

SECTION 27 00 00
COMMUNICATIONS BASIC REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Work included in 27 00 00, Communications Basic Requirements applies to Division 27, Communications work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of communications systems for proposed project.
- B. Contract Documents include, but are not limited to, Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Drawings, Addenda, Owner/Architect Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.
- C. Definitions:
 - 1. Provide: To furnish and install, complete and ready for intended use.
 - 2. Furnish: Supply and deliver to project site, ready for unpacking, assembly and installation.
 - 3. Install: Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at project site as required to complete items of work furnished.
 - 4. Approved or Approved Equivalent: To possess the same performance qualities and characteristics and fulfill the utilitarian function without any decrease in quality, durability or longevity. For equipment/products defined by the Contractor as "equivalent," substitution requests must be submitted to Engineer for consideration, in accordance with Division 01, General Requirements, and approved by the Engineer prior to submitting bids for substituted items.
 - 5. Authority Having Jurisdiction (AHJ): Indicates reviewing authorities, including local fire marshal, Owner's insurance underwriter, Owner's Authorized Representative, and other reviewing entity whose approval is required to obtain systems acceptance.
 - 6. Entrance Facility (EF): Area or location that contains entrance point (demarcation) cable and associated equipment for telecommunication services entering the building.
 - 7. Equipment Room (ER): Area or location that contains backbone cabling associated with interbuilding cable or cable that connects buildings together in a campus environment. ERs may contain Main Cross-Connects, Intermediate Cross-Connects, Horizontal Cross-Connects, and Telecommunication Rooms.
 - 8. Main Cross-Connect (MC): Area or location that contains telecommunications equipment for connecting backbone cable to/from Intermediate Cross-Connects and Horizontal Cross-Connects. Active telecommunications equipment will often be contained in this area to serve as the telecommunications hub or headend. Backbone cable from Local Exchange Carrier's point of demarcation will connect to building backbone cable or active telecommunications equipment at this location.
 - 9. Intermediate Cross-Connect (IC): Area or location that contains telecommunications equipment for connecting backbone cable from the MC to backbone cable distributing to one or many Horizontal Cross-Connects. This location may contain active telecommunications equipment.
 - 10. Horizontal Cross-Connect (HC): Area or location that contains telecommunications equipment, cable terminations and cross-connect wiring. HC is the recognized connection point between backbone and horizontal pathway facilities.
 - 11. Telecommunications Room (TR): Area or location containing telecommunications equipment, cable terminations and cross-connect wiring. Three applications serviced by TRs are horizontal cable connections, backbone system interconnection and entrance facilities. The TR provides facilities (space, power, grounding, etc.) for housing

telecommunications equipment. TR may contain a MC, IC or HC and a demarcation point or an interbuilding entrance facility.

12. Interbuilding Cable: Backbone cable associated with connecting buildings together in a multibuilding or campus environment.
13. Intrabuilding Cable: Backbone cable associated with connecting Entrance Facility, Equipment Rooms, Main Cross-Connects, Intermediate Cross-Connects, Horizontal Cross-Connects, and Telecommunication Rooms together on single floor or multifloor building.

1.02 RELATED SECTIONS

- A. Contents of Section applies to Division 27, Communications Contract Documents.
- B. Related Work:
 1. Additional conditions apply to this Division including, but not limited to:
 - a. Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
 - b. Drawings
 - c. Addenda
 - d. Owner/Architect Agreement
 - e. Owner/Contractor Agreement
 - f. Codes, Standards, Public Ordinances and Permits

1.03 REFERENCES AND STANDARDS

- A. References and Standards per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, individual Division 27, Communications Sections and those listed in this Section.
- B. Codes to include latest adopted editions, including current amendments, supplements and local jurisdiction requirements in effect as of the date of the Contract Documents, of/from:
 1. State of Washington:
 - a. IBC - International Building Code
 - b. IFC - International Fire Code
 - c. IMC - International Mechanical Code
 - d. NEC - National Electrical Code
 - e. UPC - Uniform Plumbing Code
 - f. WAC - Washington Administrative Code
 - g. WSEC - Washington State Energy Code
- C. Reference standards and guidelines include but are not limited to the latest adopted editions from:
 1. ABA - Architectural Barriers Act
 2. ADA - Americans with Disabilities Act
 3. ANSI - American National Standards Institute
 - a. ANSI/TIA-568-C.0 - Generic Telecommunications Cabling for Customer Premises
 - b. ANSI/TIA-568-C.1 - Commercial Building Telecommunications Cabling Standard
 - c. ANSI/TIA-568-C.2 - Balanced Twisted-Pair Telecommunications Cabling and Components Standard
 - d. ANSI/TIA-568-C.3 - Optical Fiber Cabling Components Standard. Commercial Building Telecommunicating Cabling Standard

- e. ANSI/TIA-569-B - Commercial Building Standard for Telecommunications Pathways and Spaces
- f. ANSI/TIA-570-B - Residential Telecommunications Infrastructure
- g. ANSI/TIA-942 - Telecommunications Infrastructure Standard for Data Centers
- h. ANSI/TIA/EIA-606-A - Administration Standard for Commercial Telecommunications Infrastructure
- i. ANSI-J-STD-607-A - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
- 4. APWA - American Public Works Association
- 5. ASCE - American Society of Civil Engineers
- 6. ASHRAE Guideline 0, the Commissioning Process
- 7. ASTM - ASTM International
- 8. BICSI - Building Industry Consulting Service International
 - a. BICSI TDMM - Telecommunications Distribution Methods Manual
 - b. BICSI ESSDRM - Electronic Safety & Security Design Reference Manual
 - c. BICSI AVDRM - AV Design Reference Manual
- 9. CFR - Code of Federal Regulations
- 10. EIA - Electronic Industries Association
- 11. EPA - Environmental Protection Agency
- 12. ETL - Electrical Testing Laboratories
- 13. FCC - Federal Communications Division
- 14. FM - FM Global
- 15. IBC - International Building Code
- 16. IEC - International Electrotechnical Commission
- 17. IEEE - Institute of Electrical and Electronics Engineers
- 18. ISO - International Organization for Standardization
- 19. MSS - Manufacturers Standardization Society
- 20. NEC - National Electric Code
- 21. NEMA - National Electrical Manufacturers Association
- 22. OSHA - Occupational Safety and Health Administration
- 23. TIA - Telecommunications Industry Association
- 24. UL - Underwriters Laboratories Inc.
- 25. WSSP - Washington Sustainable School Protocol
- D. See Division 27, Communications individual Sections for additional references.
- E. Where code requirements are at variance with Contract Documents, meet code requirements as a minimum requirement and include costs necessary to meet these in Contract. Machinery and equipment are to comply with OSHA requirements, as currently revised and interpreted for equipment manufacturer requirements. Install equipment provided per manufacturer recommendations.
- F. Whenever this Specification calls for material, workmanship, arrangement or construction of higher quality and/or capacity than that required by governing codes, higher quality and/or capacity take precedence.

1.04 SUBMITTALS

- A. See Division 01, General Requirements for Submittal Procedures.
- B. Provide drawings in format and software release equal to the design documents. Drawings to be the same sheet size and scale as the Contract Documents.
- C. "No Exception Taken" constitutes that review is for general conformance with the design concept expressed in the Contract Documents for the limited purpose of checking for conformance with information given. Any action is subject to the requirements of the Contract Documents. Contractor is responsible for the dimensions and quantity and will confirm and correlate at the job site, fabrication processes and techniques of construction, coordination of the work with that of all other trades, and the satisfactory performance of the work.
- D. Provide product submittals and shop drawings in electronic format only. Electronic format must be submitted via posted to ftp site. For electronic format, provide one zip file per specification division containing a separate file for each Specification Section. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. Copy Architect on all transmissions/submissions.
- E. Product Data: Provide manufacturer's descriptive literature for products specified in Division 27, Communications Sections.
- F. Identify/mark each submittal in detail. Note what differences, if any, exist between the submitted item and the specified item. Failure to identify the differences will be considered cause for disapproval. If differences are not identified and/or not discovered during the submittal review process, Contractor remains responsible for providing equipment and materials that meet the specifications and Drawings.
 - 1. Label submittal to match numbering/references as shown in Contract Documents. Highlight and label applicable information to individual equipment or cross out/remove extraneous data not applicable to submitted model. Clearly note options and accessories to be provided, including field installed items. Highlight connections by/to other trades.
 - 2. Include technical data, installation instructions and dimensioned drawings for products, fixtures, equipment and devices installed, furnished or provided. Reference individual Division 27, Communications specification Sections for specific items required in product data submittal outside of these requirements.
 - 3. See Division 27, Communications individual Sections for additional submittal requirements outside of these requirements.
- G. Maximum of two reviews of complete submittal package. Arrange for additional reviews and/or early review of long-lead items; Bear costs of additional reviews at Engineer's hourly rates. Incomplete submittal packages/submittals will be returned to contractor without review.
- H. Resubmission Requirements: Make corrections or changes in submittals as required, and in consideration of Engineer's comments. Identify Engineer's comments and provide an individual response to each of the Engineer's comments. Cloud changes in the submittals and further identify changes which are in response to Engineer's comments.
- I. Structural/Seismic: Provide weights, dimensions, mounting requirements and like information required for mounting, seismic bracing, and support. Indicate manufacturer's installation and support requirements to meet ASCE 7-10 requirements for non-structural components. Provide engineered seismic drawings and equipment seismic certification. Equipment Importance Factor as specified in Division 01 and in Structural documents.
- J. Trade Coordination: Include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and connections as required per Division 27, Communications Coordination Documents. For equipment with electrical connections, furnish copy of approved submittal for inclusion in Division 26, Electrical submittals.
- K. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.

L. Substitutions and Variation from Basis of Design:

1. The Basis of Design designated product establishes the qualities and characteristics for the evaluation of any comparable products by other listed acceptable manufacturers if included in this Specification or included in an approved Substitution Request as judged by the Design Professional.
2. If substitutions and/or equivalent equipment/products are being proposed, it is the responsibility of parties concerned, involved in, and furnishing the substitute and/or equivalent equipment to verify and compare the characteristics and requirements of that furnished to that specified and/or shown. If greater capacity and/or more materials and/or more labor is required for the rough-in, circuitry or connections than for the item specified and provided for, then provide compensation for additional charges required for the proper rough-in, circuitry and connections for the equipment being furnished. No additional charges above the Base Bid, including resulting charges for work performed under other Divisions, will be allowed for such revisions. Coordinate with the requirements of "Submittals." For any product marked "or approved equivalent," a substitution request must be submitted to Engineer for approval prior to purchase, delivery or installation.

M. Shop Drawings:

1. Provide coordinated Shop Drawings which include physical characteristics of all systems, device layout plans, and control wiring diagrams. Reference individual Division 27, Communications specification Sections for additional requirements for Shop Drawings outside of these requirements.
2. Provide Shop Drawings indicating access panel locations, size and elevation for approval prior to installation.

N. Samples: Provide samples when requested by individual Sections.

O. Resubmission Requirements:

1. Make any corrections or change in submittals when required. Provide submittals as specified. The engineer will not be required to edit and/or interpret the Contractor's submittals. Changes made for the resubmittal will be indicated in a cover letter with reference to page(s) changed and will reference response to comment. Indicate changes for the resubmittal in a cover letter with reference to page(s) changed and reference response to comment. Cloud changes in the submittals.
2. Resubmit for review until review indicates no exception taken, or "make corrections as noted."
3. When submitting Drawings for Engineers re-review, clearly indicate changes on Drawings and "cloud" any revisions. Submit a list describing each change.

P. Operation and Maintenance Manuals, Owner's Instructions:

1. Submit, at one time, electronic files (PDF format) on CD/DVD of manufacturer's operation and maintenance instruction manuals and parts lists for equipment or items requiring servicing. Submit data when work is substantially complete and in same order format as submittals. Include name and location of source parts and service for each piece of equipment. Create bookmarks and make PDF searchable.
 - a. Include copy of approved submittal data along with submittal review letters received from Engineer. Data to clearly indicate installed equipment model numbers. Delete or cross out data pertaining to other equipment not specific to this project.
 - b. Include copy of manufacturer's standard Operations and Maintenance for equipment. At front of each tab, provide routine maintenance documentation for scheduled equipment. Include manufacturer's recommended maintenance schedule and highlight maintenance required to maintain warranty. Furnish list of routine maintenance parts, including part numbers, sizes, quantities, relevant to each piece of equipment: batteries, lamp lenses, speakers and filters.

- c. Include Warranty per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 27 00 00, Communications Basic Requirements and individual Sections.
 - d. Include product certificates of warranties and guarantees.
 - e. Include copy of complete parts list for equipment. Include available exploded views of assemblies and subassemblies.
 - f. Include copy of burn-in and test reports specific to each piece of equipment.
 - g. Include copy of software/appliance programming.
 - h. Include commissioning reports.
 - i. Engineer will return incomplete documentation without review. Engineer will provide one set of review comments in Submittal Review format. Contractor must arrange for additional reviews; Contractor to bear costs for additional reviews at Engineer's hourly rates.
2. Thoroughly instruct Owner in proper operation of equipment and systems. Where noted in individual Sections, training will include classroom instruction with applicable training aids and systems demonstrations. Submit copy of material used for Owner instruction. Field instruction per Section 27 00 00, Communications Basic Requirements Article titled "Demonstration."
 3. Copies of certificates of code authority inspections, acceptance, code required acceptance tests, letter of conformance and other special guarantees, certificates of warranties, specified elsewhere or indicated on Drawings.
- Q. Record Drawings:
1. Maintain at site at least one set of drawings for recording "as-constructed" conditions. Indicate on Drawings changes to original documents by referencing revision document, and include buried elements, location of conduit, and location of concealed communication items. Include items changed by field orders, supplemental instructions, and constructed conditions.
 2. Record Drawings are to include equipment and fixture/connection schedules that accurately reflect "as constructed or installed" for project.
 3. At completion of project, input changes to original project on Revit Model and make one set of black-line Drawings created from Revit Model in version/release equal to Contract Drawings. Submit Revit disk and Drawings upon substantial completion.
 4. At completion of project, show changes and deviations from the Drawings in red on one set of black-line drawings. Include written Addendums, RFIs, and change order items. Make changes to Drawings in a neat, clean, and legible manner.
 5. Invert elevations and dimensioned locations for incoming utilities and site raceways below grade extending to 5-feet outside building line.
 6. See Division 27, Communications individual Sections for additional items to include in Record Drawings.

1.05 QUALITY ASSURANCE

- A. Regulatory Requirements: Work and materials installed to conform with all local, state, federal and other applicable laws and regulation.
- B. Drawings are intended to be diagrammatic and reflect the Basis of Design manufacturer's equipment. They are not intended to show every item in its exact dimensions, or details of equipment or proposed systems layout. Verify actual dimensions of systems (i.e., conduit) and equipment proposed to assure that systems and equipment will fit in available space. Contractor is responsible for design and construction costs incurred for equipment other than

Basis of Design, including, but not limited to, architectural, structural, electrical, HVAC, fire sprinkler, and plumbing systems.

- C. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.
- D. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.
- E. Provide products that are UL listed.
- F. Contractor Qualifications:
 - 1. Minimum of five years experience in the design, installation, testing and maintenance of communications systems.
 - 2. Must employ at least one full time BICSI certified Registered Communications Distribution Designer (RCDD) who is involved in reviewing work performed by contractor on this project.
 - 3. Maintain a local service facility which stocks spare devices and/or components for servicing systems.
 - 4. Have performed successful installation and maintenance of at least three projects similar in scope and size. Be able to provide project references for these three projects, including scope of Work, project type, Owner/user contact name and telephone number.
 - 5. The contractor selected for this project must be certified by the manufacturer of the approved products and utilize these components for completion of work.

1.06 WARRANTY

- A. Provide written warranty covering the work for a period of one year from date of Substantial Completion in accordance with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 27 00 00, Communications Basic Requirements and individual Division 27, Communications Sections.
- B. Sections under this Division can require additional and/or extended warranties that apply beyond basic warranty under Division 01, General Requirements and the General Conditions. Confirm requirements in all Contract Documents.

1.07 COORDINATION DOCUMENTS

- A. Prior to construction, prepare and submit coordinated layout Drawings (composite drawings), to coordinate installation and location of ductwork, grilles, diffusers, piping, fire sprinklers, plumbing, lights, and electrical services. Composite Drawings show services on single sheet. Key Drawings to structural column identification system. Prior to completion of Drawings, coordinate proposed installation with architectural and structural requirements, and other trades (including plumbing, HVAC, fire protection, electrical, ceiling suspension, and ceiling tile systems, etc.), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e. roofing, ceiling, finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence. Unless otherwise required by Division 00, Procurement and Contracting Requirements and/or Division 01, General Requirements, Division 27, Communications to combine information furnished by other trades onto master coordination documents.
- B. Prepare Drawings as follows:
 - 1. Coordination models/drawings may be created using Revit 3D modeled elements or a 3D CAD software. The modeled elements to be graphically represented within the model as a specific system, object or assembly in terms of size, shape, location, quantity, and orientation with detailing, fabrication, assembly, and installation information. Non-graphic information may also be attached to the model elements. Model elements must have the ability to be spatially coordinated with other modeled elements using either Revit, Autodesk Navisworks or Autodesk A360.

2. Drawings in Revit Model. Revit Model release equal to design documents. Drawings to be same sheet size and scale as Contract Drawings and indicate location, size and elevation above finished floor of equipment and distribution systems.
3. Review and revise, as necessary, section cuts in Contract Drawings after verification of field conditions.
4. Incorporate addenda items and change orders.
5. Provide additional coordination as requested by other trades.
- C. Advise Architect in event conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.
- D. Verify in field exact size, location, invert, and clearances regarding existing material, equipment and apparatus, and advise Architect of discrepancies between that indicated on Drawings and that existing in field prior to installation related thereto.
- E. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Provide like items from one manufacturer, including but not limited to jacks, patch panels, equipment connection cords and wall plates.

2.02 MATERIALS

- A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data and are to be UL or ETL approved or have adequate approval or be acceptable by State, County, and City authorities. Equipment/fixture supplier is responsible for obtaining state, county, and city acceptance on equipment/fixture not UL approved or not listed for installation.
- B. Articles, fixtures, and equipment of a kind to be standard product of one manufacturer.
- C. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.
- D. Hazardous Materials:
 1. Comply with local, State of Washington, and Federal regulations relating to hazardous materials.
 2. Comply with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for this project relating to hazardous materials.
 3. Do not use any materials containing a hazardous substance. If hazardous materials are encountered, do not disturb; immediately notify Owner and Architect. Hazardous materials will be removed by Owner under separate contract.

2.03 ACCESS PANELS

- A. See Division 01, General Requirements and Division 08, Openings for products and installation requirements.
- B. Confirm Access Panel requirements in Division 01, General Requirements and 08. In absence of specific requirements, comply with individual Division 27, Communications Sections and the following:
 1. Provide flush mounting access panels for service of systems, equipment and individual components requiring maintenance or inspection. Where access panels are located in fire-rated assemblies of building, rate access panels accordingly.
 - a. Ceiling access panels to be minimum of 24-inch by 24-inch required and approved size.
 - b. Wall access panels to be minimum of 12-inch by 12-inch required and approved size.

- c. Provide screwdriver operated catch.
- d. Manufacturers and Models:
 - 1) Drywall: Karp KDW.
 - 2) Plaster: Karp DSC-214PL.
 - 3) Masonry: Karp DSC-214M.
 - 4) 2 hour rated: Karp KPF-350FR.
 - 5) Manufacturers: Karp, Milcor, Elmdor, Acudor, or approved equivalent.

PART 3 - EXECUTION

3.01 ACCESSIBILITY AND INSTALLATION

- A. Confirm Accessibility and Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 27 00 00, Communications Basic Requirements and individual Division 27, Communications Sections.
- B. Install equipment requiring access (i.e., amplifiers, taps, zone controllers, volume controls, and storage devices) so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not install equipment in obvious passageways, doorways, scuttles or crawlspaces which would impede or block intended usage.
- C. Install equipment and products complete as directed by manufacturer's installation instructions. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation instructions conflict with Contract Documents, request clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing and coordination with other trades and disciplines.
- D. Earthwork:
 - 1. Confirm Earthwork requirements in Contract Documents. In absence of specific requirements, comply with individual Division 27, Communications Sections and the following:
 - a. Perform excavation, dewatering, shoring, bedding, and backfill required for installation of work in this Division in accordance with related earthwork divisions. Contact utilities and locate existing utilities prior to excavation. Repair any work damaged during excavation or backfilling.
 - b. Excavation: Do not excavate under footings, foundation bases, or retaining walls.
 - c. Provide protection of underground systems. Review the project Geotechnical Report for references to corrosive or deleterious soils which will reduce the performance or service life of underground systems materials.
- E. Firestopping:
 - 1. Confirm Firestopping requirements in Division 07, Thermal and Moisture Protection.
 - 2. In absence of specific requirements, comply with individual Division 27, Communications Sections and coordinate location and protection level of fire and/or smoke rated walls, ceilings, and floors. When these assemblies are penetrated, seal around piping, ductwork and equipment with approved firestopping material. Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
- F. Plenums: In plenums, provide plenum rated materials that meet the requirements to be installed in plenums. Immediately notify Architect/Engineer of discrepancy.

3.02 SEISMIC CONTROL

- A. Confirm Seismic Control requirements in Division 01, General Requirements, Structural documents, and individual Division 27 Communications Sections.

- B. Earthquake resistant designs for Communications (Division 27) equipment and distribution, i.e. cabinets and racks, ceiling assemblies, raceways, ladder racking, etc. to conform to regulations of jurisdiction having authority.
- C. Restraints which are used to prevent disruption of function of piece of equipment because of application of horizontal force to be such that forces are carried to frame of structure in such a way that frame will not be deflected when apparatus is attached to a mounting base and equipment pad, or to structure in normal way, utilizing attachments provided. Secure equipment and distribution systems to withstand a force in direction equal to value defined by jurisdiction having authority.
- D. Provide stamped Shop Drawings from licensed Structural Engineer of seismic bracing and seismic movement assemblies for cabinets, racks, major equipment and overhead raceways. Engineer to design and provide stamped Shop Drawings cabinets, racks, major equipment and overhead raceway. Submit Shop Drawings along with equipment submittals.
- E. Provide stamped Shop Drawings from licensed Structural Engineer of seismic flexible joints for piping and crossing building expansion or seismic joints. Submit Shop Drawings along with seismic bracing details.
- F. Provide means to prohibit excessive motion of communications equipment during earthquake.

3.03 REVIEW AND OBSERVATION

- A. Confirm Review and Observation requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 27 00 00, Communications Basic Requirements and individual Division 27, Communications Sections.
- B. Notify Architect and Engineer, in writing, at following stages of construction so that they may, at their option, visit site for review and construction observation:
 - 1. Underground conduit installation prior to backfilling.
 - 2. Prior to ceiling cover/installation.
 - 3. When main systems, or portions of, are being tested and ready for inspection by AHJ.
- C. Final Punch: Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

3.04 CUTTING AND PATCHING

- A. Confirm Cutting and Patching Requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 27, Communications Sections and the following:
 - 1. Proposed floor cutting/core drilling/sleeve locations to be approved by Project Structural Engineer. Submit proposed locations to Architect/Project Structural Engineer. Where slabs are of post tension construction, perform x-ray scan of proposed penetration locations and submit scan results including proposed penetration locations to Project Structural Engineer/Architect for approval. Where slabs are of waffle type construction, show column cap extent and cell locations relative to proposed penetration(s).
 - 2. Cutting, patching and repairing for work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting included under this Section will be performed by skilled craftsmen of each respective trade in conformance with appropriate Division of Work.
 - 3. Additional openings required in building construction to be made by drilling or cutting. Use of jack hammer is specifically prohibited. Patch openings in and through concrete and masonry with grout.
 - 4. Restore new or existing work that is cut and/or damaged to original condition. Patch and repair specifically where existing items have been removed. This includes repairing and painting walls, ceilings, etc. where existing conduit and devices are removed as part of this

project. Where alterations disturb lawns, paving, and walks, surfaces to be repaired, refinished and left in condition matching existing prior to commencement of work.

5. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.

3.05 EQUIPMENT SELECTION AND SERVICEABILITY

- A. Replace or reposition equipment which is too large or located incorrectly to permit servicing, at no additional cost to Owner.

3.06 DELIVERY, STORAGE AND HANDLING

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 27, Communications Sections and the following:
 1. Handle materials delivered to project site with care to avoid damage. Store materials on site inside building or protected from weather, dirt and construction dust. Insulation and lining that becomes wet from improper storage and handling to be replaced before installation. Products and/or materials that become damaged due to water, dirt and/or dust as a result of improper storage to be replaced before installation.
 2. Protect all equipment and conduit to avoid damage. Close conduit openings with caps or plugs. Keep motors and bearings in watertight and dustproof covers during entire course of installation.

3.07 DEMONSTRATION

- A. Confirm Demonstration requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 27 00 00, Communications Basic Requirements and individual Division 27, Communications Sections.
- B. Upon completion of work and adjustment of equipment and test systems, demonstrate to Owner's Authorized Representative, Architect and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field instruction to Owner's Maintenance Staff as specified in Division 01, General Requirements, Section 27 00 00, Communications Basic Requirements and individual Division 27, Communications Sections.
- C. Manufacturer's Field Services: Furnish services of a qualified person at time approved by Owner, to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations.
- D. Training and Demonstration per Section 01 91 13, General Commissioning Requirements.

3.08 CLEANING

- A. Confirm Cleaning requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 27 00 00, Communications Basic Requirements and individual Division 27, Communications Sections.
- B. Upon completion of installation, thoroughly clean exposed portions of equipment, removing temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated during work.

3.09 INSTALLATION

- A. Confirm Installation requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 27 00 00, Communications Basic Requirements and individual Division 27, Communications Sections.
- B. Install equipment and devices in accordance with manufacturer's installation instructions, plumb and level and firmly secured to mounting surfaces. Maintain manufacturer's recommended clearances.

- C. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test operation and demonstrate compliance with requirements. Replace damaged or malfunctioning equipment.
- D. Provide miscellaneous supports/metals required for installation of equipment.

3.10 PAINTING

- A. Confirm Painting requirements in Division 01, General Requirements and Division 09, Finishes. In absence of specific requirements, comply with individual Division 27, Communications Sections and the following:
 - 1. Ferrous Metal: After completion of communications work, thoroughly clean and paint exposed supports constructed of ferrous metal surfaces in telecommunications rooms, i.e., hangers, hanger rods, equipment stands, with one coat of black asphalt varnish for exterior or black enamel for interior, suitable for hot surfaces.
 - 2. In a telecommunications room, on roof or other exposed areas, equipment not painted with enamel to receive two coats of primer and one coat of rustproof enamel, colors as selected by Architect.
 - 3. See individual equipment Specifications for other painting.
 - 4. Structural Steel: Repair damage to structural steel finishes or finishes of other materials damaged by cutting, welding or patching to match original.
 - 5. Conduit: Clean, primer coat and paint interior conduit exposed in finished areas with two coats paint suitable for metallic surfaces. Color selected by Architect.
 - 6. Covers: Covers such as manholes, vaults and the like will be furnished with finishes which resist corrosion and rust.

3.11 ACCESS PANELS

- A. Confirm Access Panel requirements in Division 01, General Requirements. In absence of specific requirements, comply with individual Division 27, Communications Sections and the following:
 - 1. Provide access panels for access to concealed equipment, junction boxes and controls. Quantity and location of access panels is the responsibility of the contractor to coordinate with as-built conditions and may not be indicated on Drawings. Submit proposed access panel layout to architect for confirmation of design intent.

3.12 ACCEPTANCE

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 27, Communications Sections and the following:
 - 1. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:
 - a. Testing Reports
 - b. Cleaning
 - c. Operation and Maintenance Manuals
 - d. Training of Operating Personnel
 - e. Record Drawings
 - f. Warranty and Guaranty Certificates, including extended manufacturer's warranties.
 - g. Start-up/test Documents and Commissioning Reports

3.13 FIELD QUALITY CONTROL

- A. Confirm Field Quality Control requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 27 00 00, Communications Basic Requirements and individual Division 27, Communications Sections.
- B. Tests:
 - 1. Conduct tests of equipment and systems to demonstrate compliance with requirements specified. Reference individual Specification Sections for required tests. Document tests and include in Operation and Maintenance Manuals.
 - 2. During site evaluations by Architect or Engineer, provide appropriate personnel with tools to remove and replace trims, covers, and devices so that proper evaluation of installation can be performed.

3.14 LETTER OF CONFORMANCE

- A. Provide Letter of Conformance, copies of manufacturers' warranties and extended warranties with a statement that Communications items were installed in accordance with manufacturer's recommendations, UL listings and FM Global approvals. Include Letter of Conformance, copies of manufacturers' warranties and extended warranties in Operation and Maintenance Manuals.

END OF SECTION

SECTION 27 05 28
PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Raceway
 - 2. Rigid Metal Conduit and Fittings
 - 3. Electrical Metallic Tubing and Fittings
 - 4. Conduit Accessories
 - 5. Penetration Sealing Systems
 - 6. Telecommunications Outlet Boxes
 - 7. Innerduct
 - 8. Innerduct Fittings
 - 9. Wire Basket Runway
 - 10. J-Hooks
- B. This Section specifies the requirements to provide communications conduit raceways, boxes, cable trays, innerduct and fittings.

1.02 RELATED SECTIONS

- A. Contents of Division 27, Communications and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 27 00 00, Communications Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

- A. Submittals as required by Section 27 00 00, Communications Basic Requirements and Division 01, General Requirements.
- B. Provide plan drawings showing completions and as-built corrections which indicate type, size, placement, routing and/or length for raceway and cable tray components; e.g., manholes, handholes, conduit, boxes, enclosures, etc.

1.05 QUALITY ASSURANCE

- A. Quality assurance as required by Section 27 00 00, Communications Basic Requirements and Division 01, General Requirements.

1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 27 00 00, Communications Basic Requirements and Division 01, General Requirements.

1.07 DEFINITIONS

- A. Conduit: Round raceway.
- B. Conduit Body: Separate portion of a conduit or tubing system that provides access through removable cover(s) to the interior of the system at a junction of two or more sections of the system or at a terminal point of the system.
- C. Pull Box Enclosure: Box with a cover installed in one or more runs of raceway to facilitate pulling conductors through the raceway system. There are no openings in the cover.

- D. Raceway: Enclosed channel designed expressly for holding wires or cables. Metal or insulating material and the term includes conduit, tubing, wireways, underfloor raceways and surface raceways; does not include cable tray.
- E. Wire Basket Runway Systems: Includes, but are not limited to straight sections of type wire basket runway cable trays, bends, tees, elbows, drop-outs, supports and accessories.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Raceway:
 - 1. Koppers Bitumastic
 - 2. Scotchwrap
 - 3. Or approved equivalent.
- B. Rigid Metal Conduit and Fittings:
 - 1. Sealing Fittings:
 - a. Crouse-Hinds
 - b. Or approved equivalent.
- C. Electrical Metallic Tubing and Fittings:
 - 1. Allied Tube and Conduit
 - 2. Or approved equivalent.
- D. Conduit Accessories:
 - 1. Duct Spacers:
 - a. Carlon
 - b. Or approved equivalent.
 - 2. Expansion/Deflection Fittings:
 - a. Appleton
 - b. Or approved equivalent.
 - 3. Pulltape:
 - a. George-Ingraham
 - b. Or approved equivalent.
 - 4. Duct Plugs:
 - a. Carlon
 - b. Or approved equivalent.
- E. Penetration Sealing Systems:
 - 1. SEMCO
 - 2. Or approved equivalent.
- F. Telecommunications Outlet Boxes:
 - 1. Raco
 - 2. Or approved equivalent.
- G. Innerduct:
 - 1. Carlon
 - 2. Or approved equivalent.
- H. Innerduct Fittings:

1. Carlon
2. Or approved equivalent.
- I. Wire Basket Runway:
 1. Cablofil
 2. Or approved equivalent.
- J. J-Hooks:
 1. Erico
 2. Or approved equivalent.

2.02 RACEWAYS

- A. Raceways: Labeled and/or listed as acceptable to the AHJ as suitable for the use intended.
- B. Table 1: Product Identification:

Product Designation	Product Type
RGS	Rigid Galvanized Steel
EMT	Galvanized Steel Tubing
PVC	Polyvinylchloride Conduit

- C. The product identification codes used for the Communications Raceways and Boxes in Part 2, Products, are summarized in Table 1.
- D. Bitumastic material or plastic tape.

2.03 RIGID METAL CONDUIT AND FITTINGS

- A. Conduit: Type RGS - rigid galvanized steel.
- B. Fittings and Conduit Bodies: In-line straight-through, threaded, galvanized steel fittings and Type C conduit bodies only; do not use bends or tees, e.g., Lbs.
 1. Bonding and Grounding Locknuts and Wedges: Malleable iron with set screws and lug screws.
 2. Insulated Bushing: Malleable iron with integral insulated throat, rated for 150C.
 3. Bonding and Grounding Bushing: Malleable iron with integral insulated throat, rated for 150C, with solderless lugs or lug screws.
 4. Sealing Fittings: Threaded type conduit seal fittings and sealing compound suitable for hazardous location installations in accordance with NEC:
 - a. Crouse-Hind retrofit sealing fitting EYSR.
 - b. Crouse-Hind CHICO A sealing compound.

2.04 ELECTRICAL METALLIC TUBING AND FITTINGS

- A. Type EMT: Electrogalvanized steel tubing.
- B. Fittings and Conduit Bodies:
 1. In-line straight-through steel or malleable iron fittings and Type C conduit bodies only; do not use bends or tees, e.g. Lbs.
 2. Wet Areas: Steel compression-type couplings and nipples.
 3. Dry Areas: Set screw-type couplings and nipples.
 4. Bonding Locknuts:
 - a. Malleable iron with set screws and lug screws.
 - b. Insulated Bushing: Malleable iron with integral insulated throat, rated for 150C.

- c. Bonding and Grounding Bushing: Malleable iron with integral insulated throat, rated for 150C, with solderless lugs or lug screws.

2.05 CONDUIT ACCESSORIES

- A. Duct Spacers:
 - 1. Nonmetallic base and intermediate duct spacers with locking keyways designed specifically for use with nonmetallic conduit; e.g., Carlon SNAP-LOC duct spacers for 4-inch diameter conduit with 1-1/2-inch separation.
 - 2. Base Spacer: S288NHN.
 - 3. Intermediate Spacer: S289NHN.
- B. Expansion/Deflection Fittings: Similar to Crouse-Hinds XD expansion/deflection coupling or Appleton DF Series deflection and expansion coupling.
- C. Pulltape: Measuring and pulling tape constructed of synthetic fiber with plastic jacket, printed with accurate sequential footage marks; e.g., George-Ingraham 1/2-inch tape 9216-JK.
- D. Duct Plugs:
 - 1. Aboveground Conduit Openings: Tapered PVC plugs with tab for pulltape; e.g., Carlon 4-inch PVC plugs with pull tab, P258NT.
 - 2. Underground or Underslab Conduit Openings: Removable screwtight compression type duct plugs with wing-nut and corrosion resistant hardware; e.g. Vikimatic 4-inch, Part Number 40D402U. Use appropriate part number according to duct size.

2.06 PENETRATION SEALING SYSTEMS

- A. Firestopping: Provide fire barrier penetration sealing materials as specified in Division 07, Firestopping Section.
- B. Duct Water Seal: Products suitable for closing underground and entrance duct openings, where innerduct or cable is installed, to prevent entry of gases, liquids, or rodents into the structure; e.g., SEMCO PR 851.

2.07 TELECOMMUNICATIONS OUTLET BOXES

- A. Sheet Metal Outlet Boxes: Minimum 4-inch square by 2-1/8-inch deep, galvanized steel for use with single-gang plaster rings.
- B. Nonmetallic Outlet Boxes: Minimum 4-inch square by 2-1/2-inch-deep. Provide gasketed, watertight single-gang cover.
- C. Cast Boxes: 4-inch square by 2-1/8-inch deep cast Feralloy, gasketed single-gang cover, threaded hubs.
- D. Floor Boxes for Installation in Cast-In-Place Concrete Floors: Flush mounted and fully adjustable formed steel as shown on the Drawings. Floor boxes provided by Division 26, Electrical.

2.08 INNERDUCT

- A. Outdoor Innerduct: 1-inch inside diameter corrugated, ribbed, or smooth walled, semi rigid PVC or heavy-wall polyethylene tubing.
- B. Indoor Innerduct: 1-inch inside diameter corrugated, ribbed, or smooth walled, semi rigid nonflammable PVC tubing, which meets UL94V-O vertical flame test for general applications.
- C. Plenum-Listed Indoor Innerduct: 1-inch inside diameter corrugated walled innerduct for use in plenum air handling spaces.

2.09 INNERDUCT FITTINGS

- A. Couplings: Metallic or nonmetallic quick-connect, reverse threaded and Schedule 40 couplings for connecting sections of installed innerduct.
- B. Innerduct Caps: Removable push-in caps for plugging 1-inch innerduct.

2.10 WIRE BASKET RUNWAY

- A. Tray sizes have 4-inch side height.
- B. Supply straight sections in standard 120-inches, except where shorter lengths are permitted to facilitate tray assembly lengths as shown on Drawings.
- C. Tray Widths: 12-inches or 18-inches.
- D. Make splice plates the fast splice type as indicated below for each tray type.
 - 1. Make splice plates of yellow zinc dichromate steel.
 - 2. Furnish splice plates with straight sections and fittings as required by manufacturer.
 - 3. Finish: Electro zinc.
- E. Wire Basket Runway Supports: Trapeze style supports.
- F. Materials and Finish: Continuous steel welded and formed wire mesh, electro zinc finish.
- G. Loading Capacities: Wire basket runways to meet NEMA Class Designations.
- H. Manufacturers: Subject to compliance with these Specifications, install wire basket runway.
- I. Wire basket tray to be white in color with a solid bottom tray insert white in color.

2.11 J-HOOKS

- A. Constructed of galvanized steel, stainless steel or hot dipped zinc.
- B. Wires or all-thread supports mounted to structure.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

- A. Workmanship:
 - 1. Provide, condition, apply, install, connect and test manufactured products, materials, equipment and components in accordance with the manufacturer's specifications and printed instructions.
 - 2. The installation of system components to be carried out under the direction of qualified personnel. Appearance to be considered as important as mechanical and electrical efficiency. Workmanship to meet or exceed industry standards.
 - 3. Place support for raceways, cable trays, backboards, equipment racks and cabinets.
- B. Protection During Construction: Protect products from the effects of moisture, corrosion and physical damage during construction. Except during installation activity in a section, keep openings in conduit, tubing and wireway capped with manufactured seals during construction.
- C. Concrete Sleeves: Conduits routed perpendicular through floors, walls, or other concrete structures to pass through cast-in-place conduit sleeve openings wherever possible, or appropriate size holes to be bored to accommodate the installation of conduit sleeves. The size and location of the holes to not impair the structure's integrity.
 - 1. Concrete Boring: Bore a hole in the concrete with a diameter of 1/2 to 1-inch larger than the conduit sleeve to be installed. Grout around the conduit sleeve and finish to match existing surroundings.
 - 2. Conduits that rise vertically through a slab to be stubbed 6-inches above the floor and capped pending future use.
- D. Drywall/Gypsum Board Sleeves: Install insulating throat bushings on both ends of conduit sleeves placed in fire-rated walls using drywall construction.
- E. Where conduit enters a structure through a concrete roof or membrane waterproofed wall or floor:
 - 1. Provide a watertight seal.

2. With Concrete Encasement: Install watertight entrance seal device on the accessible side.
 3. Securely anchor malleable iron body of watertight entrance seal device into construction with one or more integral flanges.
 4. Secure membrane waterproofing to watertight entrance seal device in a permanent, watertight manner.
- F. Provide continuous sleeving through walls, floors and ceilings separating each telecom outlet from its respective MER/TR room, using sleeve conduit size as required per Standards. Restore penetrations through rated assemblies to original fire rating per NFPA and local codes.
- G. Locate sleeves as shown on Drawings. Where sleeves are not shown on Drawings, install sleeves above suspended ceilings and locate to minimize length of pathway for future cable from telecom outlet to MER/TR rooms.
- H. Where sleeves are routed between rooms with floating ceilings, extend conduits horizontally 2-feet over edge of floating ceiling to avoid exposed cabling from being seen at floor level.
- I. Make floor penetrations no more than 4-inches from wall. Install conduit stubs to extend 4-inches from floor base. Cap conduits for protection.
- J. Provide removable heat-expanding pillows at fire barrier penetrations as specified in Firestopping section and described as Firestop Material Type 7 (indicated as FSM-7).
- K. Grounding: Provide ground connections and bonding continuity between raceway and wire basket runway sections, boxes, enclosures, cabinets and fittings as required per code and industry standard.
- L. Provide plenum rated products, components and accessories for installation in plenums.

3.02 RACEWAYS

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's written instructions and recommendations.

3.03 RIGID METAL CONDUIT AND FITTINGS

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's written instructions and recommendations.

3.04 ELECTRICAL METALLIC TUBING AND FITTINGS

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's written instructions and recommendations.
- C. Minimum Backbone Conduit Requirements: Install three 4-inch conduits from MER to each TR, unless otherwise noted on Drawings.
- D. Conduit Type:
1. Install the following types of circular communications raceway in the locations listed unless otherwise indicated on the Drawings.
 - a. Interior Dry Locations, Exposed: EMT with set screw fittings.
 - b. Interior Dry Locations, Concealed (Not Embedded in Concrete): EMT with set screw fittings.
 - c. Interior Wet Locations: EMT with compression fittings.
- E. Conduit Bends and Sweeps:
1. Make changes in direction of communications conduit runs with sweeps of the longest possible radius.
 2. Make sweeps in parallel or banked runs of conduits, 2-inches and larger in diameter, from the same center or centerline so that sweeps are parallel and of neat appearance.
 3. Field-Made Bends and Sweeps:

- a. Use an acceptable hickey or conduit-bending machine.
 - b. Do not heat metal raceways to facilitate bending.
 - c. Before installing 4-inch field-made sweeps in duct banks, pull a 3-1/2-inch diameter by 12-inch long mandrel through duct sections to verify circularity and sweep radius.
4. The angular sum of the bends between pull points and/or pull boxes to not exceed 180 degrees.
5. Minimum Inside Bend Radius for Communications Conduit Bends, Sweeps, Boxes and Fittings:
 - a. One-inch conduit, 11-inches
 - b. Two-inch conduit, 21-inches
 - c. Three-inch conduit, 36-inches
 - d. Four-inch conduit, 48-inches
 - e. Other sizes, 10 times the inside diameter of the conduit.
6. Do not install boxes, bends, elbows, tees, conduit bodies and other conduit fittings, which do not provide for the minimum inside cable bend radius specified in paragraph E above.
 - a. Conduit Bodies: In-line straight-through Type C conduit fittings can be used as pull boxes for conduit up to a maximum of 2-inches ID. Other conduit fittings, which include direction changes such as E, L, LB, LR, LL, LRT, TA, TB and X, are not allowed.
 - b. Refer design or installation conflicts with these requirements to the Architect.

3.05 CONDUIT ACCESSORIES

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's written instructions and recommendations.
- C. Duct Spacers: Install per manufacturer's recommendation.
- D. Expansion/Deflection Fittings: Install per manufacturer's recommendation.
- E. Pulltape: Install per manufacturer's recommendation.
- F. Duct Plugs: Install per manufacturer's recommendation.

3.06 PENETRATION SEALING SYSTEMS

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's written instructions and recommendations.
- C. Seal conduit entering structures at the first box or outlet to prevent the entrance of gases, liquids, or rodents into the structure.
 1. Empty Conduits: Removable screwtight duct plugs.
 2. Innerduct Installed: Suitable duct water seal between conduit and innerduct. Manufactured seals in empty innerduct.
 3. Cable Installed: Suitable duct water seal between conduit and cable, or between innerduct and cable.

3.07 TELECOMMUNICATIONS OUTLET BOXES

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's written instructions and recommendations.
- C. Provide 4-inch by 4-inch by 2-1/8-inch deep outlet boxes for mounting telecommunications outlets with single-gang plaster rings as required, or as indicated on the Drawings.
- D. Do not install outlet boxes back to back in walls. Provide minimum 6-inch separation, except provide minimum 24-inch separation in acoustic-rated walls.

- E. Locate outlet boxes in masonry walls to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat openings for outlet boxes. Use boxes with sufficient depth to permit conduit hubs to be located in masonry void spaces.
- F. Provide knockout closures for unused openings.
- G. Support telecommunications outlet boxes independently of conduit.
- H. Use multiple-gang boxes where more than one device is mounted together; do not use sectional outlet boxes.
- I. Install outlet boxes in walls without damaging wall insulation.
- J. Coordinate mounting heights and locations of outlet boxes mounted above counters, benches and backsplashes.
- K. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. Use stamped steel stud bridges for flush outlet boxes in hollow stud wall.
- L. Provide cast outlet boxes in exterior and wet locations.

3.08 INNERDUCT

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's written instructions and recommendations.
- C. Innerduct Type:
 - 1. Underslab and Underground Conduit Installation: Outdoor innerduct.
 - 2. Aboveground and Interior Conduit Installations: Indoor innerduct.
 - 3. Interior Exposed Locations Including Cable Tray Installations:
 - a. Nonplenum Areas: Indoor innerduct.
 - b. Plenum Areas: Plenum-listed innerduct.
- D. Provide innerduct for all fiber optic cables for the entire length of the cable run.
- E. Pull innerduct through conduit or place innerduct in cable trays using continuous unspliced lengths of innerduct between pull boxes and/or section termination points as indicated on the Drawings.
- F. Cut innerduct square. Deburr cut ends.
- G. Bring innerduct to the shoulder of fittings and couplings and fasten securely.
- H. Wipe innerduct and fittings clean and dry before joining. Apply full, even coat of cement to entire area that will be inserted into fitting. Let joint cure for 20 minutes minimum.
- I. Provide suitable innerduct slack in pull boxes and at turns to ensure that there is no kinking or binding of the tubing.
- J. Make changes in direction of communications innerduct runs with sweeps of the longest possible radius and at least 10 times the inside diameter of the innerduct.
- K. During innerduct pulling, avoid excessive tension which can damage the innerduct. Inspect innerduct following placement and replace damaged sections.
- L. Indoor Conduit Installation:
 - 1. Arrange innerduct neatly, cut to proper length and remove surplus. Provide trained and bundled innerduct pigtails extending at least 18-inches beyond exposed conduit openings.
 - 2. At locations where the ends of innerduct sections appear in a pull box, join the pulltape and then splice innerduct sections together using couplers which do not reduce the inside diameter of the innerduct.
- M. Cable Tray Installation: Tie wrap innerduct to one side of vertical ladder rack every 2-feet minimum and to one side of horizontal ladder-type cable tray every 5-feet minimum.

- N. Following installation, visually inspect innerduct, remove burrs at openings and, if necessary, clean innerduct interior.
- O. Innerduct Pull Tape and Duct Plug Installation:
 - 1. Following innerduct installation, install pulltape (muletape) with preprinted foot markers in innerduct sections. Tie the pulltape securely at each end.
 - 2. Verify lengths at the time of installation and provide as-built documentation.
 - 3. Following innerduct and pulltape installation, cap or plug innerduct with manufactured seals to prevent moisture or foreign matter from entering until cable installation starts. Seal duct openings in underground or underslab innerduct sections immediately after installation using screwtight, removable, watertight and dust-tight duct plugs.

3.09 INNERDUCT FITTINGS

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's written instructions and recommendations.
- C. Wipe fittings clean and dry before joining. Apply full, even coat of cement to entire area that will be inserted into the fitting. Allow joints/assembly to cure for 20 minutes, minimum.
- D. Install per manufacturer's recommendations.

3.10 WIRE BASKET RUNWAY

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's written instructions and recommendations.
- C. Cut standard straight sections of materials to length in the field.
- D. Deburr and file rough edges and cut sections.
- E. Locations shown on the Drawings are approximate unless dimensioned.
- F. Install as shown on the Drawings and securely attach under the provisions of this section.
- G. Entire length of wire basket runway to be accessible.
- H. Maintain minimum 6-inch clearance between cable tray and piping. Locate a minimum of 12-inches away from heat sources such as parallel runs of flues, steam or hot water pipes and heating appliances.
- I. Run exposed and concealed cable tray parallel or perpendicular to walls, structural members, or intersections of vertical planes to maintain headroom and provide a neat appearance.
- J. Do not obstruct passageways.
- K. Route wire basket runway within the assigned communications utility space.
- L. Install appropriate cable tray bends, dropouts and other accessories to protect minimum cable bend radius and provide adequate support at locations where cable direction changes occur.
- M. Cable tray to be installed a minimum of 12-inches above the accessible ceiling.

3.11 J-HOOKS

- A. Install J-hooks rated for Category 6 and Category 6A cable for support of cabling from the wire basket tray to the outlet location.
- B. J-hooks are to be installed on dedicated wires or all thread rods mounted to structure. J-hooks are not to attach to ceiling grid wires.

END OF SECTION

SECTION 27 11 01
COMMUNICATION EQUIPMENT ROOMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Telecommunications Backboards
 - 2. Equipment Racks
 - 3. Vertical Wire Managers
 - 4. Horizontal Wire Managers
 - 5. Telecommunications Grounding
 - 6. Ladder Rack Cable Runway
- B. The telecommunications equipment room is intended to house racks and equipment necessary for the support of the voice and data cabling infrastructure as well as other low-voltage systems.

1.02 RELATED SECTIONS

- A. Contents of Division 27, Communications and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 27 00 00, Communications Basic Requirements and Division 01, General Requirements.
- B. Use this Section in conjunction with the other Division 27, Communications Sections and related Contract Documents to establish the total general requirements for the project technology systems and equipment.

1.04 SUBMITTALS

- A. Submittals as required by Section 27 00 00, Communications Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Procedures for cable labeling and identification, long term documentation methods and numbering scheme in accordance with ANSI/TIA/EIA- 606-A.
 - 2. A copy of certified installer certificates and warranty certificates for products proposed.

1.05 QUALITY ASSURANCE

- A. Quality assurance as required by Section 27 00 00, Communications Basic Requirements and Division 01, General Requirements.

1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 27 00 00, Communications Basic Requirements and Division 01, General Requirements.

1.07 SYSTEM DESCRIPTION

- A. The communications room distribution subsystem refers to the passive components used to terminate cabling subsystems and distribute technology services. This subsystem includes but is not limited to installations in the Main Equipment Room (MER), Telecommunications Rooms (TR) and Entrance Facility (EF).

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Telecommunications Backboards:

1. Reference 2.02A for requirements.
2. Or approved equivalent.
- B. Equipment Racks: Chatsworth; Model 55053-703.
- C. Vertical Wire Managers: Chatsworth; Model 35522-703.
- D. Horizontal Wire Managers; 19-inches wide, two rack units high: Chatsworth; Model 35441-702.
- E. Telecommunications Grounding:
 1. Telecommunications Main Grounding Busbar (TMGB): Chatsworth; Model 40153-020.
 2. Telecommunications Grounding Busbar (TGB): Chatsworth; Model 13622-010.
 3. Telecommunications Ground Accessories:
 - a. One Hole Ground Terminal Block: Chatsworth; Model 08009-001.
 - b. Two Hole Ground Terminal Block: Chatsworth; Model 40167-001.
 - c. Two Hole Grounding Lug: Chatsworth.
 - d. Cable Runway Ground Strap Kit: Chatsworth; Model 40164-001.
- F. Ladder Rack Cable Runway:
 1. Cable Runway: Chatsworth; Model 11275-712.
 2. Runway Wall Angle Support: Chatsworth; Model 11421-712.
 3. Runway to Rack Mounting Bracket: Chatsworth; Model 10595-712.
 4. Cable Runway Junction-Splice Kit: Chatsworth; Model 16302-701.
 5. Cable Runway Butt-Splice Kit: Chatsworth; Model 16301-701.
 6. Cable Runway Triangle Support Bracket: Chatsworth; Model 11312-712.
 7. Cable Runway Radius Drop: Chatsworth; Model 12100-712.
 8. Cable Runway Radius (Stringer): Chatsworth; Model 12101-701.
 9. Cable Runway Foot Kit: Chatsworth; Model 11309-701.

2.02 TELECOMMUNICATIONS BACKBOARDS

- A. 3/4-inch minimum thickness, A/C grade or better, void-free plywood, fire treated backboard.

2.03 EQUIPMENT RACKS

- A. 7-foot high, 19-inches wide, EIA free-standing rack, UL listed, black finish.

2.04 VERTICAL WIRE MANAGERS

- A. 7-feet high, 8-inches wide, 12-inches deep with front and rear doors and horizontal managers built in, black finish.

2.05 HORIZONTAL WIRE MANAGERS

- A. 19-inches wide, two rack units high.

2.06 TELECOMMUNICATIONS GROUNDING

- A. Telecommunications Main Grounding Busbar (TMGB): Solid copper busbar kit, 20-inches long, 1/4-inch thick, wall mounted with standoffs.
- B. Telecommunications Grounding Busbar (TGB): Solid copper busbar kit, 10-inches long, 1/4-inch thick, wall-mounted with standoffs.
- C. Telecommunications Ground Accessories:
 1. One hole ground terminal block, holds two wires up to size #4.
 2. Two hole ground terminal block, holds two wires up to size 2/0.
 3. Two hole grounding lug.

4. Cable runway ground strap kit.

2.07 LADDER RACK CABLE RUNWAY

- A. Cable Runway: 12-inches wide, 10-foot lengths, steel construction.
- B. Runway wall angle support.
- C. Runway to rack mounting bracket.
- D. Cable runway junction-splice kit.
- E. Cable runway butt-splice kit.
- F. Cable runway triangle support bracket.
- G. Cable runway radius drop.
- H. Cable runway radius (stringer).
- I. Cable runway foot kit.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

- A. Provide all components of the telecommunications system from a single manufacturer.
- B. Make floor penetrations no more than 4-inches from wall. Install conduit stubs to extend 4-inches from floor base. Cap conduits for protection.
- C. Seismic installations require additional bracing of cabinets and overhead cable runways to building structure, as advised by and certified by a licensed structural engineer.
- D. Ladder Rack Cable Tray:
 1. Provide cable tray as shown in drawing package. The locations shown may need to be adjusted slightly in the field to assure proper placement.
 2. Field cut to length tray Sections with a minimum number of splice points. Make field cuts using the manufacturers recommended equipment.
 3. Deburr and file rough edges on cable tray.
 4. Provide seismic bracing for installed cable trays.
- E. Labeling:
 1. Label racks with the equipment room number and a unique identifier beginning with the telecom room number and the number one, i.e. TR1-1.
 2. Label the telecommunications grounding busbar and bonding conductor with the equipment room number and a unique identifier, beginning with the number one, i.e. TGB-SVR1. The designation for the Telecommunications Main Ground Busbar begins with TMGB.
 3. Submit labeling schemes to the Architect for approval prior to testing and labeling.

3.02 TELECOMMUNICATIONS BACKBOARDS

- A. Mount plywood backboard vertically, 4-inches from floor, all walls covered within each telecommunications space.
- B. Mount backboards with the smooth "A" surface facing away from the wall. Paint the backboard with two coats of fire resistant paint prior to mounting.
- C. Install boards plumb, level and secured to studs or solid concrete or masonry walls. Use a minimum of six appropriate fasteners for every 16 SF of backboard. Anchors for attaching equipment boards include:
 1. Material/Substrate: Anchor type.
 2. Concrete/Masonry: Expansion anchors; wedge type with washer located on the backside of the board.
 3. Gypsum Wallboard: Togglebolts; use pan head type.

- D. Powder drive anchors, molly bolts and tappets are not allowed.

3.03 EQUIPMENT RACKS

- A. Fasten free-standing equipment racks to the telecom room floor using a minimum of four 1/2-inch concrete anchors.
- B. Position equipment racks according to drawings with a minimum of 3-feet of clearance in front and back. Field verify the dimensions of the room prior to installation of racks and report any discrepancies to the Architect.
- C. Provide proper seismic bracing and wire management from backboard to freestanding equipment rack, per IBC.

3.04 VERTICAL WIRE MANAGERS

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.
- C. Bolt vertical wire managers for free-standing equipment racks to the side of the rack using manufacturer's recommended hardware.

3.05 HORIZONTAL WIRE MANAGERS

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.

3.06 TELECOMMUNICATIONS GROUNDING

- A. Bond equipment racks and ladder racking to each equipment room TGB (one per equipment room minimum) with #6 AWG or larger, stranded copper conductor.
- B. Connect each TMGB and TGB to the main electrical main distribution panel and building steel using a 3/0 AWG or larger, stranded copper conductor. Coordinate exact routing and connection points with the electrical contractor.
- C. Two hole lugs are required on all ground cable connecting to the TMGB and TGB.

3.07 LADDER RACK CABLE RUNWAY

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.

END OF SECTION

SECTION 27 13 00
COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

1.01 SUMMARY

- A. Work included:
 - 1. Copper Backbone Cable
 - 2. Fiber Optic Backbone Cable
 - 3. Copper Termination Hardware
 - 4. Fiber Optic Termination Hardware
 - 5. Fiber Patch Cords

1.02 RELATED SECTIONS

- A. Contents of Division 27, Communications and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 27 00 00, Communications Basic Requirements and Division 01, General Requirements.
- B. Meet requirements of NFPA 780, Standards for Installation of Lightning Protection Systems.

1.04 SUBMITTALS

- A. Submittals as required by Section 27 00 00, Communications Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Procedures for cable labeling and identification, long term documentation methods and numbering scheme in accordance with ANSI/TIA/EIA- 606-A.
 - 2. A copy of certified installer certificates and warranty certificates for products proposed.

1.05 QUALITY ASSURANCE

- A. Quality assurance as required by Section 27 00 00, Communications Basic Requirements and Division 01, General Requirements.
- B. Manufacturers to have a recognized certified installer program in place for system components proposed. Cable will be approved with manufacturer system installed.

1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 27 00 00, Communications Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Labor, materials and documentation according to selected manufacturer requirements necessary to ensure that the Owner will be furnished with an Extended Product Warranty and Application Assurance of a minimum of 20 years in length. The Application Assurance Warranty will cover the failure of the wiring system to support current or future applications that are designed for the link/channel specifications of ANSI/TIA/EIA-568-C.
 - 2. Provide a warranty on the physical installation.
 - 3. Furnish necessary documentation required by the manufacturer immediately following 100 percent testing of cables.
 - 4. Administer the warranty process with the responsible manufacturer's representative. Provide warranty directly to the Owner from the manufacturer. Ensure that the manufacturer provides the Owner with the appropriate warranty certification within 90 calendar days of the final project completion.

1.07 SYSTEM DESCRIPTION

- A. Provide a standards-based cable system to serve backbone communication systems requirements as specified in these specifications and shown on Drawings. Closely follow ANSI/TIA/EIA, IEEE and ISO standards which apply to backbone communication systems.
- B. Install backbone cables from the MDF to the IDF raceway systems as shown on Drawings.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Copper Backbone Cable: Berk-Tek
- B. Fiber Optic Backbone Cable: Berk-Tek
- C. Copper Termination Hardware: Leviton.
- D. Fiber Optic Termination Hardware: Leviton.
- E. Fiber Patch Cords: Leviton.

2.02 COPPER BACKBONE CABLE

- A. Intrabuilding Distribution, Without Overall Shield: 100 ohm, CAT 3, 24 AWG, multi-pair cable.
 - 1. Riser rated, CMR rated jacket.
 - 2. Plenum rated, CMP rated jacket.

2.03 FIBER OPTIC BACKBONE CABLE

- A. Intrabuilding Multimode Riser: 12 strand, 50/125 micron, laser optimized distribution cable with maximum attenuation of 3.5 dB/km at 850 nm and 1.5 dB/km at 1300 nm. Minimum bandwidth is 2000 MHz-km at 850 nm and 500 MHz-km at 1300 nm. OFNR rated.
- B. Intrabuilding Multimode Plenum: 12 strand, 50/125 micron, laser optimized distribution cable with maximum attenuation of 3.5 dB/km at 850 nm and 1.5 dB/km at 1300 nm. Minimum bandwidth is 2000 MHz-km at 850 nm and 500 MHz-km at 1300 nm. OFNP rated.

2.04 COPPER TERMINATION HARDWARE

- A. Category 5e Modular Patch Panels: 24 port, 8-position modular jack panel, high density, 6 port modules, Enhanced Category 5e, IDC terminals, T568A/B wiring scheme.

2.05 FIBER OPTIC TERMINATION HARDWARE

- A. Fiber Termination Shelf:
 - 1. 3.5-inch high shelf designed for mounting in 19-inch equipment racks and capable of accepting 6 adapter panels. The shelf will contain built-in slack management and be accessible from the front or rear with locking doors.
 - a. 19-inch rack mount, 19-inches deep.
 - 2. Fiber Adapter Panels: Adapter panel for high density termination shelf with 6 LC multimode phosphor-bronze alignment sleeves.
- B. Multimode LC Connector: Ceramic tip LC style capable of being terminated on 50/125 fiber with 900 micron buffer.

2.06 FIBER PATCH CORDS

- A. Multimode Fiber Optic Jumpers: Factory terminated double ended, two strand multimode cordage with LC connectors on each end, length as defined by the Owner.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

- A. Miscellaneous Hardware: Provide supporting hardware, cable ties, labels, pull rope and other miscellaneous hardware for a complete and operable system.

- B. Provide like items from one manufacturer, such as cable, patch panels, connectors, and equipment connection cords.
- C. Communications Backbone Cabling includes cables, connectors, patch panels and patch cords, as well as the necessary support systems, such as cable managers, tie wraps and D-rings.
- D. Furnish and install materials necessary for a complete and working system.
- E. Contractor must be a Certified Installer for selected manufacturer prior to, during and through completion of the system installation and must be able to provide the manufacturer's extended warranty.
- F. Perform work in a neat and workmanlike manner.
- G. Firestopping: Install all firestop systems in accordance with manufacturer's recommendations. Firestop systems to be completely installed and available for inspection by local inspection authorities prior to cable system acceptance.
- H. Install cable after interior of building has been physically protected from the weather and mechanical work likely to damage cabling has been completed.
- I. Before installing cabling, ensure cable pathways are completely and thoroughly cleaned:
 - 1. Inspect conduit, wireway, cable trays and innerduct systems prior to installation.
 - 2. Swab any additional enclosed raceway and innerduct systems.
- J. Provide protection for exposed cables where subject to damage. Provide abrasion protection for any cable or wire bundles, which pass through holes or across edges of sheet metal.
- K. Install cable ties and other cable management clamps via hand so they fit snugly. Do not over tighten or use mechanical tools which could compress, crimp, or otherwise change the physical characteristics of the cable jacket or distort the placement of twisted-pair components. Replace any cable exhibiting stresses due to over tightening of cable management devices.
- L. Where possible, route cables in overhead cable trays and inside wire management systems attached to the equipment cabinets and racks. Use Velcro ties or ducts to restrain cabling installed outside of wire management systems on racks or in cabinets.
- M. Limit cable raceway fill to less than the TIA/EIA-569-B maximum fill for the particular raceway type.
- N. If a J-hook or trapeze system is used to support cable bundles, support cables at a maximum of 48 to 60-inch intervals. Cables are prohibited to rest on acoustic ceiling grids or panels.
- O. Install cable above fire-sprinkler systems and ensure the cable does not attach to the system or any ancillary equipment or hardware. Install cable system and support hardware so it does not obscure any valves, fire alarm conduit, boxes, or other control devices.
- P. Do not attach cables to ceiling grid or lighting fixture wires. Where support for cable is required, install appropriate carriers to support the cabling.
- Q. Any cable damaged or exceeding recommended installation parameters during installation will be replaced by the contractor prior to final acceptance at no cost to the Owner.
- R. Unshielded Twisted Pair Cable Installation Practices:
 - 1. Install cable in accordance with manufacturer's recommendations and best industry practices.
 - 2. Do not exceed the cable's minimum bend radius and maximum pulling tension.
 - 3. Install unshielded twisted pair cable so there are no bends smaller than four times the cable outside diameter at any point in the run and at the termination field.
- S. Provide the following minimum separation distances between pathways for copper communications cables and power wiring of 480 volts or less:
 - 1. Open or Nonmetal Communications Pathways:

- a. 12-inches from electric motors, fluorescent light fixtures and unshielded power lines carrying up to 3 kVA.
 - b. 36-inches from electrical equipment and unshielded power lines carrying more than 5 kVA.
 - c. 48-inches from large electrical motors or transformers.
2. Grounded Metal Conduit Communications Pathways:
 - a. 2-1/2-inches from electrical equipment and unshielded power lines carrying up to 2 kVA.
 - b. 6-inches from electrical equipment and unshielded power lines carrying from 2 kVA to 5 kVA.
 - c. 12-inches from electrical equipment and unshielded power lines carrying more than 5 kVA.
 - d. 3-inches from power lines enclosed in a grounded metal conduit (or equivalent shielding) carrying from 2 kVA to 5 kVA.
 - e. 6-inches from power lines enclosed in a grounded metal conduit (or equivalent shielding) carrying more than 5 kVA.
- T. Determine requirements for plenum rated cable and devices. When doubt exists, seek prior determination in writing by AHJ.
- U. Seal conduits entering from outside the building and install listed firestop material in conduits and sleeves to satisfy NEC and local codes.
- V. Unshielded Twisted Pair Termination:
 1. Dress and terminate cables in accordance with the recommendations made in the ANSI/TIA/EIA-568-C.1 document, manufacturer's recommendations and best industry practices.
 2. Maintain the cable jacket within 1-inch of the termination point.
 3. Do not exceed 0.5-inch of pair untwist at the termination point.
 4. Do not exceed 4 times the outside diameter of the cable in the termination area for bend radiance compliance.
 5. Neatly bundle and dress cables to their respective panels or blocks. Feed each panel or block by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.
- W. Testing Procedures:
 1. Test cables and termination hardware for defects in installation and to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA/EIA-568-C. Verify pairs of each installed cable prior to system acceptance. Repair or replace any defect in the cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels and connector blocks in order to ensure 100 percent useable conductors in cables installed.
 2. Test cables in accordance with this document, the ANSI/TIA/EIA standards, the manufacturer's procedures and best industry practice. If any of these are in conflict, bring any discrepancies to the attention of the project team for clarification and resolution.
 3. Test Unshielded Twisted Pair cables as follows:
 - a. Test twisted-pair copper cable links for continuity, pair reversals, shorts, opens and performance as indicated below. Additional testing is required to verify Category performance. Test cabling using a Level IV test unit for Category 6 performance compliance as specified in ANSI/TIA/EIA-568-C.

- b. Continuity: Test each pair of each installed cable using a test unit that shows opens, shorts, polarity and pair-reversals, crossed pairs and split pairs. Test shielded/screened cables with a device that verifies shield continuity in addition to the above stated tests. Record the test as pass/fail as indicated by the test unit in accordance with the manufacturers' recommended procedures and referenced to the appropriate cable identification number and circuit or pair number. Correct or repair any faults in the wiring and re-test the cable prior to final acceptance.
 - c. Length: Test each installed cable link for installed length using a TDR type device. Test the cables from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length will conform to the maximum distances set forth in the ANSI/TIA/EIA-568-C standard. Record cable lengths, referencing the cable identification number and circuit or pair number. For multi-pair cables, record the shortest pair length as the length for the cable.
4. Follow the Standards requirements established in ANSI/TIA/EIA-568-C.
5. Perform testing with a Level IV tester The basic tests required are:
 - a. Wire Map
 - b. Length
 - c. Attenuation
6. Provide test results in electronic format, with the following minimum information per cable:
 - a. Circuit ID
 - b. Test result, "Pass" or "Fail"
 - c. Date and Time of test
 - d. Project Name
7. Fiber Test Documentation: Provide electronic CD disk and hard copy test reports from ANSI/TIA/EIA-526-14A Method B Standards. Calculate a "Loss Budget" for each cable length based on cable length and connectors. Provide as a minimum, OTDR test results in the form of a printed waveform and text table for both 850 nm and 1300 nm for multimode fiber and 1350 nm and 1510 nm for singlemode fiber. Test fibers and connector systems for end-to-end attenuation. Provide a power meter test on fiber optic strands at both wavelengths A to B, B to A and OSPL (OSPL is as defined as $L_a + L_b$). Include the results of unsatisfactory tests, with an explanation of how the problem was corrected. Clearly label connector and fiber loss on test waveforms.
8. Provide an electronic copy of the test results, in the native tester software format, to the Architect along with the printed test results.
9. Provide a fully functional version of the tester software for use by the Architect in reviewing the test results.

3.02 COPPER BACKBONE CABLE

- A. Install per manufacturer's instructions and recommendations.
- B. Reference 3.01, General Installation Requirements.
- C. Install backbone cables separately from horizontal distribution cables.
- D. Install a pull cord (nylon; 1/8-inch minimum) with cable installed in conduit.
- E. Where cables are installed in conduits, install the backbone and horizontal cables in separate conduits.
- F. Where cables are installed in an air-return plenum, install riser-rated cable in metallic conduit.
- G. Where backbone cables and distribution cables are installed in a cable tray, install backbone cables first, and bundle them separately from the horizontal distribution cables.
- H. Labeling:

1. Label cables using a machine printed label at each end of the cable at approximately 6-inches of the termination point. Do not use handwritten labels.
2. Labels to denote to and from with room names and numbers.
3. Provide the final cable ID matrix to the Architect for approval one week prior to cable installation.
4. Note labeling information on the As-Built Drawings.

3.03 FIBER OPTIC BACKBONE CABLE

- A. Install per manufacturer's instructions and recommendations.
- B. Reference 3.01, General Installation Requirements.
- C. Place fiber optic cable so as to maintain the minimum cable bend radius limits specified by the manufacturer or ten times the cable diameter, whichever is larger.
- D. Place fiber optic cable runs in innerduct. Use care when handling fiber optic cable. Carefully monitor pulling tension so as not to exceed the limits specified by the manufacturer.
- E. Terminate fiber optic cable in rack-mounted fiber optic termination units at each end using standard LC style bulkhead connectors.
- F. Splicing of fiber optic cable is prohibited.
- G. Labeling:
 1. Label cables using a machine printed label at each end of the cable at approximately 6-inches of the termination point. Do not use handwritten labels and fiber strand count.
 2. Labels to denote to and from with room names and numbers.
 3. Provide the final cable ID matrix to the Architect one week prior to cable installation.
 4. Note labeling information on the As-Built Drawings.

3.04 COPPER TERMINATION HARDWARE

- A. Install per manufacturer's instructions and recommendations.
- B. Reference 3.01, General Installation Requirements.
- C. Dress and terminate cables in accordance with the recommendations made in the ANSI/TIA/EIA-568-B standard, manufacturer's recommendations and best industry practices.
- D. Pair untwist at the termination is not to exceed 0.125-inch.
- E. Bend radius of the cable in the termination area is not to exceed four times the outside diameter of the cable.
- F. Dress cables to their respective panels or blocks. Feed each panel or block by an individual bundle, separated and dressed back to the point of cable entrance into the rack or frame.
- G. Maintain the cable jacket to the termination point.

3.05 FIBER OPTIC TERMINATION HARDWARE

- A. Install per manufacturer's instructions and recommendations.
- B. Reference 3.01, General Installation Requirements.
- C. Neatly coil fiber slack within the fiber space tray or enclosure.
- D. Individually attach each cable to its respective fiber enclosure by mechanical means. Securely attach the cable strength member to the cable strain-relief bracket in the enclosure.
- E. Clearly label each cable at the entrance to the enclosure. Cables labeled within the bundle will not be accepted.
- F. Install fiber distribution unit at the top of Rack #1.

3.06 FIBER PATCH CORDS

- A. Install per manufacturer's instructions and recommendations.
- B. Reference 3.01, General Installation Requirements.
- C. Provide sufficient duplex fiber optic patch cords at each fiber termination point to cross-connect one-half the number and type of fibers terminated there, Assume a minimum of two duplex fiber optic jumpers per termination point for a 6-strand optical fiber. Provide lengths for a neat appearance not to exceed 15-feet.
- D. Field terminated patch cords are not allowed.

END OF SECTION

SECTION 27 15 00
COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Station Cabling
 - 2. Modular Jacks
 - 3. Work Area Outlets
 - 4. Patch Panels
 - 5. Patch Cords

1.02 RELATED SECTIONS

- A. Contents of Division 27, Communications and Division 01, General Requirements apply to this Section.
- B. Use this Section in conjunction with other Division 27, Communications specifications and related Contract Documents to establish the total general requirements for the project communications systems and equipment.

1.03 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 27 00 00, Communications Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

- A. Submittals as required by Section 27 00 00, Communications Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Procedures for cable labeling and identification, long term documentation methods and numbering scheme in accordance with ANSI/TIA/EIA-606A.
 - 2. A copy of certified installer certificates and warranty certificates for products proposed.

1.05 QUALITY ASSURANCE

- A. Quality assurance as required by Section 27 00 00, Communications Basic Requirements and Division 01, General Requirements.
- B. Manufacturers to have a recognized certified installer program in place for system components proposed. Cable will be approved with manufacturer system installed.

1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 27 00 00, Communications Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Labor, materials and documentation according to selected manufacturer requirements necessary to ensure that the Owner will be furnished with an Extended Product Warranty and Application Assurance of a minimum of 20 years in length. The Application Assurance Warranty will cover the failure of the wiring system to support current or future applications that are designed for the link/channel specifications of ANSI/TIA/EIA-568-C.1. These applications include, but are not limited to, 10BASE-T, 100BASE-T, 1000BASE-T, 10GBASE-T and 155 Mb/s ATM.
 - 2. A warranty on the physical installation.
 - 3. Necessary documentation required by the manufacturer immediately following 100 percent testing of cables.

- C. Administer the warranty process with the responsible manufacturer's representative. Provide warranty directly to the Owner from the manufacturer. Ensure that the manufacturer provides the Owner with the appropriate warranty certification within 90 calendar days of the final project completion.

1.07 SYSTEM DESCRIPTION

- A. Provide a standards-based cable system to serve horizontal communication systems requirements as specified and as shown on Drawings. Closely follow ANSI/TIA/EIA, IEEE and ISO standards.
- B. The horizontal distribution subsystem refers to intrabuilding twisted-pair communications cabling connecting telecommunications rooms (TRs) to telecommunications outlets (TOs) located at individual work areas and consists of the following:
 - 1. Category 6 cables for work area outlets and Category 6A cables for wireless outlets.
 - 2. The horizontal system includes cables, jacks, patch panels and patch cords, as well as the necessary support systems, such as cable managers and faceplates.
 - 3. Cables are routed through conduit, open ceiling areas, non-ventilated spaces above ceiling tile and through plenum air-handling spaces above ceiling tile.
 - 4. Furnish and install materials necessary for a complete and working system.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Station Cabling: Berk-Tek.
- B. Modular Jacks: Leviton.
- C. Work Area Outlets: Leviton.
- D. Patch Panels: Leviton.
- E. Patch Cords: Leviton.

2.02 STATION CABLING

- A. Category 6A Unshielded Twisted Pair:
 - 1. 100 ohm, Category 6A, 23 AWG, 4-pair unshielded twisted pair, CMP rated jacket, color green.
 - 2. 100 ohm, Category 6A, 23 AWG, 4-pair unshielded twisted pair, CMR rated jacket, color green.
- B. Category 6 Unshielded Twisted Pair:
 - 1. 100 ohm, Category 6, 23 AWG, 4-pair unshielded twisted pair, CMP rated jacket, color blue.
 - 2. 100 ohm, Category 6, 23 AWG, 4-pair unshielded twisted pair, CMR rated jacket, color blue.
 - 3. 100 ohm, Category 6, 23 AWG, 4-pair unshielded twisted pair, Indoor/Outdoor rated, color black.

2.03 MODULAR JACKS

- A. Category 6A Modular Jacks:
 - 1. Eight-position modular jack, Category 6A, IDC terminals, T568A/B wiring scheme
 - 2. Each jack must be stamped or have icons to identify it as CAT 6A.
 - 3. Color: Green.
- B. Category 6 Modular Jacks:
 - 1. Eight-position modular jack, Category 6, IDC terminals, T568A/B wiring scheme

2. Each jack must be stamped or have icons to identify it as CAT 6.
3. Color: Green.

2.04 WORK AREA OUTLETS

- A. Flush Mounted Faceplate:
 1. One-port faceplate with recessed label fields, mounts within a single-gang wall box.
 2. Four-port faceplate, constructed from high impact thermo-plastic, with recessed label fields, mounts within a single-gang wall box.
 3. Faceplate color to match electrical.
- B. Dust Covers: Single port dust cover for modular openings, color to match faceplate.

2.05 PATCH PANELS

- A. Category 6A Modular Patch Panels:
 1. 24 port, eight-position modular jack panel, high density, 6 port modules, Category 6A, IDC terminals, T568A/B wiring scheme.
 2. 48 port, eight-position modular jack panel, high density, 6 port modules, Category 6A, IDC terminals, T568A/B wiring scheme.
- B. Category 6 Modular Patch Panels: 48 port, eight-position modular jack panel, high density, 6 port modules, Category 6, IDC terminals, T568A/B wiring scheme.

2.06 PATCH CORDS

- A. Category 6A Modular Patch Cords: Factory terminated double ended, eight-position to eight-position, modular, stranded conductors, 4 pair, color, blue. 5-feet and 7-feet.
- B. Category 6 Modular Patch Cords: Factory terminated double ended, eight-position to eight-position, modular, stranded conductors, 4 pair, color, blue. 5-feet and 7-feet.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

- A. Miscellaneous Hardware: Provide supporting hardware, cable ties, labels, pull rope and other miscellaneous hardware for a complete and operable system.
- B. Provide like items from one manufacturer, such as jacks, patch panels, equipment connection cords and wall plates.
- C. Horizontal cabling includes cables, jacks, patch panels and patch cords, as well as the necessary support systems, such as cable managers and faceplates.
- D. Furnish and install materials necessary for a complete and working system.
- E. Contractor must be a Certified Installer for selected manufacturer prior to, during and through completion of the system installation and must be able to provide the manufacturer's extended warranty.
- F. Perform work in a neat and workmanlike manner.
- G. Install cable after interior of building has been physically protected from the weather and mechanical work likely to damage cabling has been completed.
- H. Before installing cabling, ensure cable pathways are completely and thoroughly cleaned.
 1. Inspect conduit, wireway, cable trays and innerduct systems prior to installation.
 2. Swab any additional enclosed raceway and innerduct systems.
- I. Provide protection for exposed cables where subject to damage. Provide abrasion protection for any cable or wire bundles, which pass through holes or across edges of sheet metal.
- J. Install cable ties and other cable management clamps via hand so it fits snugly. Do not over tighten or use mechanical tools which could compress, crimp, or otherwise change the physical

characteristics of the cable jacket or distort the placement of twisted-pair components. Replace any cable exhibiting stresses due to over tightening of cable management devices.

- K. Where possible, route cables in overhead cable trays and inside wire management systems attached to the equipment cabinets and racks. Use Velcro ties or ducts to restrain cabling installed outside of wire management systems on racks or in cabinets.
- L. Co-install a pull cord (nylon; 1/8-inch minimum) with cable installed in conduit.
- M. Limit cable raceway fill to less than the TIA/EIA-569-B maximum fill for the particular raceway type.
- N. If a J-hook or trapeze system is used to support cable bundles, support horizontal cables at a maximum of 48- to 60-inch intervals. Cables are prohibited to rest on acoustic ceiling grids or panels.
- O. Bundle horizontal distribution cables in groups of no more than 50 cables. Cable bundle quantities in excess of 50 cables may cause deformation of the bottom cables within the bundle and degrade cable performance.
- P. Install cable above fire-sprinkler systems and ensure that the cable does not attach to the system or any ancillary equipment or hardware. Install cable system and support hardware such that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.
- Q. Do not attach cables to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, install appropriate carriers to support the cabling.
- R. Any cable damaged or exceeding recommended installation parameters during installation will be replaced by the contractor prior to final acceptance at no cost to the Owner.
- S. Determine requirements for plenum rated cable and devices. When in doubt, seek determination in writing by Authority Having Jurisdiction (AHJ) prior to ordering. Without written confirmation from the AHJ, Contractor to assume that a plenum rating is required.
- T. Unshielded Twisted Pair Cable Installation Practices:
 - 1. Install cable in accordance with manufacturer's recommendations and best industry practices.
 - 2. Install cables in continuous lengths from origin to destination (no splices).
 - 3. Do not exceed the cable's minimum bend radius and maximum pulling tension.
 - 4. Install unshielded twisted pair cable so that there are no bends smaller than four times the cable outside diameter at any point in the run and at the termination field.
 - 5. Do not exceed 25-lbf pulling tension on 4-pair UTP cable.
- U. Provide the following minimum separation distances between pathways for copper communications cables and power wiring of 480 volts or less:
 - 1. Open or Nonmetal Communications Pathways:
 - a. 12-inches from electric motors, fluorescent light fixtures and unshielded power lines carrying up to 3 kVA.
 - b. 36-inches from electrical equipment and unshielded power lines carrying more than 5 kVA.
 - c. 48-inches from large electrical motors or transformers.
 - 2. Grounded Metal Conduit Communications Pathways:
 - a. 2-1/2-inches from electrical equipment and unshielded power lines carrying up to 2 kVA.
 - b. 6-inches from electrical equipment and unshielded power lines carrying from 2 kVA to 5 kVA.
 - c. 12-inches from electrical equipment and unshielded power lines carrying more than 5 kVA.

- d. 3-inches from power lines enclosed in a grounded metal conduit (or equivalent shielding) carrying from 2 kVA to 5 kVA.
- e. 6-inches from power lines enclosed in a grounded metal conduit (or equivalent shielding) carrying more than 5 kVA.

V. Unshielded Twisted Pair Termination:

- 1. Coil cables in the in-wall or surface-mount boxes if adequate space is present to house the cable coil without exceeding the manufacturers bend radius. In hollow wall installations where box-eliminators are used, excess wire can be stored in the wall. Do not store more than 12-inches of UTP in an in-wall box, modular furniture raceway, or insulated walls. Loosely coil and store excess slack in accessible ceiling space above each drop location when there is not enough space present in the outlet box to store slack cable.
- 2. Dress and terminate cables in accordance with the recommendations made in the ANSI/TIA/EIA-568-C.1 document.
- 3. Terminate four pair cables on the jack and patch panels using T568B wiring scheme.
- 4. Maintain the cable jacket within 1-inch of the termination point.
- 5. Do not exceed 0.5-inch of pair untwist at the termination point.
- 6. Do not exceed four times the outside diameter of the cable in the termination area for bend radiance compliance.
- 7. Neatly bundle and dress cables to their respective panels or blocks. Feed each panel or block by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.

W. Testing Procedures:

- 1. Test cables and termination hardware for defects in installation and to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA/EIA-568-C. Verify pairs of each installed cable prior to system acceptance. Repair or replace any defect in the cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels and connector blocks in order to ensure 100 percent useable conductors in cables installed.
- 2. Test cables in accordance with this document, the ANSI/TIA/EIA standards, the manufacturer's procedures and best industry practice. If any of these are in conflict, bring any discrepancies to the attention of the project team for clarification and resolution.
- 3. Test Unshielded Twisted Pair Cables as Follows:
 - a. Test twisted-pair copper cable links for continuity, pair reversals, shorts, opens and performance as indicated below. Additional testing is required to verify Category performance. Test horizontal cabling using a Level IV test unit for Category 6 and 6A performance compliance as specified in ANSI/TIA/EIA-568 C.
 - b. Continuity: Test each pair of each installed cable using a test unit that shows opens, shorts, polarity and pair-reversals, crossed pairs and split pairs. Test shielded/screened cables with a device that verifies shield continuity in addition to the above stated tests. Record the test as pass/fail as indicated by the test unit in accordance with the manufacturers' recommended procedures and referenced to the appropriate cable identification number and circuit or pair number. Correct or repair any faults in the wiring and retest the cable prior to final acceptance.
 - c. Length: Test each installed cable link for installed length using a TDR type device. Test the cables from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length will conform to the maximum distances set forth in the ANSI/TIA/EIA-568-C Standard. Record cable lengths, referencing the cable identification number and circuit or pair number.
- 4. Follow the Standards requirements established in ANSI/TIA/EIA-568-C.

5. Perform testing with a Level IV tester. The basic tests required are:
 - a. Wire Map
 - b. Length
 - c. Attenuation
 - d. NEXT (Near-end Crosstalk)
 - e. Return Loss
 - f. ELFEXT Loss
 - g. Propagation Delay
 - h. Delay Skew
 - i. PSNEXT (Power Sum Near-end Crosstalk Loss)
 - j. PSELFEXT (Power Sum Equal Level Far-end Crosstalk Loss)
 6. Provide test results in electronic format, with the following minimum information per cable:
 - a. Circuit ID
 - b. Test Result, "Pass" or "Fail"
 - c. Date and Time of Test
 - d. Project Name
 7. Provide an electronic copy of the test results, in the native tester software format, to the Architect along with the printed test results.
 8. Provide a fully functional version of the tester software for use by the Architect in reviewing the test results.
- X. Labeling:
1. Label horizontal cables using a machine printed label at each end of the cable at approximately 6-inches of the termination point. Do not use handwritten labels.
 2. Label patch panel ports and TO ports with the cable identifier.
 3. Labels to be Telecom Room number, patch panel number and patch panel port number. Provide the final cable ID matrix to the Architect for approval one week prior to cable installation.
 4. Note labeling information at each outlet on the record drawings.
- Y. Coordination of Conditions: Structured cabling for wireless access points of a given description may be used in more than one type of ceiling or wall structure. Coordinate ceiling construction, wall types, recessing depth and other construction details prior to ordering special components indicated in the details for shipment. Where materials supplied do not match ceiling construction replace them at no cost to Owner.

3.02 STATION CABLING

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.

3.03 MODULAR JACKS

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.

3.04 WORK AREA OUTLETS

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.

3.05 PATCH PANELS

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.

3.06 PATCH CORDS

- A. Field terminated patch cords and jumpers are not allowed. At a minimum, provide equipment connection cords for one-half the total number of cables installed at each termination point. For example: A telecommunications outlet with four Category 6 cables installed would require two Category 6 equipment connection cords at the work area outlet and two Category 6 equipment connection cords in the telecommunications equipment room for a total of four Category 6 equipment connection cords.

END OF SECTION

SECTION 27 51 16
PUBLIC ADDRESS SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes:
 - 1. A complete integrated public address, intercom, bell and clock system for coverage of all areas shown on the Drawings.

1.02 RELATED SECTIONS

- A. Division 01, General Requirements
- B. Division 27, Communications
- C. Section 27 05 00, Common Work Results for Communications
- D. Section 27 05 28, Pathways for Communications Systems
- E. Section 27 08 00, Commissioning of Communications
- F. Section 27 15 00, Communications Horizontal Cabling

1.03 REFERENCES

- A. References, Codes and Standards as required by Section 27 05 00, Common Work Results for Communications and Division 01, General Requirements.

1.04 QUALITY ASSURANCE

- A. Conform to the quality assurance requirements of Section 27 05 00, Common Work Results for Communications and Division 01, General Requirements.

1.05 SUBMITTALS

- A. Including, but not limited to: Product Data Sheets, Shop Drawings, etc.
- B. General: Submit in accordance with Section 27 05 00, Common Work Results for Communications submittal requirements.
- C. Closeout Submittals: Submit in accordance with Section 27 05 00, Common Work Results for Communications submittal requirements.

1.06 SYSTEM OPERATON

- A. Performance
 - 1. Public address system provides paging throughout areas of the building at a minimum of 6 dB above the ambient noise level.
 - 2. Make provisions for additional signal inputs into the system.
 - 3. Provide public address system input into assisted listening transmitter system.

PART 2 PRODUCTS

2.01 PRODUCTS

- A. System Controller:
 - 1. Performance:
 - a. Controller shall include a programmable event scheduling capability for initiating pre-programmed bell/tone events.
 - b. Shall include total quantities of end-point licenses to support all end-points as part of this project plus 15% future capacity.
 - c. Shall be capable of sending text to phones and other end-point types
 - d. Shall provide synchronization for clocks

- e. Shall include gateways/relay modules for connection to the fire alarm system and public address system amplifiers.
 - f. Shall seamlessly integrate to any VoIP/SIP or legacy phone system via SIP, FXO or Loop Start Trunk.
 - g. Provide streaming audio inputs for background music to zones
 - 2. Manufacturer:
 - a. Frontrow
- B. Stream Decoder:
 - 1. Performance:
 - a. Networked audio decoder that accepts streaming audio input (raw PCM) and delivers line level audio output for reamplification
 - b. Inputs/outputs:
 - 1) (1) input power jack
 - 2) (1) RJ45 network jack
 - 3) (1) 3.5mm unbalanced stereo audio input jack
 - 4) (1) 3.5mm mic input jack
 - 5) (2) captive screw general purpose output (GPO) relay terminals (4 position)
 - 6) (3) captive screw general purpose input (GPI) relay terminals (4 position)
 - 7) (1) 3.5mm infrared control output jack
 - 8) (1) captive screw RS232 serial control input/output terminal (3 position)
 - 2. Manufacturer:
 - a. Frontrow CM800
- C. Classroom Controller/Receiver/Amplifier:
 - 1. Performance:
 - a. Inputs/outputs:
 - 1) Input power jack (mains 18Vdc, 3.5A)
 - 2) Input power jack (PoE 12-18Vdc, 24W)
 - 3) (3) Jacks for external sensor connection (RCA)
 - 4) Audio out jack (with gain control) (3.5mm)
 - 5) Audio out jack (max gain output) (3.5mm)
 - 6) (3) Stereo audio in jacks (with stereo sound output) (RCA)
 - 7) (1) serial communications port
 - 8) (1) Jack Pair (supplying 12VDC to power and connectivity to control panels) (RJ45)
 - 9) (1) Power output (for network switch) (5V, 1A)
 - 10) (1) Power output (for HDBaseT HDMI receiver) (18V, 2A)
 - 11) (1) Power output (for HDMI audio de-embedder) (5V, 1A)
 - 12) (1) Terminal block for analog page override
 - 13) (1) Intercom input jack (RJ45)

- 14) (1) IR blaster port (3.5mm)
- 15) (1) Network Jack (RJ45)
- 16) (2) 4-pin captive screw loud speaker terminals (second is optional).
Left and right (stereo output)
- 17) (1) 4-pin captive screw general purpose input (GPI) relay terminal
- 18) (1) 4-pin captive screw RS232 serial control input/output terminal (3
position)
- 2. Enclosure:
 - a. Mounting type: Flush In wall
 - b. Size: 23.75 by 12 by 2.5-inch
 - c. Plenum rated
- 3. Manufacturer:
 - a. Frontrow ICR-01
- D. Combination Sensor-Speaker Assembly:
 - 1. Performance:
 - a. Basis specification: Frontrow 202-05-000-00 IR Speaker Kit
 - b. Form: A single speaker enclosure containing two offset woofers and a centrally mounted tweeter, plus a centrally mounted, integrated IR receiving module
 - c. Mounting type: wall mount
 - d. Speaker power rating: 20 Watts RMS/30 Watts Max.
 - e. Speaker impedance: 4 Ohms nominal
 - f. Speaker frequency response: 150Hz -20kHz
 - g. Inputs:
 - 1) 2 quick connect/disconnect speaker cable terminals
 - 2) 1 RCA sensor cable connector
 - 2. Manufacturer:
 - a. Frontrow
- E. Intercom Module:
 - 1. Performance:
 - a. Integrated Speaker
 - b. Integrated microphone
 - c. Push to talk button with rotary volume
 - d. RJ45 power and signal connection
 - e. Mounted in a single gang enclosure
 - 2. Manufacturer:
 - a. Frontrow CB75
- F. Ceiling and Wall Speakers:
 - 1. Performance:
 - a. UL listed single voice coil, 8-inch diameter, 8 Ohm impedance, with 10 ounces ceramic magnet, and 70 volt line transformers, tapped in 5 steps from 1/4W to 5W. Frequency response, 70 to 10,000 Hz with an 8 watt RMS power rating.

2. Manufacturers:
 - a. Frontrow
 - b. Or approved equal.
- G. Speaker Baffles and Enclosures:
 1. Performance:
 - a. Baffle: Flush 12-inch diameter perforated metal with white semi-gloss epoxy finish.
 2. Enclosure:
 - a. Recessed round backbox with resonance damping material and T-bar mounting device.
 - b. Four, 1/2-inch / 3/4-inch knockouts. Quam ERD8/SSB-2 or approved.
 3. Manufacturers:
 - a. Frontrow
 - b. Or approved equal.
- H. Horns:
 1. Performance:
 - a. Rectangular 9-inch by 12-inch loudspeaker with integral driver and 1.5-inch diameter voice coil. The sound pattern shall have a 60 degrees horizontal and 40 degrees vertical beam width over a 400-6,500 Hz frequency range.
 - b. Positive lock swivel bracket shall provide orientation adjustment in all three planes.
 - c. Provide built-in 70V line transformer 5 step adjustments from 1.9W to 30W.
 2. Manufacturers:
 - a. Frontrow
 - b. Or approved equal.
- I. Analog Clocks
 1. Performance:
 - a. Receive power and time data from PoE Switch
 - b. Synchronized enabled
 - c. Wire Guard Model in areas where protection is required as indicated on drawings or by owner.
 2. Manufacturers:
 - a. Pyramid
 - b. Or approved equal.
- J. Cabling:
 1. Performance:
 - a. IP Speaker: Cat6 UTP network cable
 - 1) Manufacturer: Nexans (Berk-Tek)
 - b. Speaker: Two conductors stranded tinned copper, twisted pair, 16 gage, PVC jacket.
 - c. Combination Sensor-Speaker:
 - 1) Main jacket: UL listed, Plenum rated jacket
 - 2) Sensor cable: RG58/u coaxial cable CL3P shielded, UL listed, Plenum rated jacket
 - 3) Speaker cable: 18 AWG 2 conductor UL listed CL2P Plenum-rated

- d. Analog Clocks: Category 6 UTP network cable
 - 1) Manufactures: Nexans (Berk-Tek)

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install speakers and enclosures as shown on the Drawings.
- B. Final speaker terminations made by the equipment supplier.
- C. Install amplifiers and other equipment per manufacturer's recommendations and as detailed on
- D. the Drawings.
- E. Adjust speaker taps for uniform sound coverage.
- F. Adjust automatic level controllers for proper operation in assembly area.
- G. Install assisted listening transmitter in equipment rack. Connect audio input and antenna.

3.02 WIRING

- A. Install with conduits, outlet boxes, enclosure fittings, connectors, and accessories necessary to ensure a complete operating system in compliance with applicable codes and regulations.
- B. Conduit: Install in accordance with Section 26 05 33, Raceways and Boxes for Electrical Systems.
- C. Wire and Cable:
 - 1. Install wiring in metal conduit or within equipment.
 - 2. Cable, lace, and tag cables within equipment with E-Z code markers indicating circuit number and type.
 - 3. Use markers on power conductors at each outlet to pull box at each equipment enclosure.
 - 4. Do not install microphone wiring in conduits carrying speaker wires.
- D. Install conduit identification labels as detailed on the Drawings.

3.03 DRAWINGS

- A. Installation and Record Drawings called for under submittals consist of reproducible drawings with outlets, devices, terminal cabinets, conduits and wiring shown. Prints of these drawings submitted to the Engineer for approval prior to starting installation.
- B. Submit drawings, when approved, then form the basis for installation.
- C. At the completion of the work, deviations from the installation drawings incorporated on the reproducibles to indicate as-built conditions. Drawings will then be submitted to the Engineer as Record Drawings for the system.

3.04 TESTING

- A. Test cables and wiring for continuity, shorts, and grounds by use of an ohmmeter prior to energizing circuits.
- B. Provide instruments, equipment, and personnel necessary for testing of electrical installations and make sure such personnel are available during final testing to make immediate adjustments.
- C. Maintain written records of test results, with data carefully and accurately assigned to the cable identification as specified.
- D. Perform testing in the presence of the Owner unless specifically waived.
- E. Submit a copy of test data the Owner.
- F. Factory-trained representative of manufacturer to supervise the final testing of the system.
- G. Testing subject of approval and acceptance of the Owner.

3.05 TRAINING

- A. Conduct a minimum of two maintenance training sessions (one for each shift). Maintenance training sessions includes walk-thru of the completed facilities identifying the location, address, and means of access to every device.
- B. Training sessions with fully qualified, trained representatives of the equipment manufacturer who is thoroughly knowledgeable of the specific installation.

END OF SECTION