cabling infrastructure. Cabling will be terminated in existing Telecommunication spaces.
  - .2 Service activation work includes activating circuits in a very methodical, organized, pre-planned, and logical approach, for both voice and data services.

##### ARTICLE 2 – TECHNICIAN/INSTALLER QUALIFICATION

###### 2.1 General

- 2.1.1 Technician/Installer qualification requirements are those required of Technician/Installer within the trade(s) under which they are participating on the Project.
- 2.1.2 The qualification requirements are the minimum requirements.
- 2.1.3 The categories below define the general scope of work by function. The category is not exhaustive of the work details.
- 2.1.4 Qualification requires that all of the items in the category are satisfied.

###### 2.2 Communications Cabling Work

- 2.2.1 Communications cabling work includes installation, termination, and testing installation, termination; installation, termination, and testing of category 6, 4-pair UTP communications station cable; Installation, termination, and testing of coax RG-11/RG-6 cabling, labeling of cables, WAO's and hardware; installation of equipment racks; installation of cable management hardware; and installation of termination frames, wall fields, and hardware.
- 2.2.2 Qualified Technician/Installers shall perform communications cabling work on the Project as follows:
- .1 Only qualified BICSI Technicians/Installers or those under direct on-site supervision of a BICSI Certified Technician shall install copper cable.
    - .1 Are familiar with and routinely install communications cable in accordance with the methods specified in industry standard TIA/EIA 568-B and C, Commercial Building Communications Cabling Standard.
    - .2 Are familiar with and routinely install communications pathways in accordance with the methods specified in industry standard TIA/EIA 569-A, Commercial Building Standard for Communications Pathways and Spaces.
    - .3 Are familiar with the National Electrical Code adopted by the local Authority Having Jurisdiction and as applicable to cable installation to the extent that the methods and practices used to install communications cable comply with the Code.
    - .4 Install twisted-pair category 6 UTP communications cable routinely.
    - .5 Install coax RG-11 and RG-6 cabling with compression connectors routinely.
    - .6 Have a minimum of one year of experience installing, routing, support, and placement of category 6 communications cable.
    - .7 Are accustomed to, familiar with, and routinely use tools and equipment for installation of multiple reels and large volumes of category 6 UTP, multi-pair copper cable, coaxial RG-11 and RG-6 cable, and SM/MM optical fiber riser cable.
    - .8 Are accustomed to, familiar with, and routinely apply typical industry practices and methods for installation and support of category 6 twisted pair UTP communications cable and optical fiber riser cable.
    - .9 Are a BICSI Certified Installer or are under the direct supervision of an on-site foreman who is a current BICSI Certified Technician and could provide copy of current updated certificate.
  - .2 Only qualified BICSI Technicians/Installers or those trained specifically by the manufacturer of the cabling systems to be installed shall terminate and test copper cable. Qualified technicians terminating and testing copper cable are those who:
    - .1 Routinely install, terminate, and test the cable and connectivity products specified herein, or proposed on the bid.
    - .3 Are accustomed to, familiar with, and routinely use Level III and Level IV certification testers for twisted pair category 6 UTP communications cables and are knowledgeable to interpret and trouble shoot test results.
    - .4 Are a current BICSI Certified Technician, a Certified BICSI Installer or certified by the manufacturer of the cabling system to be installed and could provide copy of current certification certificate.
  - .3 Only qualified Technicians shall splice copper cable. Qualified Technicians/Installers splicing copper cable are those who:
    - .1 Routinely terminate multi-pair copper cable.
    - .2 Are accustomed to, familiar with, and routinely use tools and equipment for splicing multi-pair cables.
    - .3 Are accustomed to, familiar with, and routinely use test equipment to verify correct pair splicing and are knowledgeable to interpret and trouble shoot test results.
    - .4 Are a current BICSI Certified Technician and could provide copy of current certification certificate.

## ARTICLE 3 - CONTRACTOR QUALIFICATION REQUIREMENTS

- 3.1 General
  - 3.1.1 Contractor qualification requirements are those required of the Contractor to perform the work on the Project.
  - 3.1.2 The qualification requirements are the minimum requirements.
  - 3.1.3 Qualification requires that all of the items in each category are satisfied and support documentation submitted to owner.
- 3.2 Project Administration
  - 3.2.1 The nature of the Project work necessitates a formally defined process of administration. Project administration includes project scheduling; crew scheduling; materials handling; tracking field changes; etc.
  - 3.2.2 Qualified Contractors are those who:
    - .1 Have experience managing projects equal to or larger than the project being bid.
    - .2 Are accustomed to, familiar with, and routinely use formal project administration practices and procedures.
    - .3 Have provided large project scheduling and are accustomed to and familiar with large project scheduling practices.
    - .4 Are accustomed to, familiar with, and routinely use project scheduling software.
- 3.3 Project Staffing
  - 3.3.1 The Project size and schedule requires teams of qualified Technicians/Installers performing work throughout the building. In general each team shall be dedicated to the Project until the work is complete in an effort to assure work continuity, familiarity with the Project and quality control. Teams include both qualified Technicians/Installers and supervisory personnel such as Project Managers. Those with PMP, TPM, CTS or RCDD designation are desirable.
  - 3.3.2 Staffing requirements are driven by the building construction schedule.
  - 3.3.3 Qualified Contractors are those who:
    - .1 Have a minimum of 5 years' experience in this field of work.
    - .2 Can provide a dedicated team of qualified Technicians to complete the communications construction work within the construction time framed outlined by construction contractor and owner.
    - .3 Have a Registered Communications Distribution Designer (RCDD) or certified BICSI ITS Technician on staff to ensure project quality control and adherence to industry Communications standards as required by the project specifications.
- 3.4 Activation Experience
  - 3.4.1 Activation work includes installation of cross-connect jumpers; verifying that the correct control, and monitoring signals appear at the outlet location, verifying that the correct designation number appears at the outlet location; plugging in telephones, facsimile machines etc., to the cabling system, defining the activation strategy; applying an attention to detail to track cable records changes; planning and strategizing the Project cabling process such that activation of the communication circuits minimizes the quantity and duration of any required service outages.
  - 3.4.2 Qualified Contractors are those who:
    - .1 Have performed the number of activations equal to or larger than the scope of the work for this Project.
    - .2 Can identify the methods they routinely apply to an activation process to ensure that the correct telephone number appears at the outlet.
    - .3 Can identify the methods they routinely apply to an activation process to ensure that all instruments are activated and plugged into the outlet.

END OF SECTION

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SECTION 27 05 53  
IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 – GENERAL

**1.01 SCOPE OF WORK**

- A. Furnish, and install all materials and equipment and provide all labels required as shown on the Drawings, Schedules and as specified.
- B. It is the intent of the Specifications, Drawings and Schedules that all labels will be machine based labels which are legible and provided in locations which are readily visible.
- C. Only those items affected by the installation of the Project shall be labeled unless otherwise indicated.
- D. Labeling includes all riser cables, horizontal cables, faceplates, patch panels, cabinets, wall fields, grounding/bonding conductors and bus bars.

**1.02 SECTION INCLUDES**

- A. Termination Hardware and Cable Labels

**1.03 RELATED WORK**

- A. Section 27 05 00 - Common Work Results for Communications Systems
- B. All references including Division 26 apply.
- C. The work in this section is subject to requirements of the Contract Documents including General Conditions, Supplementary Conditions, General Requirements.

**1.04 SUBMITTALS**

- A. Submit product data as required herein under provisions of Section 27 05 00 - Common Work Results for Communications Systems.
- B. Submit product data for the following:
  - 1. Manufacturer and model of labeling device.
  - 2. Proposed method of jack labeling, including nomenclature and syntax.
- C. Submit shop drawings for equipment under each section per requirements listed in that section.
- D. Submittals shall be grouped with related systems.
- E. Submit catalog sheets or photocopies. Do not submit hard copies of web pages. Web pages change frequently and will be rejected.
- F. Circle noted item with black pen or use arrows that can be copied.
- G. At end of project submit record documents, as-builts, certificates, warranties and other operational manual documents to assist owner to maintain all systems.

- H. Work shall not proceed without Engineer's approval of submitted items. Materials that are installed without Engineer approval risk forced removal by contractor at Engineer request.
- I. Shop Drawings shall contain sufficient information, clearly presented, to determine compliance with drawings, specifications and design intent. Include additional information and products that may be required to provide a complete, functioning system even if those items are not specifically listed in the project documents.

#### **1.05 WORK INCLUDES**

- A. A complete, integrated, organized, intuitive labeling system for all communications cables, patch panels, faceplates and equipment. Labelling conventions shall match existing labeling conventions. Confirm labelling conventions with owner prior to labeling.
- B. Labels using black ink on white paper, printed plastic or engraved tags.
- C. Labeling for riser cables, horizontal station cables, faceplates, patch panels, cabinets, wall fields, grounding/bonding conductors and bus bars.
- D. Accurate as-built documentation in AutoCAD format that matches one-to-one the labels provided in the field.

#### **1.06 STANDARDS AND CODES**

- A. Work shall be installed in accordance with national and state laws, ordinances, and regulations. All applicable OSHA regulations shall be complied with.
- B. Unless otherwise noted, all labels at distribution frames shall follow the color coding scheme identified by the owner.

#### **1.07 DIMENSIONS AND DEFINITE LOCATIONS**

- A. Unless otherwise indicated, the exact location of labels shall be established in the field in accordance with instructions from the Owner. Consideration shall be given to construction features, label placement as affected by Work by other Trades, and label placement to provide maximum benefit and minimum obstruction of physical equipment and hardware features.

#### **1.08 DRAWINGS AND SPECIFICATIONS**

- A. The Contractor shall keep a detailed up-to-date record of the label information and placement of all labels installed as specified herein.
- B. The Contractor shall fill-in the label information on the forms or data documents provided by the Owner. The information requested is typically that which can only be provided after installation.

#### **1.09 SUBSTITUTIONS**

- A. No substitutions shall be allowed unless specified.

#### **1.10 CLEANING**

- A. The Contractor shall clean all surfaces prior to the attachment of labels. Follow the manufacturer's recommendations for cleaning.
- B. The Contractor shall follow the manufacturer's recommendations for affixing labels.

## PART 2 – PRODUCTS

### 2.01 TERMINATION HARDWARE AND CABLE LABELS

- A. Acceptable Manufacturers of Labeling Machine:
  - 1. Panduit
  - 2. Brady
  - 3. Silver Fox
  - 4. System manufactured for or by the proposed structure cabling system.
  
- B. Acceptable Methods:
  - 1. Black letters on white paper
  - 2. Machine produced, not handwritten
  - 3. Arial or block font
  - 4. Black letters printed on light colored plastic
  - 5. Labels as part of a manufacturer's system or product
  - 6. Engraved plastic or metallic tags
  - 7. Black letters on reflective yellow, sticky-backed products sometimes used for telco applications to label large cables, splices, wall fields and pedestals.
  - 8. Permanent

## PART 3 – EXECUTION

### 3.01 SPACES

- A. Item: Telecommunications Room (TR):
  - 1. Provide label on plywood near ICM system patch panels indicating room number.
  - 2. Large black letters on reflective yellow, sticky-backed label.

### 3.02 TERMINATION HARDWARE

- A. See design/construction documents for example of wall field layout and labeling.
  - 1. Copper Termination Hardware
  
- B. Item: SIO faceplate
  - 1. Label Location: On the top of the faceplate in the outlet location window and behind the clear plastic window.
  - 2. Label Information: See copper cable specification.
  - 3. Method: Manufacturer's white paper inserts. Print the information on an adhesive label and affix the label to the paper insert. Labels shall not be affixed to the clear plastic window. Install icon representing service at that jack position as defined by the cable records.
    - a. Machine printed Brady Labels.
    - b. Brady label part number:
  
  - 4. Format: Font should be sized to fill the area of the strip. The font should be Helvetica or equal and bold. Use one line format.
  - 5. Example: See copper cable specification

### **3.03 EQUIPMENT AND EQUIPMENT RACKS**

#### **A. Item: Equipment Rack Labeling**

1. The equipment racks are typically 19" free-standing or wall-mounted relay racks, floor mounted cabinets or wall mounted cabinets.
2. Label Location: On front surface above door
3. Method: Machine printed Brady Labels
4. Format: Large font, black letters on white background, indicate cabinet number
5. Example: CABINET #1, CABINET #2, etc.

END OF SECTION

SECTION 27 15 10  
HORIZONTAL COPPER CABLE AND EQUIPMENT

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

A. Base Bid:

1. Contractor provide:

- a. Horizontal unshielded twisted pair (UTP) station cable consisting of Category 6 cable to function as a universal structured cabling system for data.
- b. Cable terminations in patch panels and station jacks
- c. Testing, labeling and manufacturer's certification (performance warranty)
- d. Accurate as-built jack plans in AutoCAD format indicating actual field labels at each location.

B. Unit Bid:

1. Contractor provide alternate unit bid price to:

- a. Add or delete one SIO which includes cable of any length, jack, faceplate, patch panel port, labeling and testing.

**1.02 SECTION INCLUDES**

- A. Unshielded Twisted Pair Cable
- B. Miscellaneous Cable
- C. Modular Jacks and Faceplates
- D. Data Patch Field
- E. Coax and Connectors
- F. Splicing
- G. Cable Support
- H. Testing Requirements
- I. Labeling Requirements

**1.03 RELATED WORK**

- A. Section 27 05 00 - Common Work Results for Communications Systems
- B. All references including Division 26 apply.

#### **1.04 SUBMITTALS**

- A. Submit shop drawings for equipment under this section per section 01 30 00 – Administrative Requirements.
  - 1. Unshielded Twisted Pair Cable
  - 2. Miscellaneous Cable
  - 3. Modular Jacks and Faceplates
  - 4. Data Patch Field
  - 5. Coax and Connectors
  - 6. Splicing
  - 7. Cable Support
  - 8. Testing Equipment
  - 9. Labels
- B. Submittals should be grouped to include complete documentation of related systems, products and accessories in a single submittal. If provided electronically in PDF format, one specification section should equal one file or file name. Do not scan multiple specification sections into one file.
- C. Where applicable, dimensions shall be marked in units to match those specified.
- D. Submittals shall be original catalog sheets or photocopies thereof. Facsimile (fax) sheets or printed web pages shall not be accepted. Circle appropriate part number with black pen. Circle appropriate picture if more than one appears on page. Do not use highlighter which cannot be reproduced on a copy machine.
- E. Contractor shall indicate on submittal the system(s) served by each cable submitted.
- F. Submit manufacturer's installation instructions.
- G. For testing equipment, submit current year's calibration certificate.
- H. Project Record Documents: Record on plans actual locations of components and information outlets with their associated faceplate labels.
- I. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.
- J. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- K. Work shall not proceed without Engineer's approval of submitted items.

#### **1.05 PERFORMANCE TESTING**

- A. The following equipment shall be performance tested
  - 1. Unshielded Twisted Pair Cable
    - a. Per ANSI/TIA-568-C.2
  - 2. Miscellaneous Cable
    - a. Per manufacturer recommendations or continuity test at a minimum

3. Modular Jacks and Faceplates
  - a. Per ANSI/TIA-568-C.2
4. Data Patch Field
  - a. Per ANSI/TIA-568-C.2
5. Coax and Connectors
  - a. Continuity and sweep test
6. Splicing
  - a. Continuity
7. Cable Support
  - a. Visual inspection, j-hook supports every 48"
8. Testing
  - a. Equipment to be calibrated yearly (provide certificate)
  - b. Cables to be tested as described in Part 3 - Execution
9. Labeling
  - a. Visual inspection to confirm that all faceplates are labeled per Part 3 – Execution or per owner/engineer approved method.

## **1.06 WORK BY OWNER**

- A. Owner to provide
  1. Final cross connects to voice backbone cable or outside lines
  2. Final connections all electronic equipment unless noted otherwise
  3. Provision of all patch cords

## **PART 2 – PRODUCTS**

### **2.01 UNSHIELDED TWISTED PAIR CABLING**

- A. General:
  1. Cabling shall:
    - a. Be constructed of individually twisted pairs.
    - b. Be suitable for installation in environment defined.
    - c. Be packaged to minimize tangling and kinking of cable during installation.
  2. Pair twists of any pair shall not be the same as any other pair.
  3. Pair twist lengths shall be selected by manufacturer to ensure compliance with near-end crosstalk (NEXT) requirements of ANSI/TIA 568-C.2.

4. Four pair, 23 AWG, with a bisector tape separating pairs, that delivers the performance needed for the unshielded twisted pair, solid copper cables.
5. Number of pairs per sheath: 4
6. UL Listing: Plenum (CMP)
7. Color Coding:
  - a. White-Blue
  - b. White-Orange
  - c. White-Green
  - d. White-Brown
8. Conductor Resistance: 7.61W per 100/Meter at 68° (maximum)
9. Characteristic Impedance: 100W +/- 15% @ 1 to 100 Meters
10. Maximum Attenuation: 2.0 dB/Meter @ 1.0 MHz or 5.0% above TIA 568 15.6 dB/Meter @ 62.5 MHz
11. Capacitance: 5.6 nF/100m at 1kHz
12. Near End Crosstalk: 71 dB @ 1.0 MHz or 6dB above TIA 568 49.4 dB @ 62.5 MHz

B. Station Data Cable:

1. Manufacturers: General, Belden, Panduit, Commscope
2. Cable shall:
  - a. Be a single vendor end to end solution with better than minimally compliant performance ratings.
  - b. Be plenum rated.
  - c. Shall be used for both voice and data applications.
  - d. Blue color sheath
  - e. Category 6, capable of 1 Gig transmission and utilizing 802.3AT Power over Ethernet (PoE+) at 25 Watts
  - f. Exceed ANSI/TIA 568-C.2 performance specifications for Category 6 by average of 2dB.
  - g. Better than minimally compliant Category 6.

## 2.02 MISCELLANEOUS CABLING

- A. Speaker/sound system, security and audio-visual cable – see specification 27 40 00.
- B. Patch Cords – by owner

## 2.03 MODULAR JACKS AND FACEPLATES

A. General:

1. Manufacturers: To match brand of station data cable
2. Voice and data jacks shall snap into mounting frame, which shall mount into faceplate.
3. Jacks and connectors may be mounted directly into faceplate.

B. Faceplates:

1. Faceplates shall:
  - a. Be constructed of high impact plastic (except where noted otherwise).
  - b. Color shall match the electrical faceplate color. Confirm final color of faceplate onsite prior to procuring.
  - c. Be configured to mount on standard, single gang outlet box when wall mounted.

- 1) Exception: Conference/meeting room projector outlets to be double gang faceplates
  - d. Incorporate recessed designation strips at top and bottom of frame for identifying labels.
  - e. Triple row faceplates with no provisions for labeling of middle outlet row are not acceptable.
  - f. Designation strips shall be fitted with clear plastic covers.
  - g. Accommodate minimum of 4 modular jacks and connectors.
2. All device plates in Mechanical Rooms shall be brushed stainless steel with proper openings for the wiring device.
- C. Data Jack:
- 1. Data Jacks shall:
    - a. Meet the following specifications:
      - 1) Category: 6
      - 2) Shall be “tuned” to match data cable in every respect as a “certified” system.
      - 3) **Be of same brand as selected cable** unless prior engineer approval is obtained.
    - b. Be non-keyed, 8-pin Modular Jack (8P8C).
    - c. Be pinned per 568B with pair as follows. Confirm pinning with Owner prior to installation.
      - 1) Pair 1 - Pins 5 & 4
      - 2) Pair 2 - Pins 1 & 2
      - 3) Pair 3 - Pins 3 & 6
      - 4) Pair 4 - Pins 7 & 8
    - d. Be orange in color. Since all universal cable may be used for any purpose, there is no need to color code jacks according to application. Confirm color(s) with owner prior to procuring.
  - 2. Interface between jack and station cable shall be insulation displacement type contact. Termination components shall be designed to maintain cable's pair twists as closely as possible to point of mechanical termination.
  - 3. Jack contacts shall have minimum of 50 micro-inches of gold plating.

## 2.04 DATA PATCH FIELDS

- A. Data Patch Panels:
- 1. Manufacturers: To match brand of station data cable
  - 2. Panels shall:
    - a. Be rack mountable in standard TIA 84”H x 19”W equipment racks.
    - b. Match cable and jack type, compatible with Cat 6 “certified system”.
    - c. Consist of modular 110-type connector system or blank panels able to accept snap-in jacks.
    - d. Have ability to seat and cut 8 conductors (4 pairs) at a time.
    - e. Have ability of terminating 22-26 AWG plastic insulated, solid and stranded copper conductors.

- f. Be designed to maintain cable's pair twists as closely as possible to point of mechanical termination.
- g. Have cable support and strain relief devices to secure cables at 110-type termination blocks.
- h. Ensure minimum bend radius requirements are satisfied.
- i. Have color-coded designation strips to identify cable types and ID numbers.
- j. Be flat or angled to permit direct access to vertical cable managers.
- k. Permit individual cable or jack labeling.
- l. Provide sufficient patch panel ports for current project plus 25% spare, unused ports for future use by owner.

## 2.05 COAX AND CONNECTORS

### A. Station Coaxial Cable shall be RG-6 type

- 1. Manufacturers: CommScope, Belden or match brand of station data cable
- 2. Construction (RG-6 type, quad-shield):
  - a. Center Conductor: 18 AWG copper-clad steel (0.040" nominal outer diameter).
  - b. Dielectric: Gas expanded (foamed) polyethylene (0.180" nominal diameter).
  - c. First shield: Aluminum-polypropylene-aluminum laminated tape with overlap bonded to dielectric.
  - d. Second shield: 34 AWG aluminum braid wire (60% coverage).
  - e. Third shield: Non-bonded foil shield.
  - f. Fourth shield: 34 AWG aluminum braid wire (60% coverage).
- 3. Specifications:
  - a. Impedance:  $75 \pm 3$  ohms
  - b. Velocity of Propagation: 87% nominal
  - c. Maximum Attenuation @ 68°F: 1.60 dB/100 ft. (55 MHz)
  - d. 5.65 dB/100 ft. (750 MHz)
  - e. Cable Rating: Type CATVP or plenum rated as required by installation location
- 4. Coax Connectors
  - a. See specification 27 40 00 for further information.

## 2.06 CABLE SUPPORT

### A. J-Hooks

- 1. Wide-base design with smooth, beveled edges providing a large bending radius for all J-Hook sizes.
- 2. Meets ISO/IEC 18010, TIA-569-B and is used for large-diameter cable, including Cat. 6A
- 3. Accommodates a variety of attachment methods – threaded rod, wall mount, etc. and is expandable for additional integrated pathways
- 4. Easily attaches to other fasteners in multiple configurations: J-Hook- to- J-Hook or J-Hook to fasteners
- 5. Requires no screws, rivets or special tools for installation of fastener assemblies, tree bracket assemblies or puller assemblies.

### B. "Arlington" Loop or Saddle Cable Hangers

1. Provides sturdy reliable support of Category 5, 6 or fiber optic cable without sagging, bending or damaging the cable.
2. UL/CSA Listed for Environmental Handling Spaces
3. Flexible and non-metallic
4. Single or multiple LOOP hangars mount in a variety of ways and rotate to any angle
5. Sizes/Cable Holding Capacity - 2" holds a 2" cable bundle, 2.5" holds a 2.5" cable bundle, and 5" holds a 5" cable bundle
6. Available with or without UV rating

C. Bridle Rings

1. Bridle rings (made of round stock) by themselves are not acceptable
2. Bridle rings may be acceptable if used in conjunction with wide-surface plastic saddle inserts

**2.07 TESTING EQUIPMENT**

A. Hand-Held Portable Tester

1. Level III field tester for Category 6 class E cabling for up to 250 MHz
2. Level IV field tester for Category 6A class EA cabling up to 500 MHz
3. Factory calibrated yearly (certificate for current year must be provided)
4. Capable of printing individual cable test results in text and graphical formats
5. Capable of printing one sheet per test or roll up of many tests on one sheet indicating simple PASS or FAIL result
6. Capable of converting files to PDF format
7. Tester interface adapters must be of high quality and be capable of using the installed connectivity manufacturer's patch cables for performing permanent link certification testing.
8. Capable of Auto-Testing from either the display unit or the remote unit to decrease testing time

**2.08 LABELING**

- A. All communication components shall be labeled in accordance with owner's conventions. See section 27 05 53 for further information.

**PART 3 – EXECUTION**

**3.01 CABLE INSTALLATION REQUIREMENTS**

A. Station Data Cable

1. Provide Station Data Cable from SIOs to TRs.
2. Terminate Station Data Cables in rack mounted Data Patch Panels.
3. Station Data Cables shall be home run to TRs from SIO locations.
4. Cables shall have pair twists preserved to point of termination
5. Cable jacket shall be continuous to within 1/2" of termination or as recommended by certified system.
6. Terminate Cable pairs in TRs and at SIOs.
7. Maximum station cable length shall not exceed 295 ft. (90 meters) measured from termination block in TRs to SIO, including slack required for installation and termination. Contractor is responsible for installing station cable to avoid unnecessarily long runs.
8. Any area that cannot be reached within above constraints shall be identified and reported to Engineer immediately. Installation shall not proceed for cables beyond prescribed distance limitations. Notify engineer of any cables that will be between 270 and 295 feet long.

B. Cable Routing

1. Cabling shall be run in raceways provided, or as designated on floor plans.
2. Cable shall be free of tension at both ends. In cases where cable must bear stress, provide Kellm grips to spread stress over longer length of cable.
3. Make every effort to run cables in TRs and riser shafts neatly, straight, well dressed, labeled on every floor and organized according to type or function.
4. Where station cables must pass between floors (because no TR exists on same floor), gently contain cable bundle within loop of Velcro straps and label cable bundle with TR destination including floor number and TR room number.
5. To reduce effects of EMI, the following minimum distances shall be adhered to:
  - a. 5" from power lines of 2kVA
  - b. 18" from high voltage lighting (including fluorescent)
  - c. 39" from power lines of 5kVA or greater
  - d. 39" from transformers and motors

### **3.02 MISCELLANEOUS CABLE**

- A. Provide and install cable as recommended by manufacturer
- B. Furnish patch cords to owner for every data permanent link cable in the project. The color of the jacket shall match the permanent link cable color. Length shall be 1 meter. Confirm length and color with owner prior to procuring.

### **3.03 MODULAR JACKS AND FACEPLATES**

- A. Provide one faceplate per communications outlet symbol (faceplate) shown on Project Documents.
- B. Provide data jack(s) in faceplates as shown on Project Documents.
- C. Terminate all pairs of Data Station Cable in their respective jacks.
- D. Mount jacks into faceplates and secure faceplates to outlet box or modular furniture.

### **3.04 DATA PATCH FIELDS**

- A. Data Patch Panels:
  1. Provide patch panels as shown on the Project Documents.
  2. Mount patch panels in 19" equipment racks or wall mount brackets.
  3. Provide minimum of four (4) screws to secure each patch panel onto rack.

### **3.05 COAX AND CONNECTORS**

- A. Provide backbone cable as indicated on project documents.
- B. Provide horizontal cable as indicated on project documents.
- C. Provide appropriate connectors on each cable end.

### **3.06 SPLICING**

- A. Splices are not allowed unless indicated on project documents.

### **3.07 CABLE SUPPORT**

- A. Provide J-Hooks or other approved cable supporting device for cable where cable tray and conduit are not available.
  - 1. Support cable support devices by means of threaded rod and/or beam clamps suspended from building structure or from building structures themselves such as trusses, joists, rafters, beams, columns and walls.
  - 2. If walls are used, devices must be attached only where wall studs serve as support. Supporting screws must penetrate into studs.
  - 3. Cable supporting devices must be supported on four (4) foot centers, plus or minus one (1) foot.
  - 4. Do not utilize supports for other systems (such as drop ceiling wire) without prior approval of engineer or construction manager.

### **3.08 CABLE TESTING**

- A. Handheld Tester
  - 1. Calibrate field tester each day as required by manufacturer.
  - 2. Adjust NVP (nominal velocity of propagation) values, temperature, cable brand, etc. specific to the cable brand being installed.
  - 3. Test each cable per ANSI/TIA-568-C.2 standards.
  - 4. Save each test result and label results to match actual field labels.
  - 5. Print test results or provide in electronic (PDF) format.
- B. Station Data Cable
  - 1. Test each installed link to 250 MHz as required by ANSI/TIA-568-C.2 for compliance with specified performance characteristics utilizing a Level III tester or as required by manufacturer to obtain system warranty and as required by ANSI/TIA-568-C.2 Category 6 requirements.
  - 2. Each pair of each horizontal cable shall be verified for wire map (transposed/reversed/split pairs) and shorts through toning of each conductor.
  - 3. Maximum length of station cable shall not exceed 90 meters.
  - 4. Worst case performance, based on maximum length of 90 meters, shall meet ANSI/TIA-568-C.2 standards.
  - 5. Tests made and documentation provided shall consist of wire map, Power-Sum near-end crosstalk, Power-Sum equal level far-end cross talk, return loss, attenuation, cable length and resistance using TDR technology.
  - 6. Test results shall meet or exceed cable manufacturer's requirements for Cat 6 certified system. Any cable that does not meet manufacturer's requirements for a certified system shall be retested or replaced at contractor expense until cable meets the requirements.
  - 7. Submit Test Results for each Horizontal Link in electronic form a) in the native format of the test instrument and b) summarized in a fashion that includes a graphical display of all test parameters in PDF form.
  - 8. The summary shall document the worst-case margin over minimal TIA "Category" compliance for the cables tested. The summary shall be in Adobe Acrobat PDF format.
- C. Coaxial Cable:
  - 1. Test each cable for end-to-end continuity using tone generator or other testing device.
  - 2. Use Time Domain Reflectometer (TDR) to verify cable length and to test for cable faults and breaks.
  - 3. Use step-function high resolution Time Domain Reflectometer, such as Tektronix 1502C or Hewlett-Packard 1415A.

4. Results shall be automatically plotted on X-Y plotter with Y axis voltage reflection coefficient resolution of .001 per division. X axis shall resolve down to 1" of cable.
5. TDR will sweep cable at rate no greater than 50 ft. per second, or such lower rate as necessary to resolve cable faults to the 1" and .001 VRC level.
6. After connection to Cable TV service, test each coax (television) outlet for signal strength.
7. Each coax outlet shall test to +3dB to +10dB.
8. Hook up room TVs or use temporary, portable TV to visually test and inspect channel reception and picture quality at every location. Picture quality shall be acceptable to owner/engineer. Provide notification to owner 24hrs in advance of visual inspection test.

### 3.09 LABEL IDENTIFICATION

#### A. Station Cable

1. Refer to section 27 05 53
2. Label each SIO faceplate and each cable entering SIO and TRs with unique identifying code.
3. Label cable with tag, which is wrapped around cable sheath.
4. Place faceplate labels on outside of cover.
5. Place data and voice punch down block labels above or below the termination.
6. Labeling shall be by mechanical means in black ink on non-removable tags.
7. Hand lettered designations are not allowed.
8. Station Cabling labeling code shall be as follows:
  - a. A-B-CCC where:
    - 1) A = Room number of TR where cable terminates.
    - 2) B = Floor Number (optional if room number already gives floor indication). Begin with floor on which jack is terminated.
    - 3) CCC = Jack number in sequential order on that floor, e.g. 001, 002, 003, etc. Start number sequence over on every floor.
    - 4) Example: Jack number 101 on floor 3 terminates in TR 318: 318 -101 (no need for separate floor designation in this case).
9. Faceplate labels can use common room number designations on each label strip. For example, two data jacks served from TR 318 sharing a common label strip could be represented by:
 

TR318	
101	102
10. Label all patch panels in TRs with identical label as used on jacks.
11. Labels on as-built documentation and test results to match field labels.
12. Prior to installing labels, consult with owner to verify labeling scheme.

END OF SECTION

SECTION 27 40 00  
AUDIO-VISUAL SYSTEMS

**PART 1 – GENERAL**

**1.01 SECTION INCLUDES**

- A. Equipment Standards
- B. Cabling
- C. Conduit Requirements

**1.02 RELATED WORK**

- A. Drawings and general provisions of the Contract, including General Conditions, apply to the work of this section.
- B. All references to Division 26 - Electrical work shall apply.
- C. Section 27 05 00 - Common Work Results for Communications Systems
- D. Section 27 15 10 – Horizontal Copper Cable and Equipment

**1.03 SUBMITTALS**

- A. Conform to requirements in General Conditions and Section 27 05 00.
- B. (1) PDF set of completed shop drawings shall be provided for consultant and Owner approval. **CONTRACTOR SHALL NOT PROCURE EQUIPMENT OR BEGIN WORK ON THIS PROJECT UNTIL SHOP DRAWINGS HAVE BEEN SUBMITTED AND APPROVED.**
- C. Submittal documents must be provided within 30 days of award of contract, or sooner if necessary, to comply with construction schedule. Contractor is solely responsible for all costs resulting from delay in providing shop drawings in a timely manner.
- D. These submittals or shop drawings shall include:
  - 1. A complete equipment list of all components including quantities.
  - 2. Manufacturer's catalog specification cuts and printed descriptive literature on all components being provided.
  - 3. A complete list of all cable runs including termination locations and numbers/identification schedule.
  - 4. Schematic drawings of all system wiring. The diagrams shall show schematic wiring of the equipment and all connections to be made to devices. Terminal connections in the equipment shall be numbered to correspond to the diagrams for use in making connections. Wiring diagrams shall be coordinated so that terminal numbering, circuit designation and equipment or device designations are the same on all drawings. All drawings must be submitted and approved by the Consultant before fabrication starts, but such approval will not waive any specification requirements unless so specifically stated. Final approval will be made after checking the equipment when operated in the field.
  - 5. Speaker and projector, mounting details. Manufacturer cut sheets are acceptable.

6. Page-by-page screen shots of AV touch panel control for auditorium. Narrative or matrix describing programming functions, routing functions and utility controls. This submittal must be provided 90 days prior to installation and programming. This submittal constitutes a “proposal” of intent. The owner will review and provide feedback and coordination for final programming and user interface controls.

#### **1.04 PERFORMANCE TESTING**

- A. Testing of all installed cable and equipment shall be performed by the contractor as soon as practical after equipment is installed.
- B. All cable and equipment shall be tested with state-of-the-art, industry standard test equipment by personnel properly trained to operate equipment.
- C. Testing shall be accomplished before notifying Engineer of substantial completion and before punch list is performed.
- D. A performance checklist shall be created by contractor to document operation and testing of all equipment. Checklist shall be delivered to Engineer prior to punch list and project acceptance.

#### **1.05 WORK INCLUDES**

- A. The scope of work covered under this Section includes but is not limited to:
  1. All labor, materials, equipment, tools and services required to perform all work and services for execution, installation and completion of all Audio-Visual (AV) work including all parts lists, operating instructions, and wiring diagrams shown on the drawings and as specified and completely coordinated with all other trades. Equipment and installation labor as noted on the Contract Documents for a fully functional system. Miscellaneous components, hardware, interconnections and terminations required for proper operation of all systems.
  2. All components or systems indicated on the Contract Documents.
  3. The Installing Contractor shall be responsible for the following:
    - a. Verification of accuracy and completeness of equipment lists, dimensions, mounting details and equipment compatibility.
    - b. Accurate documentation of the system operation and installation.
    - c. One year warranty of the equipment and installation.
    - d. Test equipment, tools, ladders, lifts and scaffolding required for installation.
    - e. Daily and final cleanup of debris caused by installation.
    - f. Quality Control / Commissioning of system
    - g. End user training and training manuals
- B. All supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete communications installation.
  1. Complete and in operative condition and to approval of Architect/Engineer, materials described herein and shown on drawings.
  2. Coordination with other trades as required.
  3. Complete adherence to equipment manufacturer’s recommendations to assure complete, optimal operation. Contractor shall notify Engineer where such recommendations appear to contradict project documents.
  4. Equipment, materials and accessories for communications systems as shown and noted on the drawings including but not limited to the following:
    - a. A complete raceway system including conduit, outlet box, pull boxes, junction boxes, sleeves and hangers. This work may be separated out for completion by the Division 26

- contractor. This contractor shall coordinate with the GC and Division 26 contractor to assure conduit and power is provided where required for all AV systems.
- b. Maintaining of all communications and other low voltage connections outside of or passing through the work area to other areas (if work is a renovation).
  - c. All cutting and patching to accomplish wiring tasks.
  - d. All conduit penetrations through walls and floors and complete fire stopping of penetrations per standards of a national testing laboratory.
  - e. Creation of new cable pathways through areas where no pathway currently exists.
  - f. New wiring devices, jacks and cover plates.
  - g. Complete testing, certification and creation of as-builts for all equipment locations.
- C. Furnish all materials and labor to provide complete and professionally installed systems in working order. Programming and functionality of the AV systems will be the responsibility of the AV Contractor(s). The AV Contractor(s) is expected to work in conjunction with the Owner's Staff to complete the system installation to owner's satisfaction.
- D. AV Contractor(s) shall provide any and all connectors, hardware, transformers, power supplies, rack panels, interfaces, fasteners, wire harnessing materials, bushings and any other incidentals required for complete and proper functioning of this system whether specifically listed or not. Provide proper projector lens as required for application, screen size and throw.
- E. Where conflicts exist between drawings and specifications, the contractor must bring the discrepancies to the project AE's attention no later than ten (10) days before the bid due date, or, if noticed after the bid award, prior to installation of equipment. Contractor shall deliver a completely functioning system regardless of discrepancies in the documents.
- F. In the case of a manufacturer discontinuing the manufacture of a certain piece of equipment required by this project, the contractor shall provide a new submittal for a new product that is the newer version of the discontinued product from the same manufacturer.
- G. Manufacturer's warranties to be in full effect for a minimum of one (1) year from substantial completion. The exception being commercial grade monitors must have a (3) year warranty.

#### **1.06 WORK BY OWNER**

- A. Owner may provide certain electronic equipment not indicated on project documents (workstations, IT switches, etc.). Coordinate with Owner on what and where this equipment will be used and installed.

#### **1.07 DESCRIPTION**

- A. This section covers general requirements associated with the installation of audiovisual systems within the project. Refer to sections listed below for more specific system requirements. Multiple spaces (rooms) with multiple systems may be covered under this section.
- B. Furnish all materials and labor to provide complete and professionally installed systems in working order. Programming and functionality of the AV systems will be the responsibility of the AV Contractor(s). The AV Contractor(s) is expected to work in conjunction with the Owner's Staff to complete the system installation to owner's satisfaction.
- C. In the case of a manufacturer discontinuing the manufacture of a certain piece of equipment required by this project, the contractor shall provide a new submittal for a new product that is the newer version of the discontinued product from the same manufacturer.

- D. Any changes made to the equipment specifications after bidding that result in increased cost will be considered changes to the contract and will be processed accordingly. The change in cost resulting from owner selecting a more current projector model shall be handled as follows:
  - 1. The manufacturer's suggested retail price (MSRP) of the bid product shall be obtained.
  - 2. The MSRP of the new model selected by owner shall be obtained.
  - 3. The difference between the MSRP of the two models shall be calculated.
  - 4. If the change in MSRP between bid model and new model is positive, that shall be the amount of the change order due to the contractor.
  - 5. If the change in MSRP is negative, that shall be the amount due as a credit to the owner.
- E. Manufacturer's warranties to be in full effect for a minimum of one (1) year from substantial completion.

## **1.08 BIDDER QUALIFICATIONS**

- A. AV contractor(s) shall perform the entire work of this section. These contractors shall be regularly engaged in the installation and service of audiovisual systems including but not limited to those systems listed.
- B. AV Contractors must meet the following qualifications:
  - 1. Capability to provide all systems within full and strict compliance with all provisions of this specification.
  - 2. Has been actively engaged in the installation of AV systems included under this section for a minimum of five years.
  - 3. Be a certified a dealer of the products which they are installing.
  - 4. AV contractor shall furnish upon request, a list of five projects whose size, value, scope and complexity are similar to that being bid. The minimum period of operation for each shall be 12 months. For each facility listed provide:
    - a. Name and location of installation.
    - b. Date of occupancy by Owner.
    - c. Owner's representative to contact and their telephone number.
    - d. Construction Manager or General Contractor and Architect's project manager and their telephone numbers.
  - 5. AV contractor shall have access to all necessary equipment and has organizational capacity and technical competence necessary to enable performance of this work properly and expeditiously.
  - 6. Contractor shall employ adequate number of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.
  - 7. Contractor shall provide a designated supervisor present and in charge on the project site during all phases of installation and testing of the system.
  - 8. Contractor shall be prepared to furnish copies of the installation documents from a previous similar installation.
  - 9. Contractor shall be prepared to furnish a list of test and calibration equipment for the servicing and alignment of AV systems.
  - 10. Contractor shall have AutoCAD ability to create one-line shop drawings and accurate as-built record documents.
  - 11. Contractor's compliment of equipment shall include, but is not limited to:
    - a. Sencore CP5000 display analyzer system or equivalent.
    - b. Sencore Test pattern generator.

12. Has a record of satisfactorily completing past projects. Criteria that will be considered in determining satisfactory completion of project by Contractor will include:
  - a. Completed contracts in accordance with drawings and specifications.
  - b. Diligently pursued execution of the work and completed contracts according to the established time schedule unless the Owner grants extensions.
  - c. Fulfilled guarantee requirements of the Contract Documents.
13. The AV contractor supplying the equipment shall show satisfactory evidence, upon request, that it maintains a fully equipped local service organization capable of furnishing adequate inspection and service to the systems, including replacement parts. The service organization shall be capable of a minimum 4 hour on site response time. The contractor shall produce evidence that it has had a fully experienced and established service organization for at least five (5) years and proven satisfactory installations during that time.
14. The Consultant reserves the right to request and have furnished to them any additional information he requires to determine the AV contractor's ability to complete the work. Such additional information shall be supplied with no additional costs incurred by the Owner.
15. The A/E will make such investigation as is deemed necessary to determine the ability of the AV contractor to perform the work.
16. Certification:
  - a. The Installing Contractor shall have a current AVIXA "Audio Visual Solutions Provider" (AVSP) certification. The certifications shall match the level and complexity of the scope of work.

C. Installing Contractor Personnel Qualifications:

1. Summary: The Installing Contractor shall assign at least one full-time employee to the work whose qualifications meet the following minimum requirements.
2. On-Site AV Supervision
  - a. Certifications:

Installation contractor shall have on staff a certified CTS person for design review.  
Certifications shall be provided upon request.  
Shall be Crestron Certified.
  - b. Qualifications:

Shall be capable of supervising a turn-key audiovisual system installation including, but not limited to, all cabling, loudspeakers, projection equipment, mounting hardware and electrical components including the necessary equipment, interconnections, transducers, labor, and services required to meet the functional requirement outlined in the Contract Documents.  
Shall provide all quality control (QC) and safety inspections as needed throughout installation.  
Shall conduct all AV system commissioning tests, and proof-of-performance testing/demonstration in accordance with the Contract Documents.
  - c. Other Installation Personnel:

Certification:

    - a) Must have a CTS certification.
  - d. Qualifications:

Shall be capable of working within industry standards with minimal supervision. The work shall include, but is not limited to, cabling, loudspeakers, projection equipment,

mounting hardware and electrical components including the necessary equipment, interconnections, and transducers and the downloading, or installation, of pre-developed control programs in the field.

e. On-Site Support Personnel:

Certification:

- a) Has a good general knowledge of AV installation procedures and standards and must be trained in construction site safety.
- b) AV Control Programmer: AV control and DSP programming for system equipment includes recommendations for control system features and functionality; input to AV system design; control system logic diagram, control system performance specification, block diagrams, control system program and user interface, system debug, program and source code and other system documentation as required.
- c) Must have a CTS certification, CTS-I or CTS-D certification preferred.
- d) Individuals performing the AV control programming shall have manufacturer's control system programming training and certification for the specified AV control system.
- e) Individuals performing AV-DSP programming and setup shall have manufacturer's system programming training and certification from the manufacturer for specified equipment.

f. Sub-contracting of AV work

Conditions:

- a) Sub-Contractors must conform to the same certification standards listed above and have prior approval.

D. Installing Contractor Regulatory Requirements:

1. All equipment and installations under this contract shall conform to the following:
  - a. ANSI/NFPA 70 National Electrical Code.
  - b. ANSI/IEEE C2 National Electrical Safety Code TIA/EIA Standards 568 A (including TSB 67), and 607.
  - c. IEEE/ANSI 142 1982 Recommended Practice for Grounding of Industrial and Commercial Power Systems.
  - d. ANSI/TIA-569B Commercial Building Standard for Telecommunications Pathways and Spaces
  - e. NFPA 72-2010; National Fire Alarm and Signaling Code
  - f. Illinois Accessibility Code
  - g. Refer to U of I Facilities Standards for regulations and requirements. See Instruction Media and Audio-Visual Systems Guidelines as well as Media Guidelines.

## 1.09 SERVICE

- A. On-the-premises service, parts and labor is to be provided by AV contractor during normal working hours at no cost to the Owner, for a period of 12 months from the date of final acceptance. AV contractor must respond within 24 hours or the next business day to requests for service. AV contractor must also provide technical support via telephone at no charge during the warranty period.

- B. On-the-premises service must also be made available at other than normal working hours and shall be charged by the AV contractor's service representative at current labor rates minus normal hour rate.
- C. The AV contractor shall maintain engineering and service departments capable of rendering advice regarding installation and final adjustment of the systems.

#### **1.10 MAINTENANCE AND OPERATING MANUALS**

- A. Upon project completion the Contractor shall provide four complete sets, in hard cover binders, of maintenance and operating instructions for this system and any software, CD-ROMs, DVDs or other materials provided by the manufacturer. These manuals shall include the following:
  - B. A table of contents.
  - C. Simplified operational procedures with diagrams depicting the actual equipment front panels showing the nominal level settings for the controls.
  - D. Question and answer type trouble-shooting guides.
  - E. One copy of approved system As Built drawings.
  - F. The AV contractor shall maintain in their office a record of all original manual information to be able to issue as a replacement copy, at the Owner's expense, during the time the equipment is in actual service.

#### **1.11 AS-BUILT CONSTRUCTION DRAWINGS**

- A. As built documentation shall include a complete list of all cable runs including termination locations, numbers/identification, and test data as required under the section on commissioning.
- B. The drawings are to include cable routes and outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document. Numbering, icons and drawing conventions used shall be consistent throughout all documentation provided.
- C. The owner, through the Consultant, will provide floor plans in PDF and electronic (".dwg", AutoCAD) formats on which as-built construction information can be added. These documents will be modified (in AutoCAD) accordingly by the contractor to denote as-built information as defined above and returned to the Consultant for acceptance. This information shall be supplied to the Consultant/Engineer no later than two (2) weeks after the completion of the project.
- D. Each drawing submitted by the Contractor as part of the Project Documentation shall be identified as an "As-built" drawing and include the following:
  - 1. The Contractor name and/or logo
  - 2. The date of the drawing
- E. If electronic files are utilized, all fonts, color, layer, Model Space/Paper Space conventions established in the base drawings shall be retained by the Contractor in preparation of the As-built drawings.
- F. If electronic files are utilized, prior to generation of the drawings, the Contractor shall provide a sample file and test plot to the Engineer for review and approval.
- G. All documentation shall become the property of the Owner.

## 1.12 WORK PRODUCT OWNERSHIP

- A. Throughout the course of the project, all supporting documentation, work-in-progress, programmed source code and software, written and electronic files, including all documentation and software necessary to edit and adapt the system, shall remain the property of the Owner and shall be provided to the Owner upon project completion and/or at any time during the course of a project upon request in an unsecured, unencrypted and easily modifiable format as prescribed by the Owner.
  - 1. All deliverables to be supplied to the Owner on compact disc media, and/or printed materials when requested.
  
- B. Software – Control System, DSP, and All Other Applicable Equipment
  - 1. The software developer shall retain intellectual property rights to the operation software. The Owner shall be granted a license in perpetuity for use. The following requirements shall apply.
    - a. All source code becomes the exclusive property of The Owner.
    - b. All source code changes must be fully documented.
    - c. All custom programs for remote control system touch panels, and other programmed devices, shall become the property of the Owner and shall be submitted with the final systems documentation, and/or as requested in the DVD/CD-ROM and USB solid state media.
    - d. Subsequent to system certification, source code changes and/or additional programming, whether requested by the Owner or performed by the Installing Contractor, will be warranted by the Installing Contractor for a period of one (1) year, with the Installing Contractor responsible for the diagnosis and repair.
    - e. The vendor shall ensure that the current program is saved to CD-ROM and/or USB-solid state media and backed up on electronic hard-disc/server.
    - f. No program resident in a control system shall be overwritten until a back-up of the resident program is made.
    - g. All documentation, not residing in the code, must be provided on CD-ROM and/or USB-solid state media in Adobe PDF and Microsoft Office format.
  - 2. The Installing Contractor shall also offer an annual “Software Maintenance” contract.
    - a. This shall cover all software provided as part of this system and/or written for this system and shall include both routine upgrades to applications and operating systems, as well as any modifications to software that may be required by Any Company.
    - b. The Software Maintenance contract shall commence immediately after expiration of the warranty period and continue for three (3) years.
    - c. The owner shall be under no obligation to enter into this “Software Maintenance” contract, it shall be used for reference only.
  - 3. Written Release:
    - a. A written release will be given by the Installing Contractor for all control programming done by the Installing Contractor’s personnel or sub-contractors. The release shall acknowledge the ownership and right to modify programming directly, or to have the programming modified by others on the Owner’s behalf.
    - b. A CD shall be supplied with the written release that includes the program and source code for the system in an unencrypted format.

## **PART 2 – PRODUCTS**

### **2.01 EQUIPMENT STANDARDS**

- A. Complete AV systems consisting of all the individual systems as shown and specified are required. Equivalent manufacturers and products shall be in strict accordance with this specification. Substitutions during the construction phase may be permitted only with prior approval from the Owner's Staff and in writing from the AV consultant. For bidding purposes, no substitutions will be accepted or considered. Bidders are to adhere strictly to the project documents.
- B. It is the responsibility of the AV contractor to verify the completeness of the drawings, specifications and schedules and the suitability of devices to meet the intent of the specifications. Any additional equipment, accessories or incidentals required, whether or not specifically mentioned herein, shall be provided by the contractor without claim for additional payment, it being understood that a complete operational system is required.
- C. All materials and equipment shall be new and unused. Unless specifically approved by the Consultant, all materials and equipment in the system shall be the standard design or model ordinarily supplied as a product item by manufacturers regularly engaged in the production of such equipment. They shall be the manufacturer's latest standard designs current at the time of delivery, modified only to the extent necessary to comply with the requirements of these specifications. Where two or more units of the same class of equipment are required, such units shall be the standard product of a single manufacturer, but individual classes of compatible equipment may be the products of different manufacturers. Manufacturers shall be established in the industry so that prompt and continued service and delivery of spare parts may be assured.
- D. All equipment quantities listed in audiovisual specification sections are for reference only and could vary depending on the type of manufacturer equipment provided. Refer to schematic drawings to provide consultant approved quantities to meet design intent.
- E. All components that comprise the various systems shall be UL listed where a UL listing exists for that component or system.
- F. Equipment provided by this contractor shall be fully coordinated with all other equipment required for complete system function. This includes power, cooling, cabling, mounting equipment and locations, and controls.
- G. Contractor shall anticipate future cost increases of equipment in their bid, whether such increases are due to inflation or technology change. Technology changes frequently and manufacturers change or discontinue products. Contractor shall make reasonable assumption regarding possible cost increases and technology changes in the period between bidding and installation.
- H. **Contractor shall provide current models at time of installation.** Do not provide older models no longer in production or out of service.

### **2.02 SUBSTITUTIONS**

- A. Consideration for substitutions during the bidding phase may be allowed in light of a significant gain or advantage in quality of product or considerable cost savings to the Owner. It is the contractor's responsibility to obtain approval on all substitutions prior to bid. **FAILURE TO OBTAIN APPROVAL FOR SUBSTITUTIONS SHALL BIND THE CONTRACTOR TO PROVIDING THE SPECIFIED EQUIPMENT WITHOUT REQUEST FOR ADDITIONAL PAYMENT.** Contractors request for approval shall include the reason for requesting the substitution along with any relevant product data.
- B. Requests for substitutions must be made at least 20 days prior to intended bid.

## 2.03 EQUIPMENT BY ROOM

**SEE SECTION 3.2.2 of the RFP document for the equipment list by room.**

## 2.04 CABLING

- A. All applicable provisions of the NEC and local codes shall apply. All cabling and wiring shall be in metallic conduit or raceway or supported securely with approved j-hook devices.
- B. All BNC type connections shall employ true 75 ohm connectors.
- C. All cabling shall be in accordance with manufacturer's recommendations. If the manufacturers recommended cabling for equipment proposed as equivalent in quality and performance cannot be accommodated in the conduit indicated in the contract documents, without exceeding normal fill or code requirements, the contractor shall furnish and install the additional required conduit without cost to the Owner.
- D. All cabling shall be either enclosed within conduit or supported by J-hooks.
- E. All systems wiring shall be color coded with labeling and coding as submitted and approved by shop drawing.
- F. Cabling shall be continuous and shall not be spliced between equipment. Color coding and tagging shall be maintained throughout the system at all accessible locations to the cabling.
- G. This Contractor to provide cabling as required for point-to-point equipment operation (as well as all other cabling required for equipment operation).
- H. Cables in poke-through floor device are indicated on project documents.
- I. Poke Through provided by Electrical Contractor (EC). Device plates provided by AV Contractor. AV Contractor to coordinate with EC and review Division 26 specifications for poke through device type. Device plates are indicated on project documents.
- J. AV system cabling is divided into classes that may not be intermixed within a conduit or raceway. Conduits for different AV cabling classifications must maintain minimum separations from each other and from other services. In certain cases, AV system cabling of different classes may pass through or terminate in a common enclosure provided that proper separation is maintained within the enclosure. AV system cabling may not be intermixed with AC wiring within a conduit, raceway or enclosure. AV system cabling may not be intermixed with wiring related to any other trades or discipline including but not limited to; fire protection, HVAC, CATV, alarm, intercom, master clock, access control or other similar systems within a conduit, raceway or enclosure.
- K. Wiring classifications, type and minimum separations are as follows. Not all cabling will apply to all projects. They are noted here as a reference.
- L. All voice/data/audio/visual cabling run free air (not in conduits) must meet or exceed NEC requirements and be suitable for the environment for which it is installed (plenum rated).
- M. Microphone Level:
  - 1. 22 Ga. Stranded copper (7x30), insulated conductors, shielded twisted pair, bonded foil shield 100% coverage and 22 A WG stranded tinned copper drain wire. ASTM tinned copper conductor 22 A WG. Polypropylene insulation thickness: 008 (.20mm) Overall bonded @

shielded with aluminum foil. Overall 75° C PVC jacket Nom. jacket thickness .020" (.51 mm) Nominal O.D. 135" (3.43 nun) Electrical Characteristics: Nominal capacitance: 34 pf/ft.> 67 pf/m. Nom. D.C.R. @ 20°C: 17 Oil 000 ft. Nom. Velocity of Prop. : 66%

2. Maintain minimum 6" separation from conduits containing other low voltage services. Maintain minimum 12" separation from long parallel conduit runs containing AC voltages below 250 volts. Maintain minimum 24" separation from long parallel conduit runs containing AC voltages greater than 250 volts.
3. Acceptable: West Penn 454 or approved equal by Canare

N. Line Level Audio:

1. 22 AWG Stranded copper (7x30), insulated conductors, shielded twisted pair, bonded foil shield 100% coverage and 22 AWG stranded tinned copper drain wire, ASTM tinned copper conductor 22 AWG, Polypropylene insulation thickness: 008 (.20mm) Overall bonded @ shielded with aluminum foil. Overall 75·C PVC jacket Nom, jacket thickness, 020" (.5 I nun) Nominal OD, 135" (3.43 mm).
2. Electrical Characteristics: Nominal capacitance: 34 pf/ft.\* 67 pf/m. Nom. D.C.R. @ 20·C: 17 n/1000 ft. Nom. Velocity of Prop. 66%
3. Maintain minimum 6" separation from conduits containing other low voltage services. Maintain minimum 12" separation from conduits containing AC voltages below 250 volts. Maintain minimum 24" separation from conduits containing AC voltages greater than 250 volts.
4. Acceptable: West Penn 454 or approved equal by Canare

O. Speaker Level Audio:

1. Insulated copper, twisted pair or THHN sized per drawings. # t0 THHN or twisted pair for sub-woofers, #12 twisted pair equal to West Penn 227 for all direct coupled loudspeakers, # 16 twisted pair equal to West Peru1 225 for 70 volt circuits.
2. Maintain minimum 6" separation from conduits containing other low voltage services. Maintain minimum 6" separation from conduits containing AC voltages below 250 volts. Maintain minimum 12" separation from conduits containing AC voltages greater than 250 volts.
3. Acceptable manufactures: Belden, West Penn.

P. Coaxial Video Connectors:

1. Use only true 75 ohm crimp type connectors. Twist on type connectors are not acceptable. Acceptable: AMP 221185-1 Dual Crimp Gold Pin BNC (75 Ohms); Amphenol31-70000 Dual Crimp Gold Pin BNC (75 Ohms); Kings 2065-10-9 Dual Crimp Gold Pin (75 Ohms); Trompeter UPL220-20 Dual Crimp Gold Pin BNC (75 Ohm); ADC BNC1694D; Dual Crimp Gold Pin BNC (75 Ohm)

Q. Coax Cabling:

R. Cat 6 Cable (data):

1. Refer to specification 27 15 00 for further information.

S. Cat 6A STP Cable (Video Distribution):

1. Acceptable manufacturers: Commscope, Belden, Panduit.

T. HDMI Cable

1. HDMI, 1.3 Category 2, Supports data rates up to 4.95 GBPS, 1080p and WUXGA @ 60hz without cable equalizer.
2. Plenum as required.
3. Manufacturer: Liberty E-HDM-M series cables.
4. Or pre-approved equal.

**2.05 CONDUIT REQUIREMENTS**

- A. Conduit requirements for AV systems cabling may differ from those of Project's other trades. It is important that the electrical contractor become familiar with these specialized requirements.
- B. AV systems cabling must be enclosed within metallic conduit or raceway as shown in bid documents or supported by approved j-hook devices. Conduit, raceway and floor boxes shall be furnished and installed by electrical contractor. Conduits containing different wiring classes must maintain minimum separations. Conduits sizes and quantities shown on bid documents are minimums.
- C. Separate conduit runs specified in bid documents may not be combined for any purpose.
- D. Conduit runs entering or exiting equipment racks must be electrically isolated from the equipment rack by use of non-metallic bushings, a short run of non-metallic raceway, or other suitable means.
- E. Conduits shall run uninterrupted from the end device to the nearest accessible cable tray or to the nearest AV cabinet within casework.

**PART 3 – EXECUTION**

**3.01 GENERAL**

- A. Verify dimensions and conditions at the project site. Submit any conflicts in a timely manner for resolution. AV contractor shall coordinate their efforts with other trades to ensure timely completion of their work and to avoid conflicts over scheduling, access and locations of their work.
- B. Materials to be furnished shall include all back boxes and all wire and cable.
- C. Furnish all mounting brackets, raceways, sleeves, rack rails, termination plugs, jacks, faceplate mounting hardware, and other unique components as necessary to securely mount equipment and panels.
- D. Furnish all required equipment whether or not specifically mentioned in these specifications or all the drawings. Such devices shall include but not be limited to hardware, fasteners, rack screws, rack brackets, power supplies, fan guards, impedance matching devices, transformers, line pads, line amplifiers, relay and LED power supplies, and other devices as necessary to interface, control, or balance the AV systems.
- E. Furnish painting and finishing as required to match components, cabinetry, and room decor.
- F. Contractor shall determine the "installed" price for the AV system (by room). The costs are to include material, labor, installation, testing, documentation, commissioning, manuals, training, warranty; and the AV proportion of the Schedule of Values consisting of general conditions, bond, mobilization, record drawings, punch list, cleanup, and demobilization.

- G. Install projector mount to building structure according to manufacturer's recommendations. Contractor must verify that projector mount location complies strictly to the throw distance from the screen as recommended by the projector manufacturer for the specific projector to be installed. Make every attempt to install projector mount at the center point of the throw range.
- H. Install projector to mount according to manufacturer's recommendations.
- I. Verify correct projector throw to screen location prior to mounting any equipment. Every projector model has a different throw requirement. It is the responsibility of the contractor to verify the manufacturer's suggested throw distance from the screen to the projector lens prior to mounting any equipment. The contractor shall rely only on the manufacturer's throw specifications, not on any drawing dimension or directions from any other party.
- J. Refer to Architectural sheets for approximate projector and screen placement. Coordinate actual field placement with other utilities. Notify AE team of any conflicts.
- K. Adjust speaker placement as required to suit field conditions.
- L. Provide additional cable to connect existing paging system to page override port on Control Module in each room. Provide necessary cable, connectors, transformers or baluns to integrate the existing overhead page system with the new audio system in each classroom.
- M. Provide projection screens as indicated on project documents. Consult with Architect as required if questions arise concerning screen placement or mounting.
- N. Install projection screens in accordance with manufacturer's instructions using manufacturer's recommended hardware. Install plumb and level. Do not field cut screens.
- O. Adjust projection screens and related hardware in accordance with manufacturer's instructions for proper placement and operation.
- P. Coordinate projector placement with screen size and height for proper projector throw and tilt.
- Q. Protect all installed products until completion of project. Touch up, repair or replace damaged products before substantial completion.
- R. Avoid conflicts with light fixtures, switch locations, sprinkler heads, architectural features, casework and other items. Contractor shall visit site prior to ordering high value equipment that could be impacted by sight conditions.
- S. No screen or projector shall be installed that has known, observable obstructions between screen and projector that will prevent a full, complete image from being displayed or from being visible by all audience members. Contractor shall relocate or replace screens or projectors that do not permit full function and viewability.

### **3.02 CONTROL**

- A. AV System Control:
  - 1. Provide system programming to permit user control of all input and output routing on graphical user interface touch panel.
  - 2. Control to include all audio and video source inputs being routed to all audio and video device outputs.
  - 3. Graphic user interface (GUI) layout shall comply with AVIXA standards as well as Owner preferences.

4. Contractor shall provide screen shots of proposed GUI layouts for owner approval once basic programming or layouts have been accomplished but before final programming. Owner requires time to review proposed layouts and routing in order to provide comments to the contractor.
5. Provide submittal indicating button-by-button and page-by-page programming and GUI layouts for owner and engineer approval.
6. The contractor shall provide programming in accordance with owner comments and shall provide allowance in bid to accommodate this coordination with owner. Contractor shall seek out owner prior to final programming and provide personnel to coordinate with owner for programming and GUI layout. No change order will be accepted to comply with Owner requests for programming changes to meet their needs unless such changes are requested after final acceptance and project completion.
7. Refer to project documents for inputs and outputs. Programming and GUI shall account for and accommodate all inputs and outputs.
8. Programming and GUI shall propose certain short cuts or standard configurations that will make instructor use easy and streamlined.
9. The top of the GUI should have a menu of options for easy selection of pages or functions.
10. GUI pages or functions may be organized according to function or equipment, for example:
  - a. Video or content inputs
    - Laptop
    - Airmedia
    - PC
  - b. Screen outputs
  - c. Audio inputs
    - Audio shall follow video
    - Mics (voice lift)
  - d. Audio outputs
    - Overhead speaker control for voice lift
    - Speaker control for program audio
    - ALS system
  - e. Utilities
    - Screen, up and down
    - Display(s) on/off
11. The GUI touch panel should present the instructor with certain simple choices, defaults, standard configurations or pre-sets such as Presentation Mode 1, Presentation Mode 2, etc. or as directed by owner.
  - a. For instance, Presentation Mode 1, 2 or 3 may also automatically direct certain projectors/displays to turn on or off, certain screens to be up or down (coordinated with projectors).
  - b. Contractor shall consult with owner regarding preferences for such functionality.
  - c. During building renovation, but before AV installation, owner and engineer reserves the right to provide more detailed direction for system programming and GUI layouts. But in the absence of further direction, contractor remains responsible to provide screen shots, submittals and owner coordination.
  - d. In addition the simple or pre-set modes, utilities shall have a page to permit individual, minute functions of each item. Displays shall have a page permitting individual control of each screen/display.

12. The instructor should also have the option to individually select which inputs are routed to which outputs.
  - a. Contractor shall consult with owner regarding preferences for such functionality.

### **3.03 PREPARATION**

- A. Before starting installation, verify proper installation of the following work by others.
  1. Inspect site.
  2. Document and submit a single report for each space with AV to the Owner before any work is started on-site.
  3. Carry out this requirement for each phase of work on-site (field wiring, and system/equipment installation) for each space with AV.
  4. Frequency Coordination - Prior to ordering equipment, the Installing Contractor shall coordinate the frequencies of all wireless devices to prevent unwanted interaction between devices and rooms.
  5. This includes, but is not limited to, wireless microphones, assisted listening system devices, wireless control panels, etc.
  6. Frequency coordination shall take place with the use of a spectrum analyzer and frequency allocation/analysis software.
  7. Documentation of this frequency coordination shall be provided to the Owner for review.

### **3.04 QUALITY CONTROL/COMMISSIONING**

- A. Required testing and testing procedures are included in the Contract Documents.
  1. See related Performance Standards and Testing Procedures paragraphs in Part 3 of this technical section.
  2. The main AV milestones that testing will be required:
  3. Prototype verifications (off-site and on-site)
  4. Final System Checkout
    - a. Provide programming checklist (button by button) for system check out and verification.
  5. Final Checkout

### **3.05 WIRING**

- A. All cables and wiring are to be logically, legibly and permanently labeled for easy identification. Each wire shall be permanently marked with a number at each end. This applies to wire within a rack assembly as well as wire running in conduit. Labels on cables to be adhesive strip type covered with clear heat-shrink tubing. Factory stamped heat shrink tubing may be used in lieu of the adhesive strip style label. Hand-written or self-laminating type labels are not acceptable.
- B. Wiring designations shall be an alpha-numeric code that is unique for each cable. Locate the cable designation at the start and end of each cable run and within 2 inches of the point of termination or connection. Label must be printed in three lines so that the designator is visible from all angles. For cable runs that have intermediate splice points, the cable shall have the same designation throughout with an additional suffix to indicate each segment of the run. Actual cable designation assignments shall be determined by the installing contractor. The overall system of wire designators shall be uniform throughout the entire project from sub-system to sub-system.
- C. Provide adhesive labels on the rear of equipment where cables attach to indicate the designation of the cable connected at that point.

- D. Exposed cables shall be enclosed with surface raceway.
- E. All screw on terminals shall have crimp-on terminal lugs.
- F. Wire ends and shield drain wires shall be covered with shrink tubing.
- G. All cables in racks and custom panels shall be harnessed with suitable nylon tie wraps in a vertical and horizontal configuration. Cables that break out from harnesses for connection shall be provided with an adequate amount of slack cable for a service loop to provide access to equipment for servicing and adjustment.
- H. All voice/data/audio/visual cabling run free air (not in conduits) shall be rated for the environment in which the cables are installed.
- I. Provide speaker wire from Smart Room Module to speakers as indicated on project documents.
- J. All runs over 8 ft. to provide 2 ft. of slack cable coiled at each end of cable run.

### **3.06 EQUIPMENT GROUNDING**

- A. Bond all metallic parts to approved equipment ground.

### **3.07 WORK IN OTHER SECTIONS**

- A. The division of responsibility regarding work to be done by the Electrical Contractor and work to be done by the AV contractor shall be in accordance with the following:
- B. The following work shall be the sole responsibility of the AV contractor:
- C. Furnish and install all equipment, panels, and devices associated with the AV systems as indicated on project documents.
- D. Termination of all AV systems wiring: Coordination of AC 120 volt power and wiring within AV systems cabinet and/or Instructor's Station.
- E. Preparation of AV shop drawings, maintenance manuals, wiring diagrams and other submittals required by the individual AV system specification sections.
- F. Tests, balancing, trouble shooting, adjustments and other similar work as may be required to insure complete operating AV systems.
- G. All AV training sessions required by these specifications.
- H. Any and all warranty work associated with the building audio visual systems.
- I. Any other work associated with the AV systems that due to its technical nature should logically be performed by the AV contractor.
- J. For all video lines confirm and document the following relevant test data:
  1. Sweep all video signal paths using a broadband noise source.
  2. Measure and record signal loss using an RF spectrum analyzer at 100, 200 and 400 MHz.
  3. Verify that signal loss at 270 MHz does not exceed 3 db.
  4. Correct and faulty connections and retest as necessary.

- K. Test all video lines using a TDR to verify:
  - 1. Absence of impedance anomalies due to improper connector use or installation or cable damage or shorts.
  - 2. Proper circuit appearing at each termination location
  - 3. Continuity of all conductors
  - 4. Absence of shorts between conductors
  - 5. Absence of shorts between conductors and conduit
  - 6. Specified bandwidth is maintained
  - 7. Impedance is maintained
- L. Documentation shall include a chart listing applicable data.
- M. Provide Impedance measurements: For all permanently mounted speaker terminations, provide impedance measurement of each pair of speaker lines with all speakers connected and all amplifiers disconnected. These measurements shall be documented in a table listing impedance for each 1/3 octave band from 20Hz to 20 KHz and shall be accurate to the nearest tenth of an Ohm.
- N. Create, then provide Verification Checklist for each space or system. Checklist should include all equipment indicated on project documents and may also include important items from this execution specification. Where no coax is utilized, some sweep tests may not be required.
- O. Verify that all loudspeakers and mountings are free of buzzes and rattles when swept with sign wave tones throughout its rated bandwidth at normal levels.
- P. Verify that correct polarity is maintained throughout the entire signal path.
- Q. Verify that all equipment and systems are operating to manufactures specifications.
- R. Verify that audio systems are free of humming, buzzing, feedback, interference, spurious oscillations, digital artifacts or extraneous noises of any kind.
- S. Verify uniformity of sound coverage throughout intended coverage area. Contractor shall invite owner to attend testing sessions. Contractor to adjust sound levels in every room to meet owner's expectations.
- T. Verify with consultant measurement locations, conditions and measurement criteria.
- U. Verify that all equipment is operating correctly and is operating to manufacturers specifications.
- V. Perform sound system rough equalization, cross over and delay settings and final sound system settings.
- W. Perform all video system set up and calibration.
  - 1. Verify proper aiming, focus and image size for projectors.
  - 2. Verify proper operation of all controls.
  - 3. Verify brightness and correct color balance of each projected image using SENCORE CP5000 display analyzer system or equivalent.
- X. Verify each installed data network cable or fiber optic cable conforms to TIA/EIA performance standards.
- Y. Submit three (3) copies of a Systems Checklist or written report detailing the results of Initial Adjustments and Verification tests including all relevant drawings, charts, test instrument data and

photographs. This report shall be complete and submitted to the engineer for review a maximum of five (5) days after substantial completion. With this report, submit written certification that the installation conforms to the requirements stated herein, is complete in all respects, and is ready for owner engineer final inspection and/or owner move-in.

1. Project is not complete until a Systems Checklist has been submitted. The Checklist shall identify all systems and major components required for system function. The Systems Checklist shall be filled out by contractor during systems operational testing prior to informing AE or Owner that system is complete.
  2. Systems Checklist shall be presented to the Engineer prior to final punch list.
  3. Provide Systems Checklist per section 27 05 00. Example of possible Systems Checklist. Contractor shall augment or add columns and rows to this list according to what makes sense for each major system component.
- Z. At Engineer request, Contractor shall be present during punch list to demonstrate function of all systems to Engineer and/or Owner.
1. Termination of all AV systems wiring: Coordination of AC 120 volt power and wiring within AV systems cabinet and/or Instructor's Station.
  2. Preparation of AV shop drawings, maintenance manuals, wiring diagrams and other submittals required by the individual AV system specification sections.
  3. Tests, balancing, trouble shooting, adjustments and other similar work as may be required to insure complete operating AV systems.
  4. All AV training sessions required by these specifications.
  5. Any and all warranty work associated with the building audio visual systems.
  6. Any other work associated with the AV systems that due to its technical nature should logically be performed by the AV contractor.
  7. For all video lines confirm and document the following relevant test data:
    - a. Sweep all video signal paths using a broadband noise source.
    - b. Measure and record signal loss using an RF spectrum analyzer at 100, 200 and 400 MHz.
    - c. Verify that signal loss at 270 MHz does not exceed 3 db.
    - d. Correct and faulty connections and retest as necessary.
  8. Test all video lines using a TDR to verify:
    - a. Absence of impedance anomalies due to improper connector use or installation or cable damage or shorts
    - b. Proper circuit appearing at each termination location
    - c. Continuity of all conductors
    - d. Absence of shorts between conductors
    - e. Absence of shorts between conductors and conduit
    - f. Specified bandwidth is maintained
    - g. Impedance is maintained
  9. Documentation shall include a chart listing applicable data.
  10. Provide Impedance measurements: For all permanently mounted speaker terminations, provide impedance measurement of each pair of speaker lines with all speakers connected and all amplifiers disconnected. These measurements shall be documented in a table listing impedance for each 1/3 octave band from 20Hz to 20 KHz and shall be accurate to the nearest tenth of an Ohm.
  11. Create, then provide Verification Checklist for each space or system. Checklist should include all equipment indicated on project documents and may also include important items from this execution specification. Where no coax is utilized, some sweep tests may not be required.
  12. Verify that all loudspeakers and mountings are free of buzzes and rattles when swept with sign wave tones throughout its rated bandwidth at normal levels.

13. Verify that correct polarity is maintained throughout the entire signal path.
14. Verify that all equipment and systems are operating to manufactures specifications.
15. Verify that audio systems are free of humming, buzzing, feedback, interference, spurious oscillations, digital artifacts or extraneous noises of any kind.
16. Verify uniformity of sound coverage throughout intended coverage area. Contractor shall invite owner to attend testing sessions. Contractor to adjust sound levels in every room to meet owner's expectations.
17. Verify with consultant measurement locations, conditions and measurement criteria.

### **3.08 FULL SYSTEM CHECKOUT**

#### **A. Installing Contractor's Full System Checkout**

1. Installing Contractor will accomplish a complete system(s) inventory of all equipment, and inspection of all workmanship quality relating to installation details.
2. Installing Contractor will complete all testing for system operational compliance, and test to ensure all equipment is working fully to published specifications.
3. Results will be recorded and submitted to the Owner. Installing Contractor's test submittal will serve to allow 7-days for the Owner to make arrangements to do Final System Checkout.
4. The operation of all system equipment shall be demonstrated by the Installing Contractor.
5. Both subjective and objective tests will be required to determine compliance with the specifications.
  - a. The Installing Contractor shall be responsible for providing test equipment for these tests.
  - b. The Installing Contractor shall be responsible for providing qualified personnel to run the tests, make adjustments, and answer system questions for as long as required to accomplish the tests and setup satisfactorily.
6. The Installing Contractor shall be responsible for providing the personnel that accomplished all programming for the system; this includes the control system, AV touch panel and any DSP software. This person will be available to run requested demonstration, make adjustments, and answer system programming questions for as long as required to accomplish the demonstration satisfactorily.
7. The Contractor shall provide initial set up and testing of Crestron AirMedia devices in all locations. This may require coordination with owner for access to Owner network. Contractor shall prove system works and provide training to owner on permissions, passcodes, access to content and configurations required to permit access by Apple, Android and PC devices.
8. In the event there is required rework, large scale readjustments, or defective equipment that must be repaired or replaced, tests may be suspended or continued at the option of the Owner. Owner will advise if training can commence while any further clean-up is being done before Final System Checkout

### **3.09 TRAINING**

- A. Demonstrate to Engineer and/or owner that all individual components and all integrated systems function according to the design intent of the project documents and according to manufacturer's recommendations. Contractor shall dedicate a minimum of (4) hours to demonstrating to Engineer/Owner the operation of each room. This is in addition (prior) to actual training sessions. This is simply to demonstrate project completion and allow Engineer to perform punch list.
  1. Before scheduling such a demonstration it is the responsibility of the contractor to assure that all components and systems are functioning properly.
  2. The AV contractor shall conduct group and/or individual training sessions, as requested by the Owner, for the proper operation and maintenance of the complete system.

3. Training shall provide a total of at least four hours of instruction at the site encompassing each system installed and shall orient responsible personnel to a level satisfactory to the Owner and Consultant. Training times shall be arranged with the Owner. The training shall include the facilities electrician or other designated personnel. Training shall not take place until all systems are 100% operational and Systems Checklist has been completed.
4. The Installing Contractor shall provide on-the-job training by a qualified instructor, to personnel designated by the Owner, to instruct them in the operation and routine maintenance of the systems.
5. All training shall take place after the systems are operational, but before the acceptance tests.
6. Operational Training:
  - a. There shall be a minimum of (4) hours of end-user training for the 3<sup>rd</sup> floor rooms and (8) hrs of training for room 201 included in this specification for this activity.
  - b. In the event the Installing Contractor does not have qualified instructors on staff for certain sophisticated equipment, the Installing Contractor, at no additional cost to Owner, will provide a manufacturer's representative for such instruction to the Owner.
7. Training Materials Supplied:
  - a. System operational manual (not equipment operation manuals) that explains how to fully operate the system; from start-up to shut-down, and all operational steps in-between, in a step by step description, with pictures and other visuals to help convey information.
  - b. The Installing Contractor shall video record training session(s) for Owners reference (to help limit minor follow up phone calls in the future).
8. Maintenance Training:
  - a. A session with Owner's designated technical personnel for routine and preventive maintenance will be given.
 

This training is for scheduled preventative maintenance for such items as filter and lens cleaning, minor equipment checks and "user" adjustments.

    - a) This training is not meant to teach Owner's representatives how to use commercial test equipment and/or do sophisticated equipment/system alignment.
  - b. There shall be a minimum of two (2) hours of end-user training included in this specification for this activity.
9. Training Materials Supplied:
  - a. Utilizing the equipment manuals and flow diagrams of the required in contract closeout submittals supply a listing with suggested preventative maintenance schedule of the system equipment.
  - b. Follow-up training within sixty (60) days shall also be provided.
  - c. There shall be a minimum of two (2) hours of end-user training (per room) included in this specification for this activity.

### **3.10 FINAL CHECKOUT**

- A. Final Checkout will not be performed until the Installing Contractor's Full System Checkout has been successfully completed (including all "punch-list" items) and the test results have been reviewed by the Owner.
  1. Installing Contractor's test submittal will serve to allow 7-days for the Owner to make arrangements to do Final Checkout.

2. The Final Checkout with the Owner will consist of the following:
3. A physical inventory shall be taken of all equipment on site and will be compared to equipment lists in the contract documents and subsequent Installing Contractor submittals. This work shall be done by the contractor and provided to the A/E and Owner for review.
4. The operation of all system equipment shall be demonstrated by the Installing Contractor.
5. Both subjective and objective tests will be required to determine compliance with the specifications. The Installing Contractor shall be responsible for providing test equipment and qualified personnel for these tests.
6. All final, "as-built" drawings, run sheets, manuals, and other required documents shall be on hand.
  - a. Two complete sets of these documents shall be delivered to the Owner at this time.

### **3.11 WARRANTY**

- A. See General Conditions.
- B. Warranty period shall be a minimum of one year. Warranty period shall commence at substantial completion or first beneficial use of system by owner, whichever comes first. During the warranty period, AV contractor shall furnish on site diagnostic and repair service to installed AV systems free of charge to owner. Contractor shall respond to service requests within 24 hours. Contractor shall provide on-site diagnostic and repair service within two business days of trouble report. Contractor shall make available after hours or weekend service at a premium rate not to exceed 1.5 times normal hourly rates minus normal hourly rates.
- C. During the warranty period, the AV contractor shall provide for three service and maintenance calls by technically qualified personnel without additional charge. Calls shall be at least two hours at the site and shall be pre-arranged at least two weeks prior with the Owner.
- D. All tests, adjustments, or replacements shall be made in the presence of Owner's technician, or other person designated by the Owner's superintendent. Upon completion of each call a report will be provided to clearly indicate any replacements or adjustments and any evidence of tampering.
  1. To maintain certain manufacturer's warranties, equipment must be installed, aligned and serviced by those installers authorized by that manufacturer to perform those duties. If the Installing Contractor is not authorized, by the manufacturer, it is the Installing Contractor's sole responsibility to make the appropriate arrangements and bear all cost and consequences.
  2. In cases where the manufacturer's warranty period is greater than specified in the Contract Documents, the Installing Contractor shall provide that warranty for the full extent of the manufacturer's warranty period.
  3. The Installing Contractor shall exclude any labor costs incurred by removing and re-installing the defective items after the system's one-year warranty.
  4. In cases where the manufacturer's warranty period is less than 12 months, the Installing Contractor shall warrant the system(s) in accordance with the Contract Documents (See below).
  5. \* Optional\* The system warranty shall include a minimum of four (4) preventive maintenance visits, to perform operation checks of the equipment, screens, projector lenses and other critical surfaces, to lubricate moving parts as recommended by the respective manufacturers and to adjust and align projector to maintain optimum registration and focus.
  6. All manufacturers' equipment warranties shall be activated in the Owner's name and shall commence on the date of Substantial Completion.
  7. In the case of Installing Contractor-modified equipment, the manufacturer's warranty is normally voided. In such cases, the Installing Contractor shall provide the Owner with a warranty equivalent to that of the original manufacturer.
  8. In the event of malfunction or failure of any audiovisual equipment provided by the Installing Contractor, the Installing Contractor shall be responsible for replacement of faulty equipment =or providing "loaner" equipment at no cost to the Owner for the duration of the repairs. In the

event that “loaner” equipment is provided, said equipment shall meet or exceed the original equipment’s specifications until the original equipment is replaced.

9. In cases where the Installing Contractor is providing and installing audiovisual equipment and/or hardware to be integrated with equipment furnished by others, it shall be the responsibility of the Installing Contractor to warrant their equipment as described in the Contract Documents unless said equipment shows misuse and or abuse by others during re-installation or connection of equipment by others.
10. Telephone Support
11. Installing Contractor shall respond via telephone within two (2) hours to any request for service.
12. This first contact should outline the nature of the problem or functional anomaly.
13. The Installing Contractor shall make available personnel knowledgeable with the installed system who can address specific system issues described by the system operators.
14. Telephone support shall be available between normal business hours, Monday through Friday.
15. On-Site Support
16. The warranty shall be an “on-site” warranty, with a twenty-four (24) hour response time.
17. Warranty period shall be a minimum of one year. Warranty period shall commence at substantial completion or first beneficial use of system by owner, whichever comes first. During the warranty period, AV contractor shall furnish on site diagnostic and repair service to installed AV systems free of charge to owner. Contractor shall respond to service requests within 24 hours. Contractor shall provide on-site diagnostic and repair service within two business days of trouble report. Contractor shall make available after hours or weekend service at a premium rate not to exceed 1.5 times normal hourly rates minus normal hourly rates.
18. During the warranty period, the AV contractor shall provide for three service and maintenance calls by technically qualified personnel without additional charge. Calls shall be at least two hours at the site and shall be pre-arranged at least two weeks prior with the Owner.
19. These service and maintenance calls shall be in addition to any warranty required service calls and shall commence every 4 months after the date of final acceptance by the Owner.
20. Tests, adjustments, or replacements shall be made in the presence of Owner's technician, or other person designated by the Owner's superintendent. Upon completion of each call a report will be provided to clearly indicate replacements or adjustments and any evidence of tampering

END OF SECTION