SECTION 27 00 00- GENERAL COMMUNICATIONS REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. The work covered under this Section shall consist of a design, furnishing of all material, labor, and installation for completion of an operable end to end structured cabling system. This includes - but is not limited to - furnishing and installing cable, cable supports, cable ties, inner duct, racks, cabinets, termination components, ancillary equipment, testing, and labeling and documentation of cables and connectors, for a complete end-to-end solution.

B. Refer to the contract documents for locations of Telecom Rooms (TRs), Server Room (SR), and telecommunication outlets (TOs). Note that the port and cable count at each TO may vary by location.

C. Complete installation shall comply with the Owner provided latest telecommunication and IT standards documents.

D. It shall be the responsibility of the contractor, to work with the Owner and provide the necessary assistance to make any connections from the owners' outside plant, service provider to establish services which shall ride on the new cabling system. These activities include, but are not limited to patch cords, cross connects, general wiring, documentation, and cable pair identification.

1.2 RELATED DOCUMENTS

A. General and Supplementary Conditions

1.3 RELATED SECTIONS

A. Division 01 – General Conditions

B. Division 07 – Penetration Fire stopping

C. Division 26 - Grounding and Bonding

D. Division 26 - Raceway and Boxes

E. Division 26 - Wiring Devices

F. Division 27 - Communications

1.4 ACRONYMS AND DEFINITIONS

A. BICSI: Building Industry Consulting Service International

B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross- connection

C. EMI: Electromagnetic interference

D. Horizontal Cabling: Cabling between and including the telecommunications outlet/connector and the horizontal cross-connect

E. IDC: Insulation displacement connector

F. LAN: Local area network

G. NRTL: Nationally Recognized Testing Laboratory, an independent agency, with the experience and capability to conduct the testing indicated, as defined by OSHA in 29 CFR 1910.7

H. RCDD: Registered Communications Distribution Designer, a BICSI-certification

I. RMC: Rigid metallic conduit

J. TR: Telecom Room

K. UTP: Unshielded twisted pair

1.5 CONTRACTOR QUALIFICATIONS

A. The contractor shall be a company specializing in the installation of communication cable and accessories with a minimum of five years documented experience on similar systems.

B. Must be a current certified partner of the solutions being furnished and installed in order to meet the requirements for the manufacturers extended warranty and service programs.

C. Must hold a current communications cabling license within the State the project is taking place and must be verifiable for good standing.

D. Contractor must have satisfactorily completed (3) projects within the past 5 years of similar scope and amount within the same state.

E. The selected Contractor shall provide a Project Manager to act a single point of contact for all activities performed under this section. The Project Manager shall be a Registered Communications Distribution Designer (RCDD). The RCDD shall have a minimum of 3 years experiences in design and installation. The designer must have sufficient experience in this type project(s) as to be able to lend adequate technical support to the field forces during installation, during the warranty period and during any extended warranty periods or maintenance contracts. The Contractor must attach a resume of the responsible designer to the Contractor's submittal for evaluation.

F. The Project Manager, or designee thereof, shall be required to attend project meetings as required until project closeout/signoff.

G. Should the Project Manager assigned to this project change during the installation, the new Project Manager assigned must meet all qualifications stated in this section, and must also submit a resume for review by the Consultant.

H. If, in the opinion of the Consultant, the Project Manager does not possess adequate qualifications to support the project, the Consultant reserves the right to require the Contractor to assign a designer whom, in the Owner’s opinion, possesses the necessary skills and experience required of this project.

1.6 REGULATORY REFERENCES

A. ANSI/NFPA 70

B. City of Los Angeles Building Code.

C. ANSI/IEEE C2 - National Electrical Safety Code (NESC)

D. NFPA 70-2011 - National Electrical Code (NEC)

E. ANSI/TIA-568-C.0 – Generic Telecommunications Cabling for Customer Premises, published February 2009 and all latest addenda derived from ANSI/TIA 568-B

F. ANSI/TIA-568-C.1 – Commercial Building Telecommunications Cabling Standard, published February 2009 and all latest addenda derived from ANSI/568-B

G. ANSI/TIA-568-C.2 – Balanced Twisted Pair Telecommunication Cabling and Components Standard, published August 2009 and all latest addenda derived from ANSI/TIA 568-B

H. ANSI/TIA-568-C.3 – Optical Fiber Cabling Components Standard, published June 2008 and all latest addenda derived from ANSI/TIA 568-B

I. ANSI/TIA/EIA 569-B - Commercial Building Standard for Telecommunications Pathways and Spaces

J. ANSI/TIA-606-B – Administration Standard for Telecommunications Infrastructure, published June 2012 including all latest addenda derived from TIA-606-A

K. ANSI/TIA-607-B – Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

L. ANSI/TIA-758-A Customer Owned Outside Plant Telecommunications Infrastructure Standard

M. IEEE 142 “Green Book”- Recommended Practice for Grounding of Industrial and Commercial Power Systems

N. UL 444 - Standard for Communications Cable

O. Rural Electrification Administration (REA) PE-89 - specification for filled telephone cables with expanded insulation

P. Rural Electrification Administration (REA) PE-39 - specification for filled telephone cables

Q. CEC Article 18-27-300.22© (1)

R. NEC Article 250 for System Grounding

S. NEC Articles 770 and 800 for Cable Listing Requirements

T. Work performed should additionally comply with and follow guidelines established in the latest edition/revision, as of the date of the Contract Documents, of the following publications:

U. BICSI Telecommunications Distribution Methods Manual (TDMM)

V. BICSI Outside Plant Design Reference Manual (OSPDRM)

W. National Electrical Contractors Association (NECA)/BICSI ANSI/NECA/BICSI-568-2006 Standard for Installing Commercial Building Telecommunications Cabling

X. All materials shall be new and listed by UL and shall bear the UL label. If UL has no published standards for a particular item, then other national independent testing standards shall apply and such items shall bear those labels. Where UL has an applicable system listing and label, the entire system shall be so labeled.

Y. Notify Consultant of all material believed to be inadequate, unsuitable, in violation of law, ordinances, rules or regulations of authorities having jurisdiction.

1.7 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Consultant for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Consultant for a decision before proceeding.

1.8 SUBMITTALS

A. Submittals shall include complete documentation of the system, products and accessories in a single submittal. Incomplete submittals will be returned reviewed.

B. Prior to the start of work the Contractor shall submit shop drawings in an electronic form. Plans shall be fresh designs by the contractor; they cannot be overlays of the Consultant's package which are indicative as the contract documents. Shop drawings shall contain:
   1. Full size floor plans showing proposed cable routing, wire basket routes, labeling of all outlets, locations of pull boxes.
   2. Full size floor plans and elevations of all telecommunication room racks and cabinets; also include all walls with equipment.
   3. Elevations shall indicate part numbers and quantities for all equipment.
   4. Elevations of all type of outlet faceplates which shall include the configuration for jacks, blanks and the intended outlet labeling schemes.
   5. Floor plans shall include all ladder rack or overhead cable distribution hardware within the telecommunications rooms to be installed per manufacturer's instructions.
   6. Outside plant manhole and hand hole designs coordinated with electrical as well as the site environment if required.
   7. Outside plant conduit arrangement details within ductbank and within the manholes and handholds as necessary if required.
   8. Outside plant conduit ductbank overall routing coordinated with electrical as well as the site environment if required.
   9. All seismic bracing and support details shall be provided in coordination with the general contractor as needed.

C. Where applicable, dimensions should be marked in units to match those specified.

D. Work shall not proceed without the consultant's "no exception taken" of the submitted items.

E. Floor plans will be provided to the Contractor in electronic (AutoCAD, ".dwg") formats to be utilized by the contractor in creating complete submittals and as-built documentation. These modified documents shall be provided to the Owner as part of the Record Documents.

F. All submittal documentation shall bear the stamp of a currently verifiable BICSI RCDD.

G. Plans shall be fresh designs by the Contractor; they cannot be overlays of the Consultant's package which is indicative as contract documents.

H. Contractor must submit documentation to support all Contractor Qualifications and Requirements under Section 1.5 which is to include but not limited to the following:
   1. End to end solution and partner documentation indicating contractor's staff has gone through proper channels and training support a minimum 25 year warranty and service program by the manufacturers.
   2. BICSI affiliations by contractor.
   3. BICSI cabling team's RCDD.
   4. Current copy of the State contractor's license for Communications Cabling.
   5. Documentation of (3) similar projects within the past 5 years in the same State.

I. Contractor shall include data sheets and literature of test equipment to be used for fiber and copper cabling and components.

1.9 MANUFACTURER CERTIFIED WARRANTY

A. The manufacturer shall be a company specializing in communication cable and/or accessories with a minimum of five years documented experience in producing cable and/or accessories similar to those specified below.

B. The system shall be comprised of components from a single manufacturer or a combination of manufacturers entering into a partnering agreement that allows for a warranty of the system.

C. System warranty program documents must be from that of the cabling and component manufacturer and associated partners. Cabling and component warranty programs offered by the contractor alone are not acceptable.

D. The warranty period shall be for not less than 25 years and warranty the cabling system and components will perform to the stated specifications for the warranty period.

1.10 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

B. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

C. Requirement for specialists shall not supersede building codes and regulations governing the Work.

D. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material and design.

1.11 QUALITY CONTROL

A. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.

B. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing.

C. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work.

D. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1.12 OWNER STANDARDS

A. Work performed should additionally comply with Owner Standards.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 GENERAL

A. Contractor shall follow standard industry installation practices as described in the latest release of the BICSI TDMM.

B. Contractor shall be responsible for identifying and reporting to the Site Coordinator(s) any existing damage to walls, flooring, tiles and furnishings in the work area prior to start of work. All damage to interior spaces caused by the installation of cable, pathways or other hardware must be repaired by the Contractor. Repairs must match preexisting color and finish of walls, floors and ceilings. Any contractor- damaged ceiling tiles are to be replaced to match color, size, style and texture.

C. The installation shall be supervised on site by a BICSI certified installer.

D. The contractor shall have on staff a BICSI certified RCDD. RCDD certification shall be current and each submittal shall bear the stamp of the RCDD.

E. Outlets shall be mounted flush on a wall-mounted box, on Surface Raceway and in Modular Furniture. Information Outlet locations are identified on Project Drawings.

F. Avoid abrasion and other damage to cables during installation. Any cable damaged during installation shall be removed and a new cable installed.

G. Cables shall be a continuous run. No in-line splices are permitted except were explicitly indicated on the drawings.

3.2 DELIVERY AND STORAGE

A. Receive, handle, and store telecommunications system items and materials at the project site. Materials and items shall be so placed that they are protected from damage and deterioration.

3.3 INSTALLATION

A. The drawings for work under Division 27 Sections related to communication systems are diagrammatic and are intended to convey the scope of work and indicate the general arrangement of conduit, boxes, equipment, termination hardware, fixtures and other work included in the Contract.

B. The Contractor shall verify all dimensions and clearances before procuring any equipment.

C. Location of items required by the drawings or specifications not definitely fixed by dimensions are approximate only and exact locations necessary to secure the best conditions and results shall be determined at the site and shall be subject to the approval of the Architect/Telecom Design Engineer.

D. Follow drawings in laying out work, check drawings of other trades to verify spaces in which work will be installed, and maintain maximum headroom and space conditions at all points.
   1. Where space conditions appear inadequate, the Architect/Telecom Design Engineer shall be notified before proceeding with installation.
   2. Minor conduit and cable tray rerouting and changes shall be made at no additional cost to the Owner.
   3. As necessary, adjust elevations of rack-mounted termination hardware and horizontal wire management panels so as to compensate for rack unit sizes of actual hardware used, as compared to hardware rack unit sizes depicted in Contract Drawings.

E. Perform all work with skilled mechanics of the particular trade involved in a neat and workmanlike manner.

F. Perform all work in cooperation and coordination with other trades and schedule.

G. Furnish other trades advance information on locations and sizes of frames, boxes, sleeves and openings needed for the work, routes for conduit and cable tray raceway, and also furnish information and shop drawings necessary to permit trades affected to install their work properly and without delay.

H. Where there is evidence that work of one trade will interfere with the work of other trades, all trades shall assist in working out space allocations to make satisfactory adjustments and shall be prepared to submit and revise coordinated shop drawings.

I. With the approval of the Architect/Consultant and without additional cost to the Owner, make minor modifications in the work as required by structural interferences, by interferences with work of other trades or for proper execution of the work.

J. Work installed before coordinating with other trades so as to cause interference with the work of such other trades shall be changed to correct such condition without additional cost to the Owner and as directed by the Architect.

K. Minor changes in the locations of outlets, fixtures and equipment shall be made prior to rough in at the direction of the Architect/Consultant and at no additional cost to the Owner.

L. Contractor shall cooperate with other trades and coordinate work so that conflicts with other work are eliminated.

M. Equipment shall be installed with adequate space allowed for removal, repair or changes to equipment. Ready accessibility to removable parts of equipment and to wiring shall be provided without moving other equipment which is to be installed or which is in place. Contractor shall verify measurements. Discrepancies shall be brought to the Architect/Telecom Design Engineer's attention for interpretation.

N. Determine temporary openings in the buildings that will be required for the admission of apparatus furnished under this Division, and notify the Architect/Consultant accordingly. In the event of failure to give sufficient notice in time to arrange for these openings during construction, assume all costs of providing such openings thereafter.

O. Location of telecommunication outlets and raceway pathways are approximate and exact locations shall be determined on site.

P. Contractor shall refer to contract documents for details, reflected ceiling plans, and large scale drawings.

3.4 COORDINATION

A. The Contractor shall be responsible for the coordination of telecommunications work with the work of all other trades and shall, in preparing the drawings, check the work of other trades in order to avoid possible installation conflicts arising therefrom. It shall be understood that the work shown on the shop drawings has been so coordinated. In the event of conflicts or interference that cannot be resolved in the field, the Contractor shall request a written clarification from the Architect/Consultant.

B. Coordinate service entrance arrangement with local exchange carrier(s).
   1. Meet jointly with local exchange carrier representatives and Owner to exchange information and agree on details of equipment arrangements and installation interfaces. Record agreements reached in meetings and distribute to other participants.

C. Where work covered by this Section connects to equipment furnished under other Sections, verify telecommunications work involved in the field and make proper connection to such equipment.

END OF SECTION 27 00 00

SECTION 27 05 26- GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. The work covered under this Section shall consist of a design, furnishing of all material, labor, and installation for completion of an operable end to end structured cabling system. This includes grounding and bonding of all passive and active equipment supplied by contractor and owner.

B. This Section includes grounding of communications systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

1.2 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NEC, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
   1. Comply with UL 467.

1.3 RELATED DOCUMENTS

A. General and Supplementary Conditions

1.4 RELATED SECTIONS

A. Division 26 - Grounding and Bonding

B. Division 26 - Raceway and Boxes

C. Division 26 - Wiring Devices

D. Division 27 - Communications

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by approved manufacturers listed in Division 26 section, “Grounding and Bonding for Electrical Systems.”

B. Materials and equipment shall conform to the respective standards and to the Quality Standards stated herein. Electrical ratings shall be as indicated. Except where specifically required approvals and/or labels. Materials shall conform to the requirements of UL 467 where applicable.

2.2 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Division 26 Section “Conductors and Cables.”

B. Communications Copper Bonding Conductors: As follows
   1. Telecommunications Bonding Conductor (TBC) and Telecommunications Bonding Backbones (TBB): No. 3/0, stranded copper conductor, insulated.
   2. Telecommunications Equipment Bonding Conductor (TEBC): No. 6 AWG, stranded copper conductor, insulated.

C. Conductor, UL 83:
   1. Ground and bonding conductors shall be green-insulated, soft-drawn stranded copper conductors, unless otherwise indicated, installed with sufficient slack to avoid breaking due to settlement and movement of conductors or attached points.

2.3 SYSTEM GROUNDING CONDUCTORS SHALL BE MINIMUM OF NO. 6 AWG AND A MAXIMUM OF 3/0 AWG BARE COPPER, UNLESS OTHERWISE INDICATED OR REQUIRED BY CODE, AND SHALL BE CONTINUOUS WITH NO JOINTS OR SPLICES CONNECTOR PRODUCTS

A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.

B. Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long- barrel, two-bolt connection to ground bus bar.

C. Wire Connectors and Terminals for use with copper Conductors: UL 468A.

D. TELECOMMUNICATIONS GROUNDING BUSBAR

E. Comply with ANSI/TIA-607-B.

F. Telecommunications Main Grounding Bus bar (TMGB): Electro-tin plated copper, minimum 1/4 inch thick by 4 inches wide by minimum 20” long, with holes sized, spaced and in minimum quantities as follows:
   1. 5/16” holes at 5/8” spacing, minimum quantity of 27
   2. 7/16” holes at 1” spacing, minimum quantity of 3
   3. Provide longer TMGB as necessary to accommodate quantity of actual bonding connections required in field.
   4. Provide CPI, Lyncole XIT, or equal subject to review.

G. Telecom Grounding Bus bar (TGB): Electro-tin plated copper, minimum 1/4 inch thick by 4 inches wide by minimum 12” long, with holes sized, spaced and in minimum quantities as follows:
   1. 5/16” holes at 5/8” spacing, minimum quantity of 6
   2. 7/16” holes at 1” spacing, minimum quantity of 3
   3. Provide longer TGB as necessary to accommodate quantity of actual bonding connections required in field, per communications room.
   4. Provide CPI, Lyncole XIT, or equal subject to review.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Bond metallic raceways used for routing of communications bonding conductors, to the communications bonding conductor at each end.

3.2 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanic ally compatible.
   1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
   2. Make connections with clean, bare metal at points of contact.
   3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
   4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
   5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Equipment Grounding Conductor Terminations: Use pressure-type grounding lugs.

C. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

D. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer.

E. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

3.3 TELECOMMUNICATIONS GROUNDING AND BONDING

A. Comply with NEC, ANSI/TIA-607-B and UL 467.

B. Comply with telecommunications ground details and riser diagrams in Contract Drawings.

C. Telecommunications Grounding Bus bars: TMGB and TMB within facility to provide for telecommunications grounding system.
   1. Locate grounding terminals in each telecommunications room.
   2. Mount on wall of telecommunications entrance facility, equipment room, and closet, with standoff insulators.

D. Bonding Conductors:

1. Extend a TBC from TMGB to electrical entrance facility and connect to grounding electrode system.
2. Extend a TBB from TMGB to each TGB.
3. Extend a TEBC from TGB to ground terminals at communication relay racks, wall-mount communication racks and cabinets, primary protection blocks, overhead ladder rack runway systems and cable basket tray systems.

E. Special Requirements:
1. Bonding conductors shall be insulated copper, sized as noted in Contract Drawings.
2. Bonding conductors shall be installed without splices unless as noted in telecommunications grounding riser diagram, or as approved by Architect because of special circumstances. Where splices are necessary, they shall be accessible. Splices shall be by irreversible compression connectors or by exothermic welding.

F. Primary Protectors
1. Primary protectors shall be installed on each cable end, in the appropriate building entrance protector.
2. Primary protector enclosure shall be bonded to the building grounding system utilizing a minimum #6 AWG ground wire.

G. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

END OF SECTION 27 05 26

SECTION 27 05 28- PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. The work covered under this Section shall consist of a design, furnishing of all material, labor, and installation for completion of an operable end to end structured cabling system. This includes pathways for distribution and protection of cabling and components.

1.2 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NEC, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with UL 467.

C. General Requirements: Comply with ANSI/TIA-569-B.

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

E. Support brackets with cable tie slots for fastening cable ties to brackets.
   1. Lacing bars, spools, J-hooks, and D-rings.
   2. Straps and other devices.
   3. Bridle rings not permissible unless furnished with cable saddles.

1.3 RELATED DOCUMENTS

A. General and Supplementary Conditions

1.4 RELATED SECTIONS

A. Division 26 - Grounding and Bonding

B. Division 26 - Raceway and Boxes

C. Division 26 - Wiring Devices

D. Division 27 – Communications

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by approved manufacturers listed in Division 26 section, “Grounding and Bonding for Electrical Systems.”

2.2 CONDUIT AND ELECTRICAL BOXES

A. Comply with requirements in Division 16 Section “Raceways and Boxes.” Flexible metal conduit shall not be used, except as indicated in Contract Drawings. Coordinate with layout and sizing details and requirements as indicated in Contract Drawings.
   1. Outlet boxes shall be no smaller than 4 inches wide, 4 inches high and 2-1/8 inches deep.
   2. Minimum conduit to telecom outlet locations: Trade Size 1, unless otherwise noted in Contract Drawings.
   3. Provide a complete and function conduit pathways system with required pull boxes between the MDF/TR facility and each Telecommunications service point per Telecommunications Drawings.

2.3 J-HOOK

A. J-Hook shall have a flat bottom and provide a minimum of 1-5/8 inch cable bearing surface.

B. J-Hook shall have 90-degree radius edges to prevent damage while installing cables.

C. J-Hook shall be designed so the mounting hardware is recessed to prevent cable damage.

D. J-Hook shall be factory assembled for direct attachment to walls, hanger rods, beam flanges, purlins, strut, floor posts, etc. to meet job conditions.

E. Factory assembled multi-tiered j-hooks shall be used where required to provide separate cabling compartments, or where additional capacity is needed.

F. Manufacturer: Stiffy, Erico Caddy, or Approved Equal

2.4 FLEXIBLE NON-METALLIC INNERDUCT

A. Innerduct shall be corrugated plastic.

B. Nominal duct size shall be minimum 1-inch.

C. Innerduct shall be riser, plenum, or OSP rated as required by the installation environment.

D. Manufacturer: ENDOT, Eastern Wire, or Approved Equal

2.5 CABLE TIES

A. Bundle and support all cables and to provide a neat and orderly cabling installation.

B. Velcro tie wraps shall be used in the telecom room. Zip ties and wraps that cannot be adjusted once installed are not acceptable.

C. Wraps shall be Black in color.

D. Velcro wraps shall be plenum rated in all areas outside the telecom rooms.

2.6 DISTRIBUTION RINGS (D-RINGS).

A. Must be used to support and dress out cables on plywood backboards vertically and horizontally. Cables shall not be supported by cable ties alone on backboard.

PART 3 - EXECUTION

3.1 GENERAL

A. Cable shall be neatly dressed out in telecom rooms.

B. Secure cabling with Velcro type cable wraps only.

C. Install distribution rings on plywood backboards to support cables.

3.2 J-HOOKS

A. Provide J-hooks to support communications cables at locations where cable tray and/or conduit is not provided.

B. Provide J-hooks assemblies on 4-5 foot intervals to support all outlet cables. Install J-hooks approximately 12 inches above lay-in ceiling. Use J-hooks to support not more than 50 cables per hook. Provide additional hooks in rows as required to support more than 50 cables.

C. Secure J-hooks to concrete slab using submitted and consultant approved method.

D. Coordinate location with HVAC duct and lights. Do not install above fluorescent lighting fixtures.

3.3 FLEXIBLE NON-METALLIC INNERDUCT

A. Innerduct segments shall be spliced using couplings designed for that purpose.

B. All vacant inner duct shall be equipped with a pull cord and capped at both ends.

C. Innerduct shall extend to the ladder rack above the termination enclosure.

D. All exposed inner duct shall be labeled at 50-foot intervals with tags indicating the cable type it contains.

END OF SECTION 27 05 28

SECTION 27 08 00- COMMISSIONING OF COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. The work covered under this Section shall consist of a testing, documenting, and commissioning of an operable end to end structured cabling system.

B. Complete installation shall comply with the owner's and consultants latest telecommunication and IT standards documents.

1.2 RELATED SECTIONS

A. Division 27

1.3 PROJECT AS-BUILT AND CLOSEOUT DOCUMENTS

A. Accurately record exact sizes, locations, heights and quantities of cables and Information Outlets.

B. As-built drawings shall indicate all final cable routes and final outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document. Numbering, icons and drawing conventions used shall be consistent throughout all documentation provided.

C. Drawings shall indicate final MDF & TR locations along with their final build out conditions at end of the project.

D. Submit (1) bound folders of product used in the project for record.

E. Submit cable tester calibration reports.

F. Submit all copper and fiber optic test results as indicated in Part 3 of this specification. This should include every cable channel installed in the project.

G. Plans shall be provided in full size PDF, AutoCAD or REVIT format within (1) CD or DVD along with (1) hard copies.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 GENERAL

A. Contractor shall follow standard industry installation practices as described in the latest release of the BICSI TDMM.

3.2 IDENTIFICATION AND LABELING

A. All backbone and station cables, faceplates and termination components shall be clearly labeled in accordance with EIA/TIA 606-B.

B. The Contractor shall obtain the labeling scheme from the Owner.

C. Labels strips shall be covered with a protective plastic coating. Labels shall be machine printed. No handwritten label shall be accepted. Stick-on labels are not acceptable.

D. Components
1. The labeling made for each component should be:
   a. Unique, to prevent confusion with similar components.
   b. Legible and permanent enough to last the lifecycle of the component.
   c. The following infrastructure components should be labeled:
      1) Telecommunications spaces
      2) Telecommunications pathways
      3) Telecommunications cables
      4) Zone boxes
      5) Connecting hardware
      6) Grounding (earthing) system

E. Telecommunications Spaces
1. Telecommunications spaces include:
   a. Equipment/Server rooms (ER/SRs)
   b. Telecommunication rooms (MDF/IDF/TRs)
   c. Telecommunication enclosures (TEs)
   d. Work areas

1. Spaces should be labeled at their entrances, as follows:
   e. In small, single-story buildings, a simple sign on the door is sufficient.
   f. In larger buildings, the labeling should provide a unique identifier, since there may be a number of telecommunications spaces.

F. Telecommunications pathways
1. Labeling of pathways helps prevent inadvertent installation of cables from systems that may interfere with each other.
2. When labeling pathways, the following guidelines should be met:
   a. Labeling should be affixed at the ends of each pathway.
   b. Pathways should be labeled at regular intervals and wherever they are accessible.
   c. In a basic system, the conduits should be marked from the main SR by painting or using a permanent-colored tape-wrap made for this purpose.
   d. In systems utilizing zone boxes for consolidation or distribution of low-voltage systems, each box label should include the information about the room of origin and system usage.
   e. In complex systems or large buildings:
      1) A striped tape should wrap pathways with the base color identifying them as telecommunications pathways and tracer color identifying the individual uses.
      2) Each pathway should be assigned a unique alphanumeric identifier.
      3) All wall or floor penetrations should be labeled.
3. Telecommunications cables
   a. When labeling telecommunications cables:

1) Cables should be identified at each end with a permanent label or physical/electronic tag. The same alphanumeric identifiers should be used at both ends of the cable.
2) Cable should be identified at regular intervals throughout its length with its alphanumeric identifier when cables are rearranged, rerouted, or removed in spite of the added cost.

b. In systems that are:
1) Basic, the labeling scheme can be a simple number sequence.
2) Complex, the labeling may indicate the type, function, and terminating position.

G. Connecting hardware
1. Connecting hardware items (e.g., cross-connect fields and telecommunications outlet/connectors) require a unique, alphanumeric identification such as the following three-level scheme:
a. First level – Termination field or patch panel. Color-coding or other labeling should be used to uniquely identify each termination field on a common mechanical assembly.
b. Second level – Terminal block within a given field or patch panel, which could be a row of insulation displacement connectors (IDCs), optical fiber connectors, or modular jacks.
c. Third level – Defines the individual position within a given terminal block or patch panel.

H. Grounding (Earthing)
1. Grounding system components (e.g., ground bars and grounding conductors) require special labeling for safety and noise control purposes and for simplifying and expediting ground system audits.
2. All equipment grounding conductors should be labeled to indicate the:
a. Grounded rack, cabinet, or shelf.
b. Ground bar to which the grounding conductors are connected.
3. Each grounding conductor in a building should be labeled, including those connecting building steel, grounding electrodes, water pipes, radio towers, and telecommunications structural components.

3.2. TESTING AND COMPLIANCE

A. The Contractor is responsible for supplying all equipment and personnel necessary to conduct the acceptance tests. Testing shall be executed by technicians holding proof of successful installation certification from the system manufacturer.

B. Cable testers are to be calibrated within four (4) months of use.

C. Prior to testing, the Contractor shall provide a summary of the proposed test plan for each cable type including equipment to use, set-up, test frequencies or wavelengths, results format, etc.

D. 100% of the installed cabling links must be tested in accordance with ANSI/TIA/EIA-568-B standard and must pass the requirements described under the heading for each cable type. Any failing link must be diagnosed and corrected. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation.

E. A Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter. The test result of a parameter shall be marked with an asterisk (*) when the result is closer to the test limit than the

accuracy of the field tester. The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests. Any Fail or Fail* result yields a Fail for the link-under-test. In order to achieve an overall Pass condition, the results for each individual test parameter must Pass or Pass*.

F. Manufacturer: Fluke

3.3. CABLING ADMINISTRATION DRAWINGS

A. Prepare Cabling Administration Drawings showing building floor plans with cable administration-point identification labeling. Depict all telecommunications outlets and their associated label, provide callouts indicating locations of telecom rooms and spaces and, where applicable, indicate zone line demarcations denoting areas served by each respective telecom room. Coordinate drawing features with shop drawing requirements outlined in Section 27 00 00.

B. Prepare Drawings for use as part of cabling installation work. Periodically update Drawings to reflect constructed conditions, including any moves, changes or additions to the communications infrastructure. At completion, Cabling Administration Drawings shall reflect as-built conditions.

C. Interim Submission: Issue two (2) half-size printed copies of in-progress draft Cabling Administration Drawings to Owner no later than five (5) weeks after Substantial Completion, for Owner's use in preparation of patch schedules and to support other internal move-in planning processes. Coordinate exact timing with Owner's IT personnel.

3.4. TEST RESULTS DOCUMENTATION

A. Upon completion of the installation, the contractor shall provide (1) full electronic documentation sets to Ownership for approval.

B. Documentation shall be submitted within ten (30) working days of the completion of the testing phase. This includes draft as-built drawings. Draft drawings may include annotations done by hand.

C. All documentation, including hard copy and electronic forms shall become the property of the Owner.

3.5. WARRANTY

A. The Contractor shall guarantee all materials, equipment, etc., for (1) year from date of substantial completion of this work. This guarantee shall include all labor, material and travel time. This warranty is in addition to the cabling system manufacturer's warranty.

B. The Cabling Contractor shall provide a SCS (Structured Cabling Systems) manufacturer's warranty providing for applications assurance and protection against all product defects for a minimum period of (20) years.

END OF SECTION 27 08 00

SECTION 27 11 00- COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 SUMMARY

A. The work covered under this Section shall consist of a design, furnishing of all material, labor, and installation for completion of an operable end to end structured cabling system. Including equipment for the Telecomm Rooms.

1.2 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NEC, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.3 RELATED DOCUMENTS

A. General and Supplementary Conditions

1.4 RELATED SECTIONS

A. Division 26 - Grounding and Bonding

B. Division 27 - Communications

PART 2 - PRODUCTS

2.1 TELECOMMUNICATIONS PLYWOOD BACKBOARD

A. Backboards shall be 4'W x 8'H x ¾"D.

B. FIRE RETARDENT Finished grade of A-C or better. A-side shall face the interior of the room.

C. All sides of each backboard should be finished with (2) coats of white paint prior to installation. Plywood grade and fire rating stamps on plywood shall remain exposed and not painted over.

D. If the walls where plywood backboard will hang are fire rated or there's a requirement for fire rating per codes, the plywood backboard and finish paint must meet the same fire rated requirements.

E. A fire retardant paint additive may be used and the associated documentation should be applied to the painted backboard as proof of usage.

2.2 EQUIPMENT RACKS

A. Equipment Racks, Cable Management and Ladder Style Cable Runway shall be provided in all TR, SR, IDF, and MDFs as show on the Telecommunications Drawings and specified herein to house the Design Builder provided Patch Panels, Horizontal Cable Management, and Fiber Enclosures, and the Owner provided Network Equipment.

B. Equipment Racks and Cable Management shall be Standard (i.e. not Custom Designed or Built for this Project). All Equipment Room Fittings shall be of a single Manufacturer.

C. All Racks and Ladder Rack will be UL Listed.

D. Racks

1. 4-Post Quad Frame Equipment Racks shall be Standard 84" High EIA 19" wide and 29" deep. It shall contain front and rear C-shaped mounting rails with .375" mounting holes for cage nut or equal mounting hardware and provide a minimum of 43U of Rack Space.
   a. Manufacturer: CPI - Quadra Frame, Panduit or Approved Equal

2.3 VERTICAL CABLE MANAGEMENT

A. Vertical Cable Management shall be provided between and at the end of each row of racks as specified on the Telecommunication Drawings, and shall extend from top to bottom of each rack.

B. Vertical Cable Management shall be Double Sided and have a minimum width of 6".
1. Manufacturer: CPI, Panduit or Approved Equal

2.4 HORIZONTAL CABLE MANAGEMENT

A. Horizontal Cable Management shall be provided be provided on the front of each rack below and between each 48-Port Patch Panel and Fiber Enclosure.
1. Manufacturer: CPI, Panduit or Approved Equal

2.5 LADDER RACK

A. Ladder Rack shall be provided in TR, SR, IDF, BDF, and MDF and shall wrap the perimeter of the room.

B. Ladder Rack Shall be UL listed.

C. Ladder Rack shall have a minimum width of 12" with cross members at 9" centers. There will be 8" of open space in-between each cross member.

D. Ladder Rack shall be supported
1. Manufacturer: CPI, Panduit or Approved Equal

2.6 LADDER RACK SUPPORTS AND ACCESSORIES

A. Triangular and Wall Angle Support Brackets are to be of Aluminum or Steel construction, and need to be rated to support a minimum 80lbs.

B. The Brackets shall be attached with a minimum of ¼ " Lag Bolts to Plywood Backboards or as required to properly support the cable runway system.

C. Radius drops or "waterfalls" used to maintain the bend Radius of the cables as they exit or enter the ladder rack/tray will be manufactured from aluminum extrusion. The extrusion will be formed in a 90° arc with a minimum bend radius of 3". Radius drops will attach to either the side stringer or the cross member of the ladder rack/tray using a clevis pin. Radius drops will include 1-1/2" high cable spools that attach to the top of the radius drop to guide cables.

D. All Equipment Room Fittings shall be of a single manufacturer.

2.7 FIBER OPTIC ENCLOSURES

A. Rack-mounted Fiber Optic Patch Panel shall be capable of supporting fiber modular distribution coupler panels.

B. Fiber optic connectors shall be LC style.

C. Must comply with TIA-568-C standards.

D. Rack mount fiber patch panels shall be mountable in a standard 19-inch rack, cabinet, etc.

E. Front panel must have tray that slides out for front access.

F. Fully populate any unused bays with blank panels.

G. Manufacturer: Corning, Panduit, Commscope or Approved Equal

2.8 CATEGORY 6A PATCH PANELS

A. Compliance: Listed and third party verified to comply with TIA 568-C Category 6A specifications and associated addendums.

B. Conductive cabling and associated components shall comply with Article 800 of the NEC (2008)

C. Application: Use for termination of Category 6A, 4-Pair horizontal distribution cable.

D. Shall support either 24 or 48 Ports and be 1U or 2U, respectively.

E. Shall be flat in design.

F. Manufacturer: Leviton, Panduit, Commscope or Approved Equal

2.9 UNINTERUPTABLE POWER SUPPLY

A. 19” x 2RMS Rack Mountable Uninterruptible Power Supply.

B. 3kVA/2.7kW line interactive pure sine wave type.

C. Automatic voltage regulation with 208/30A Power input.

D. Shall include a IEEE 802.3 compliant Network Interface Card.

E. Shall include (8) 5-15R for connection to telecommunications equipment.

F. (1) UPS Shall be provided for each installed 4 post quad frame rack.

G. Manufacturer: APC SMT3000VA, Minuteman, or Approved Equal

PART 3 - EXECUTION

3.1 RACKS, CABLE MANAGEMENT, SUPPORTS, ACCESSORIES:

A. Provide all components of the ladder rack/tray system (ladder rack/tray, turns, splices, supports, and accessories) from a single manufacturer.

B. Ground all racks independently to the equipment ground bus bar with a dedicated #6 copper wire.

C. Rack elevations to be coordinated with Ownership prior to install.

D. Ladder rack/tray shall be installed with side stringers facing down so that the ladder forms an inverted U-shape and so that welds between the stringers (sides) and cross members (middle) face away from cables.

E. Ladder rack/tray shall be secured to the structural ceiling, building truss system, wall, floor or the tops of equipment racks and/or cabinets using the manufacturer's recommended supports and appropriate installation hardware and methods as defined by local code or the authority having jurisdiction (AHJ).

F. Ladder rack/tray splices will be made in mid-span, not over a support, with the manufacturer's recommended splice hardware.

G. Ladder rack/tray shall be supported every 5' or less in accordance with TIA-569. Ladder rack/tray shall be supported within 2' of every splice and within 2' on both/all sides of every intersection. Support ladder rack/tray within 2' on both sides of every change in elevation. Support ladder rack/tray every 2' when attached vertically to a wall.

H. When the pathway is overhead, ladder rack/tray shall be installed with a minimum clearance of 12" above the ladder rack/tray. Leave a minimum of 12" in between ladder rack/tray and ceiling/building truss structure. Leave a minimum of 3" in between ladder rack/tray and the tops of equipment racks and/or cabinets. Multiple tiers of ladder rack/tray shall be installed with a minimum clearance of 12" in between each tier of ladder rack/tray. When located above an acoustical drop ceiling, leave a minimum of 3" clearance between the top of the drop ceiling tiles and the bottom of the ladder rack/tray.

I. All threaded rod used in support of overhead cable trays shall have cable guard protectors installed over the exposed threaded rod in the area of the tray. The exposed end of the threaded rod hangers shall be cut flush with the mounting brackets, filed, and painted to match site conditions. Install rubber-finishing caps on any exposed metal end rail or potential sharp point.

J. Within each telecommunications room, ladder rack/tray should be bonded together, electrically continuous, and bonded to the Telecommunications Grounding Bus bar (TGB), unless otherwise noted in the specifications and contract documents. Ladder rack/tray and turns shall be bonded across each splice with a bonding kit. Ladder rack/tray shall be bonded to the (TGB) using an approved ground lug on the ladder rack/tray and a minimum #6 grounding wire or as recommended by the AHJ. Remove paint from the ladder rack/tray where bonding/ground lugs contact the ladder rack/tray so that the lug will contact bare metal. Use antioxidant joint compound in between the bare metal on the ladder rack/tray and ground lug. Use antioxidant joint compound in between the bus bar and the ground lug. Verify continuity through the bonds at splices and intersections between individual ladder rack/tray sections and turns and through the bond to the TGB.

K. The quantity of cables within the ladder rack/tray will not exceed a whole number value equal to 50% of the interior area of the ladder rack/tray divided by the cross-sectional area of the cable. The interior area of ladder rack/tray will be considered to be the width of the ladder rack/tray multiplied by a height of 2", unless cable-retaining posts are added to the ladder rack/tray. The interior area of ladder rack/tray equipped with cable retaining posts will be considered to be the width of the ladder rack/tray multiplied by a height of 6". Actual cable fill for ladder rack/tray that is not equipped with cable retaining posts will not exceed 2" in height. Actual cable fill for ladder rack/tray equipped with cable retaining posts will not exceed 6" in height.

L. The combined weight of cables within the ladder rack/tray will not exceed the stated load capacity of the ladder rack/tray as stated in the manufacturer's product specifications or load/design tables.

M. Cables (cable bundles) will be secured to the cross members of ladder rack/tray with ¾" wide reusable straps. Straps are not required when ladder rack/tray is equipped with cable retaining posts.

N. Use a radius drop to guide cables wherever cable exits overhead ladder rack/tray to access a rack, cabinet or wall-mounted rack, and cabinet or termination field. Provide a support other conductors that should be physically separated from cables within the ladder rack/tray as defined by local code or the authority having jurisdiction (AHJ).

O. Whenever possible, maintain a 2' separation between ladder rack/tray used for communications cables and pathways for other utilities or building services.

P. The installer will provide touch-up paint color-matched to the finish on the ladder rack/tray and will correct any minor cosmetic damage (chips, small scratches, etc.) resulting from normal handling during the installation process prior to delivery to the owner. If a component is cosmetically damaged to the extent that correction in the field is obvious against the factory finish, the component will be replaced with a new component finished from the factory. If a component is physically damaged due to mishandling or modification during the installation process, it shall not be used as part of the ladder rack/tray system.

3.2 FIBER OPTIC ENCLOSURE

A. Coordinate exact rack elevation prior to installing fiber optics patch panel.

B. Install new adapter panels from left to right in new housing.

3.3 CATEGORY 6A PATCH PANELS

A. Coordinate exact rack elevation prior to installing copper patch panels.

B. Install and terminate per manufacturer's recommendations.

END OF SECTION 27 11 00

SECTION 27 13 00- COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. The work covered under this Section shall consist of a testing, documenting, and commissioning of an operable end to end Communications Copper Backbone Cabling System.

B. The work covered under this Section shall consist of a testing, documenting, and commissioning of an operable end-to-end Communications Fiber Optical Backbone Cabling System.

1.2 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NEC, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. All cable and equipment shall be installed in a neat and competent manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Consultant or Consultant Representative. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where “approved equal” is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.

C. Strictly adhere to all Building Industry Consulting Service International (BICSI), Electronic Industries Alliance (EIA) and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data cabling.

D. Material and work specified herein shall comply with the applicable requirements of the current adopted revision of the following:
1. ANSI/TIA – 568 Series Commercial Building Telecommunications Cabling Standard,
2. TIA – 569 Commercial Building Standard for Telecommunications Pathways and Spaces,
3. ANSI/TIA – 606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
4. ANSI-J-STD – 607 Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
5. NFPA 70 – National Electric Code
6. BICSI – Telecommunications Distribution Methods Manual

1.3 SUBMITTALS

A. Cable Manufacturer’s data, including part numbers, cut sheets and detailed descriptions, for all proposed equipment

B. The Contractor shall submit a copper cable pulling plan for all multi-pair copper cables with a pair count of 100 pairs or greater, that includes, but is not limited to, the following:

C. Each cable run and route.

D. Date and duration of the pull.

E. Product data for all termination and test equipment to be used by Contractor to perform work.

F. Equipment shall be calibrated with traceability to National Institute of Standards and Technology (NIST) requirements.

G. Contractor shall include copy of calibration and certification that equipment calibration meets NIST standards and has been calibrated at least once in the previous calendar year.

1.4 RELATED DOCUMENTS

A. General and Supplementary Conditions

1.5 RELATED SECTIONS

A. Division 27

PART 2 - PRODUCTS

2.1 INTRA-BUILDING COPPER BACKBONE FOR ANALOG/ VOICE ONLY

A. UL-listed CMR cable: Solid copper conductors with high-density polyolefin insulation and overall low smoke PVC jacket to achieve riser (i.e., non-plenum) rating by UL standards

B. UL-listed CMP cable: Solid copper conductors with FEP insulation and overall low smoke PVC jacket to achieve plenum rating by UL standards

C. LSZH cable: Solid copper conductors with non-halogen HDPE insulation and low smoke, zero halogen, compound jacket to achieve LSZH rating by:
1. IEC 60754—Part 2.
2. IEC 61034—Part 2.
3. IEC 60332—Part 1.
4. Def Stan 713.

D. Cable shall meet the requirement of ANSI/TIA/EIA-568 series Standards for Category 3 performance.

E. Approved Manufacturer: General, Commscope, Berk Tek or Equavalent.

2.2 INTER-BUILDING COPPER BACKBONE FOR ANALOG/ VOICE ONLY

A. All cable shall be manufactured and constructed for use in the Outside Plant Environment.

B. Cable shall meet the requirement of ANSI/TIA/EIA-568 series Standards for Category 3 performance

C. Approved Manufacturer: General, Commscope, Berk Tek or Equavalent.

2.3 BUILDING ENTRANCE PROTECTORS

A. Building entrance protection for copper cabling shall be installed utilizing a two (2) foot fuse link between outside plant cable plant splice and the protector module with IDC-type input and output terminals, 100 pair-pair capacity and female mounting base, equipped with 230-volt solid-state protector modules. Sufficient protector modules shall be provided to completely populate all building entrance terminals.

2.4 INTRA-BUILDING FIBER OPTIC BACKBONE CABLING

A. Indoor Cables - All cable shall be listed for use indoors per the National Electrical Code (NFPA-70) and shall meet one of the following, per bid document.
   1. Indoor Riser Rated Tight Buffer - UL-listed OFNR: Tight buffer optical fibers, aramid strength yarn, and riser-rated outer jacket.
   2. Indoor Plenum Rated Tight Buffer UL-listed OFNP cable: Tight buffer optical fibers, aramid strength yarn, and plenum-rated outer jacket.
   3. Indoor Low Smoke/Zero Halogen Riser Rated Tight Buffer LSZH cable: Solid copper conductors with non-halogen HDPE insulation and low smoke, zero halogen, compound jacket to achieve LSZH rating.
   4. Indoor Armored Riser Rated Tight Buffer - UL-listed OFCR: Tight buffer optical fibers, aramid strength yarn, a riser-rated jacket, aluminum interlocking armor with an overall riser-rated sheath jacket to provide additional protection and security.
   5. Indoor Armored Plenum Rated Tight Buffer UL-listed OFCP cable: Tight buffer optical fibers, aramid strength yarn, a plenum-rated outer jacket, aluminum interlocking armor with an overall plenum-rated sheath jacket to provide additional protection and security.

B. Approved Manufacturer: Circa, Commscope, Marconi or Equivalent

2.5 INTER-BUILDING FIBER OPTIC BACKBONE CABLING

A. All cable shall be manufactured and constructed for use in the Outside Plant Environment and shall meet one of the following, per bid document.
   1. Outside Plant (OSP) loose tube all dielectric - Dielectric design with MDPE sheath jacket and no metallic elements to provide environmental protection.
   2. Outside Plant (OSP) loose tube metallic sheath - Metallic sheath design with MDPE sheath jacket to provide environmental protection. Metallic armor of corrugated polymer coated steel tape to provide added crush protection. Armor shall meet Telcordia requirements for superior armored cable.

B. Buffer tubes and optical fibers
   1. Industry standard buffer tubes stranded around a central strength member and compatible with standard hardware, cable routing, and fan-out kits.
   2. Optical fibers shall be industry-standard color coded and separated into 12-fiber color-coded binder groups surrounded by plastic core tubes

C. Water blocking
   1. OSP Fiber Cables are available as either fully dry or dry core with gel in the buffer tubes. The bid document will specify the cable type.
      a. Dry water-blocking compound suitable for underground conduit, direct burial, and aerial applications in cable and buffer tubes.
      b. Dry water-blocking compound suitable for underground conduit, direct burial, and aerial applications with gel filled buffer tubes.

D. Approved Manufacturer: (Leviton Cabling Systems / Berk Tek)

2.6 VOICE BACKBONE CABLING

A. Voice backbone cables shall have a minimum 10-foot service loop when terminated in the ER and TR, and at any splice points in telecommunications manholes.

2.7 110 WIRING BLOCKS

A. Application: Use to terminate copper backbone cabling installed between the termination points as indicated on drawings

B. Characteristics: 110 Wiring Blocks shall:
1. Facilitate Cross-connection and/or interconnection using either cross connect wires or patch cord.
2. Be manufactured using fire retardant molded plastic with the base consisting of horizontal index strips for termination up to 25-Pairs of conductors.
3. Support terminations of 22-26 AWG solid connectors.
4. To be wall mountable

C. Approved Manufacturer: Panduit, Commscope, or Equivalent

2.8 FIBER OPTIC ENCLOSURES

A. Rack-mounted Fiber Optic Patch Panel shall be capable of supporting fiber modular distribution coupler panels.

B. Fiber optic connectors shall be LC style.

C. Must comply with TIA-568-C standards.

D. Rack mount fiber patch panels shall be mountable in a standard 19-inch rack, cabinet, etc.

E. Front panel must have tray that slides out for front access.

F. Fully populate any unused bays with blank panels.

G. Manufacturer: Corning, Panduit, Commscope or Equivalent

2.9 INNER DUCT

A. The use of Innerduct is require for the placement of backbone fiber optic cabling. The Inner duct shall be at least a thin wall polyethylene meeting the UL specifications 2024.

B. Inner duct shall be rated for all environments in which they are installed.

C. Inner duct shall have a minimum inside diameter of 1 inch.

D. Approved Manufacturers: Carlon, Essex, General or approved equal.

2.10 COMMUNICATIONS OSP FIBER SPLICE CLOSURE

A. This section includes the minimum requirements for OSP Fiber Splice Closures.

B. OSP Closures are to be designed for aerial, buried and manhole applications and to be used with all types of Optical Fiber, Single-mode and Multimode.

C. A Closure line with different sizes of OSP Closures is required to accommodate a range of fiber counts and cable sizes.

D. The OSP Closure line is to have several different sizes to accommodate up to 384 fiber single fusion splices and to accept loose tube and central tube cables, both armored and all dielectric.

E. The Outside Plant Fiber Splice Closure must have at least one set of Express Ports to allow mid span splicing of one cable.

F. The Outside Plant Fiber Splice Closure must have at least two Drop Ports.

G. The Outside Plant Fiber Splice Closure must have a grommet system that allows for more than one cable per Drop Port, depending on cable size.

H. The Outside Plant Fiber Splice Closure must have a tray system that allows the use of multiple trays. Tray count is dependent on the number of fibers to be spliced.

I. The Outside Plant Fiber Splice Closure tray system must allow for easy access to all trays: top, inner and bottom.

J. The Outside Plant Fiber splice closures are to be designed:
   1. To comply with Telcordia GR-20 for environmental sealing and water immersion
   2. For re-entry and not require the use of an encapsulant
   3. With a flash testing port
   4. With a security locking tab
   5. With an operating temperature: Operating Temperature -40 °C to +66.5 °C (-40 °F to +151.7 °F)

K. Closure for 2 to 48 Fibers
   1. Dimensions
      a. Diameter: 127.0 mm (5.0 in)
      b. Length: 515.6 mm (20.3 in)
   2. Mechanical Specifications
      a. Cable Entry Drop Port Size: 25.0 mm (1.0 in)
      b. Cable Entry Drop Port, quantity: 2
      c. Cable Entry Express Port Size: 25.0 mm (1.0 in)
      d. Cable Entry Express Port, quantity: 2

L. Closure for 48 to 288 Fiber
   1. Dimensions
      a. Diameter: 165.1 mm (6.5 in)
      b. Length: 622.3 mm (24.5 in)
   2. Mechanical Specifications
      a. Cable Entry Drop Port Size: 25.0 mm (1.0 in)
      b. Cable Entry Drop Port, quantity: 3
      c. Cable Entry Express Port Size: 25.0 mm (1.0 in)
      d. Cable Entry Express Port, quantity: 2

PART 3 - EXECUTION

3.1 GENERAL

A. Provide all necessary products for installation of Copper Backbone cablings to include cable attachments, etc.

B. Backbone cable shall be installed following industry standard practices.

C. All Outside Plant Backbone cable shall terminate on Primary protection (per the NEC) upon entering the building.

D. Contractor shall terminate the 25-Pair copper cabling to a 110-style block. With (4) C4 clips and (1) C5 clip.

E. All installations shall comply with:
1. ANSI/TIA – 568 Series Commercial Building Telecommunications Cabling Standard,
2. TIA – 569 Commercial Building Standard for Telecommunications Pathways and Spaces,
3. ANSI/TIA – 606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
4. ANSI-J-STD – 607 Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
5. NFPA 70 – National Electric Code
6. BICSI – Telecommunications Distribution Methods Manual

F. All cabling shall be rated for the environment in which they will be installed.

G. Cable shall be continuous from end to end unless otherwise noted on drawings or directed by Owner.

H. Adhere to all manufacturer's requirements regarding pulling tension and allowable lubricants.

I. All fiber optic cabling shall be installed in 1" inner duct in conduits between terminations points, unless noted on drawings or approved by Owner.

J. All fiber runs must have a 15' service loop at each end.

K. Test, Label, and document as per section 27 08 00 requirements.

3.2 BACKBONE CABLE TESTING

A. All multi-pair copper cable pairs installed shall be tested to TIA/EIA 568A, Category 3 equivalent performance specifications. In addition, provide loop resistance measurements in ohms and dB loss at 1 KHz, 8 KHz, and 256 KHz.

B. 100% of all pairs in backbone copper cables shall be tested for continuity and wire-map.

C. Complete end-to-end test results for all Fiber Optic cables installed are required.

D. All fiber optic cable must be visually inspected and optically tested on the reel upon delivery to the installation site. Using an Optical Time Domain Reflectometer (OTDR), an access

jumper with like fiber, a pigtail, and a mechanical splice, all fibers shall be tested for continuity and attenuation.

E. Testing for continuity and attenuation on the reel must confirm factory specifications to ensure that the fiber optic cable was not damaged during shipment. The test results must match the results of the factory- attached tag on the reel, or the fiber shall not be used. Reel data sheet must be provided showing test results.

F. End to end (bi-directional) test measurements shall be provided (unless otherwise noted) for single- mode and multimode fibers (2 wavelengths per test are required). Test results must be submitted for review as part of the installation inspection requirements. Test results shall be in paper form and electronic form, and must contain the names and signatures of the technicians performing the tests.

G. Testing shall be performed on 100% of the fibers in the completed end-to-end system. ANSI/TIA-568-A, Annex H, provides the technical criteria and formulae to be used in fiber optic testing.

H. Additionally, all fiber optic cable links must pass all installation and performance tests both recommended and mandated by the cable manufacturer.

I. Testing Format: Test Results must be submitted in two (2) formats. First, must be original file(s) down loaded from tester. Second, the file must be cohesively placed in Excel or PDF format with the following fields:

J. ER/TR RM # / RM # of drop / Port # / all relevant test information in as many fields as necessary.

K. All test results are to be recorded and submitted to the Consultant.

3.3 SPLICE CASE INSTALLATION

A. Contractor shall comply applicable codes, standards and with all local codes and requirements. It is the responsibility of the contractor to identify and adhere to any unique codes or requirements governed by the region where the work is to be performed.

B. Splice Closures and Cables shall be installed following industry standard practices.

C. Slack cable is mandatory and shall be stored properly for the application.

D. Splice Closures shall be supported with the proper hardware for the application. Use of the appropriate Pole, Aerial and Maintenance Hole Hardware from the manufacturer shall be used.

E. Contractor shall not exceed the maximum pulling tension or the minimum bending radius for OSP cables per manufacturer's specifications.

3.4 CABLE SUPPORTS

A. Provide cable supports and clamps to attach cables to backboards and walls.

B. Attach horizontal and vertical backbone cables at 2-foot intervals using Owner approved supports; such as D-rings or jumper troughs utilized for wire management.

C. Attach cables to manhole racks using Owner approved methods

D. Backbone cabling shall be secured to the cable/ladder tray following manufacturer recommended procedures, and appropriate installation hardware and methods as defined by local code or the authority having jurisdiction (AHJ).

3.5 AS-BUILT DRAWINGS

A. CAD Files: Provide CAD files in .dwg or .dgn formats showing floor plans with room numbers and actual backbone cabling and pathway locations and labeling. The deliverable is required within 5 business days of final cable testing.

B. Red Line Drawings: Contract must kept one (1) E size set of floor plans on site during work hours showing installation progress marked and backbone cable labels noted. Contractor may be asked to produce these drawings for examination during construction meetings or field inspections.

END OF SECTION 27 13 00

SECTION 27 15 00- COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the minimum requirements for Copper Horizontal Cables.

B. Horizontal (to desktop) cable shall consist of Category 6A copper cable for all Data and Voice applications.

C. Outlets for wall-mounted or other “telephone only” installations shall consist of one Category 6A cable as a minimum.

D. Outlets for wireless access points (APs), IP Camera locations (SCs) and ancillary IP network appliances shall consist of Category 6A cables as a minimum.

1.2 QUALITY ASSURANCE

A. All cable and equipment shall be installed in a neat and skillful manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner or Owner Representative. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where “approved equal” is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.

B. Strictly adhere to all Building Industry Consulting Service International (BICSI), Electronic Industries Alliance (EIA) and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data cabling.

C. Material and work specified herein shall comply with the applicable requirements of the current adopted revision of the following:
1. ANSI/TIA – 568 Series Commercial Building Telecommunications Cabling Standard,
2. TIA – 569 Commercial Building Standard for Telecommunications Pathways and Spaces,
3. ANSI/TIA – 606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
4. ANSI-J-STD – 607 Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
5. NFPA 70 – National Electric Code
6. BICSI – Telecommunications Distribution Methods Manual
7. TIA/EIA-568-C.1 – Commercial Building Telecommunications Cabling Standard
8. TIA/EIA-568-C.2 - Balanced Twisted-Pair Telecommunications Cabling and Components Standards
9. ISO/IEC 11801 - Generic Cabling for Customer Premises
10. CENELEC EN-50173 - Generic Cabling Systems

1.3 CABLE CONSTRUCTION

A. Listed CMR cable: Solid copper conductors with high-density polyolefin insulation and an overall low smoke polyvinyl chloride (PVC) jacket to achieve a riser (i.e., non-plenum) rating by applicable NEC requirements.

B. Listed CMP cable: Solid copper conductors with fluorinated ethylene propylene (FEP) insulation and an overall low smoke PVC jacket to achieve plenum rating by applicable NEC requirements.

C. LSZH cable: Solid copper conductors with non-halogen high-density polyethylene (HDPE) insulation and a low smoke, zero halogen, compound jacket to achieve a LSZH rating by applicable IEC standards

D. LC cable: Solid copper conductors with FEP fluoropolymer insulation and overall FEP fluoropolymer jacket to achieve CMP 50 rating by UL standards

E. OSP outdoor cable rated for wet locations: Solid copper conductors with polyethylene insulation, polyolefin fluted center member with flooding compound, and black polyethylene jacket

F. Comply with following general physical specifications:
   1. Maximum pulling tension: 110 Newton's (25 pound-force)
   2. Operating temperature: –20 to 60 degrees C [–4 to 140 degrees F]

1.4 COORDINATION

A. Coordinate layout and installation of cable tray with other trades.

1.5 RELATED SECTIONS

A. Division 27

PART 2 - PRODUCTS

2.1 HORIZONTAL STATION CABLING

A. Unshielded Twisted-Pair Category 6A Cable (UTP)
   1. Cable shall be listed for the environment where it will be installed (Plenum, Riser, LSZH, etc.).
   2. Shall Consist of (4) 23 AWG Twisted Pairs.
   3. The overall diameter of the cable shall not exceed 0.28 inches.
   4. Cabling shall be rated to a minimum of ANSI/ TIA Category 6A Rating.
   5. Shall meet the TIA 568-C Transmission Characteristics Standard for Category 6A UTP Cable.
   6. Approved Manufacturer: Commscope, Berk Tek, Essex or Equivalent

2.2 CATERGORY 6A JACKS

A. Physical Characteristics
   1. Shall be functional from 14 degrees F to 140 degrees F.
   2. Shall be tested in accordance with ANSI/ TIA-568-C for Category 6A performance.
   3. Shall be modular RJ45 Jacks that snap into user configurable faceplates meeting the durability requirements specified in IEC 603-7.

B. Shall be 110 IDC, RJ45 type suitable for 22-26 AWG wires and be certified Category 6A compliant.

C. Conductors shall be separated and aligned internally by jack comb.

D. Wired in accordance with TIA T568C polarization sequence

E. Color(s) to be submitted to owner prior to installation.

F. Acceptable Manufacturers: Panduit, Commscope, Leviton or Equivalent.

2.3 FACEPLATES

A. Faceplates shall:
1. Comply with TIA 606-A Standard specifications.
2. Be UL listed.
3. Be from the same manufacturer as the Modular Jacks.
4. Have a recessed designation window to facilitate labeling and identification in all offices and cubicles.
5. Single gang faceplates shall support a maximum of (6) Modular Jacks.
6. Blank Fillers shall be installed when extra ports are not used.

2.4 ACCEPTABLE MANUFACTURERS: WALL PHONE FACEPLATES

A. Shall be constructed of stainless steel.

B. Shall have mounting lugs to support phone mounting.

C. Phone manufacturer and model number to be provided by Owner.

D. Shall be capable of being mounted to a single gang box.

E. Shall be wired to TIA-568B

F. Acceptable Manufacturers: Commscope, Leviton, Allen Tel or Equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

A. UTP Cabling
1. Maximum Length shall be 90 meters (295') from termination point (patch panel) to termination (wall outlet)
2. Cable above accessible ceiling shall be supported at every 5 feet on center with cable supports attached to the building structure.
3. All cables to be terminated to manufacturers recommended guidelines.
4. Cable shall have no physical defects such as cuts, tears, or bulges in the outer jack. Cable with defects shall be replaced.
5. Install cable in a neat and skillful manner. Neatly bundled and tie all cabling in accessible ceilings.
6. Maintain the following clearances from EMI sources.
   a. Power Cables = 6 inches.
   b. Fluorescent lights = 12 inches
   c. Transformers = 36 inches
7. Do not install UTP cable with more than 110N (25lbs) pull force, as specified in TIA and BICSI practices. Utilize appropriate cable lubricant in sufficient quantity to reduce pulling friction to acceptable levels on:
   a. Long pulls inside conduit.

b. Pulls of multiple cables into a single small-bore conduit.
c. Conduit runs greater than 100 lineal feet with bends of opposing direction.
d. Conduit runs that exceed 180 degrees of accumulated bends.

8. Cable jackets that are chaffed or burned exposing internal conductor's insulation or have any bare copper ("shiners") shall be replaced.
9. Fire stopping will be installed in all openings where communications cabling is installed through a fire barrier.
10. All cables will be terminated with high-density modular jacks that snap into a faceplate mounted on a wall outlet.
11. Any extra openings in faceplates will be filled in with a blank insert.
12. Terminate cabling per TIA T568B standard pin assignment.
13. All horizontal cabling is to be of a single manufacturer from Termination to Termination.

END OF SECTION 27 15 00

SECTION 274116 – INTEGRATED AUDIO-VIDEO SYSTEMS AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Provisions of Division 1 apply to this section.

B. Section Includes
1. Provide all labor, materials, transportation, and equipment to complete the furnishing, installation, assembly, set up, and testing of the Audio, Video and Control Systems work indicated on the drawings and specified herein. Notwithstanding any detailed information in this Section, provide complete, working systems. General design intent for this project is shown on the drawings and described in the specification.
2. All equipment requiring coordination with other trades must be tested and verified for proper operation. AV Contractor is fully responsible for the coordination and must resolve all conflicts with AV equipment that connect or interact with other systems.
3. Design, engineer and provide complete means of support, suspension, attachment, fastening, bracing, and seismic restraints (hereinafter "support") of the Work of this Section, including future installed equipment, in accordance with local building codes and regulations. Provide engineering of such support by parties licensed to perform work of this type in the Project jurisdiction. AV Contractor shall obtain the services of an engineer licensed to perform this work within the state or jurisdiction it is to be performed.
4. Use skilled mechanics that are capable of returning surfaces to the appearance of new work when modifying millwork.
5. Conduit and common back boxes including four square, pull boxes, junction boxes, etc. are supplied and installed by Division 26 Electrical Contractor. Connection panels that install in these boxes are supplied by AV Contractor.
6. Provide Power Over Ethernet switches and injectors where required.
7. Provide all cable and wire associated with this specification section and related documents.
8. All systems shall be completely installed with all of the necessary interconnection, power supplies, patch cords, snakes, portable equipment cables and wiring to provide a fully functioning system.
9. The governing overall requirement for this project is a complete and functional system.
10. Include work not usually shown or specified, but necessary for proper installation and operation of the system or piece of equipment.

C. Related Sections
1. Division 9.
2. Division 10.
3. Division 11.
4. Division 26.

1.2 REFERENCES

A. Comply with all applicable governing codes.

B. Comply with the following applicable organizations and standards:
1. AES Audio Engineering Society
2. ANSI American National Standards Institute
3. ASTM American Society for Testing and Materials

4. ATSC Advance Television System Committee
5. BICSI Building Industry Consulting Service International, Inc.
6. BTSC Broadcast Television Stereo Committee
7. CEDIA Custom Electronic Design and Installation Association
8. EIA Electronic Industries Alliance
   a. RS-310-C: (ANSI C83.9) Racks, Panels, and Associated Equipment
   b. RS-453: Dimensional, Mechanical, and Electrical Characteristics Defining Phone Plugs and Jacks
9. ETL Electrical Testing Laboratories, Inc.
10. FCC Federal Communications Commission
11. ICIA International Communications Industries Association
12. IEC International Electrotechnical Commission
13. IEEE Institute of Electrical and Electronic Engineers
14. INCITS InterNational Committee for Information Technology Standards
15. ISO International Organization for Standardization
16. ITU International Telecommunications Union
17. NAB National Association of Broadcasters
18. NCTA National Cable and Telecommunications Association
19. NEC National Electrical Code
20. NEMA National Electrical Manufacturers Association
21. NFPA National Fire Protection Association
22. NSCA National Systems Contractors Association
23. OSHA Occupational Safety and Health Administration
24. SMPTE Society of Motion Picture and Television Engineers
25. TASO Television Allocation Study Organization
26. TIA Telecommunications Industry Association
27. UBC Uniform Building Code
28. UL Underwriters Laboratories Inc.

C. Comply with the following Technical Guidelines:
   1. INFOCOMM Best Practices Guidelines
   2. Middle Atlantic Thermal Management White Paper
   3. Middle Atlantic Power distribution and grounding of Audio, Video and Telecommunication Equipment including addendum one.

1.3 DEFINITIONS

A. Definitions of Terms: The following definitions and conditions apply to each of the respective parameters and the measurements of those parameters, unless specifically stated otherwise:
   1. Frequency Response: The minimum acceptable frequency band over which the amplitude response is within 3 dB (or any specified range), or the specified limits of the response relative to the reference frequency (1 kHz for audio, 1.0 MHz for video) under design load conditions, at any operating level up to and including the specified maximum output while fully in compliance with all other performance specifications.
   2. Maximum Output Level: The minimum acceptable maximum signal output level (voltage, current or power) attained under design load conditions attained while fully in compliance with all other performance specifications.
   3. Harmonic Distortion: The maximum acceptable harmonic distortion measured at any operating level, up to and including the specified maximum output, with an applied sine wave signal of any frequency in the range of the specified frequency response.
   4. Audio Intermodulation Distortion: The maximum acceptable intermodulation distortion resulting from the introduction of 60 Hz and 7 kHz signals in a ratio of 4:1 under design load conditions at any operating level up to and including the specified maximum output level.

5. Signal to Noise Ratio: The minimum acceptable ratio of signal to noise levels derived from broadband measurements under design load at maximum output over the entire range of the specified frequency response.
6. Clipping Level: The minimum acceptable maximum level of signal applied to the device under design load conditions while fully in compliance with all other performance specifications.
7. Sensitivity: The maximum acceptable level of input signal applied to the device that is necessary to provide the maximum output under design load conditions.
8. Design Load: The load (in ohms) specified by usage of the particular device input or output.

B. Signal Levels: The following voltage levels shall be considered the standard operating levels for the particular circuitry, unless specifically noted otherwise (0.775 Volt = O dBu = O dBm for a 600 ohms terminated circuit):
1. Microphone Circuits: -30 dBu or less.
2. Audio Line Level Circuits: -30 dBu to +24 dBu; equivalent to -30 dBm to +24 dBm for a 600 ohms terminated circuit.
3. Loudspeaker Level Circuits: More than +24 dBu.
4. Video Line Level Circuits: 1.0 Volt, peak to peak composite signal.
5. Radio Frequency (RF), Television (MATV) Circuits: +6 to +72 dBmV (0 dBmV = 1,000 microvolts).

C. Characteristic Impedances: The following operating impedances shall be considered to be the standard operating impedances for the particular circuitry, unless specifically noted otherwise:
1. Microphone Circuits: 50-250 ohms source, 150-1500 ohms terminating, electrostatically and electromagnetically balanced to ground.
2. Audio Line Level Circuits: 600 ohms maximum source, 600 ohms minimum. terminating, line to line, electrostatically and electromagnetically balanced to ground.
3. Video Line Level Circuits: 75 ohms maximum source, 75 ohms minimum terminating to shield and signal ground, with Vertical Standing Wave Ratio (VSWR) not to exceed 1.2.
4. Radio Frequency (RF) Television Circuits: 75 ohms nominal to shield and signal ground, with Vertical Standing Wave Ratio (VSWR) not to exceed 1.2.

1.4 SYSTEM DESCRIPTION

A. Design Requirements
1. General
a. The allcove – Beach Cities Health District, audio-visual system includes Lobby + Reception, Café, Large Group Room, Work Room, The Cove, Sensory Room, Group Rooms, Chat Rooms, and related spaces is described below.
b. All audio processing functions for the system shall be implemented with Digital Signal Processing equipment (DSP). The system shall connect to the Local Area Network for monitoring. Functions provided by this system include but are not limited mixing, level control, automatic mixing, equalization, adaptive equalization, delay, routing, dynamics, filters, processors, presets, etc.
c. Where required, an integrated High-Definition multimedia presentation matrix switcher shall be provided. The switcher shall have flexible routing of digital and analog sources, microphone mixing, audio DSP, amplifier, and control system capabilities. The switcher shall support analog and digital video formats including DVI, HDMI, and Display Port (HDMI compatible).
d. Where distributed loudspeakers are required, the location and spacing of the loudspeakers shall be designed to provide even coverage throughout the space with a minimum level of variation while integrating aesthetically into the overall ceiling plan. The system shall meet the following criteria:

1) 85 dBA minimum acoustical output with speech, 100 dB minimum acoustical output with music, measured in audience area, at listener height, with applicable program material.
2) Plus or minus 3 dB variation with frequency measured from 100 Hz to 4 kHz, at all locations in the audience area.
3) 6 dB minimum acoustical gain with talker 12 inches from microphones.

e. The AV Contractor shall utilize the HDBaseT connectivity standard for transmitting and receiving audio, video, ethernet, control and low voltage power to and from remotely located audio visual equipment

f. Flat Panel LED Displays - Use the following guidelines to determine the diagonal size required in a space.
1) Display screen height shall be equal to a minimum of 1/7 the distance from the screen to the least favored viewer.
2) The bottom of the screen shall be no lower than 48 inches above finished floor.

g. Projection Systems
1) Motorized projection screen height shall be equal to a minimum of 1/6 the distance from the screen to the least favored viewer.
2) DLP Laser video projectors shall be capable of at least 3840 lines of horizontal resolution and greater than 400 Lux per square meter of light output when measured at the projection screen.
3) The bottom of the projection screen shall be no lower than 48 inches above finished floor.
4) AV Contractor shall use lens shifting when projector cannot be aligned properly to the screen. Use of keystone correction is not allowed. Provide projector lifts where required to align projector to screen.

h. Where required, a software configured, web enabled, integrated central control system shall be provided to control all aspects of the audio and video system's functions, signal routing, lighting, shades and audio levels.

i. Infrastructure will be provided for the installation of AV equipment that will be installed at a future date. This infrastructure will be labeled to allow easy identification of these devices. Back boxes will be labeled with Device ID.

2. Lobby + Reception
a. A video display shall be provided for digital signage. A networked-based visual messaging system shall be provided to display owner created content. The signage software shall allow for remote content creation, scheduling and management via an owner supplied desktop computer.
b. Recessed ceiling mounted speakers shall be provided for background music and public address announcements. The ceiling speakers shall be distributed to provide uniform sound throughout the space. This space is part of a multi-zone distributed background music system that shall be provided.

3. Cafe
a. Recessed ceiling mounted speakers shall be provided for background music and public address announcements. The ceiling speakers shall be distributed to provide uniform sound throughout the space. This space is part of a multi-zone distributed background music system that shall be provided.
b. A local wall mounted control station shall be used to interface with the main system controller. This station shall be used for source select and volume control.

4. Work Room

a. Recessed ceiling mounted speakers shall be provided for background music and public address announcements. The ceiling speakers shall be distributed to provide uniform sound throughout the space. This space is part of a multi-zone distributed background music system that shall be provided.
b. A local wall mounted control station shall be used to interface with the main system controller. This station shall be used for source select and volume control.
c. An audio input panel with line level inputs and Bluetooth audio connectivity shall be provided.

5. Large Group Room
   a. The room shall be equipped with a short-throw video projector to display multimedia presentations onto appropriately sized projection screen. The video projector shall be wall mounted and supported from the wall structure. The projector shall be capable of at least 400 lux per square meter measured at the screen with at least 4K resolution.
   b. An HDMI switcher shall be used to switch between the AV connectivity panels to the video projector.
   c. Ceiling mounted speakers shall be provided for background music, public address announcements and sound reinforcement of program material.
   d. A local wall mounted control station shall be used to interface with the main system controller. This station shall be used for source select and volume control.
   e. An audio input panel with line level inputs and Bluetooth audio connectivity shall be provided.
   f. Connectivity for a portable Assistive Listening (ALS) System shall be provided per ADA requirements.

6. Breakroom
   a. A recessed ceiling mounted speaker shall be provided for background music and public address announcements. This space is part of a multi-zone distributed background music system that shall be provided.
   b. A local wall mounted control station shall be used to interface with the main system controller. This station shall be used for source select and volume control.

7. The Cove
   a. The room shall be equipped with a video projector with 4k support to display multimedia presentations onto appropriately sized projection screen. The video projector shall be ceiling mounted and suspended from the structure above the ceiling. The projector shall be capable of at least 400 lux per square meter measured at the screen with at least 4K resolution.
   b. A digital video presentation system shall be used to route audio and video signals from the various sources to the video projector.
   c. Ceiling mounted speakers shall be provided for background music, public address announcements and sound reinforcement of program material.
   d. Wall mounted speakers shall be provided at the Exterior Terrace for background music, public address announcements and overflow of program material from The Cove.
   e. AV panels with AV connectors shall be provided for connectivity of portable AV equipment.
   f. A wireless microphone system with head worn and handheld microphones shall be included for speech reinforcement.
   g. An integrated AV network enabled central control system shall be used to control all aspects of the AV system.
   h. A Wall mounted touch panel interface shall be provided to control the system. Presets shall be programmed to allow automatic recall of predetermine signal routing.

i. An assistive listening system shall be provided for the listening enrichment of the hearing impaired and to comply with ADA requirements.
j. An equipment rack shall be provided to house power amplifiers, source equipment, video presentation system, digital signal processing and control system equipment.

8. Snack Bar
   a. A video display shall be provided for digital signage. A networked-based visual messaging system shall be provided to display owner created content. The signage software shall allow for remote content creation, scheduling and management via an owner supplied desktop computer.

9. Sensory Room
   a. Recessed ceiling mounted speakers shall be provided for background music and public address announcements. The ceiling speakers shall be distributed to provide uniform sound throughout the room. This space is part of a multi-zone distributed background music system that shall be provided.
   b. A local wall mounted control station shall be used to interface with the main system controller. This station shall be used for source select and volume control.
   c. An audio input panel with line level inputs and Bluetooth audio connectivity shall be provided.

10. Group room
   a. An appropriately sized 4K flat panel video display shall be provided.
   b. A floor box or wall panel shall be provided for connectivity of portable equipment to the video display.
   c. A recessed ceiling mounted speaker shall be provided for background music and public address announcements. This space is part of a multi-zone distributed background music system that shall be provided.
   d. A local wall mounted control station shall be used to interface with the main system controller. This station shall be used for source select and volume control.
   e. An audio input panel with line level inputs and Bluetooth audio connectivity shall be provided.

11. Chate Room
   a. A recessed ceiling mounted speaker shall be provided for background music and public address announcements. This space is part of a multi-zone distributed background music system that shall be provided.
   b. A local wall mounted control station shall be used to interface with the main system controller. This station shall be used for source select and volume control.
   c. An audio input panel with line level inputs and Bluetooth audio connectivity shall be provided.

12. Public Address System
   a. A public address system shall be provided and be able to page in all rooms with ceiling mounted speakers and in all public common areas, and corridors. Distributed ceiling speakers shall be utilized to provide speech paging reinforcement.
   b. The public address system shall be controlled via an owner provided computer(s).
   c. Paging shall be initiated from the telephone system. Operators will pick up the handset, dial a four-digit number code to allow them access to the system. An “ALL PAGE” four-digit code will be programmed into the system to allow building wide paging.

B. Software Programming
   1. General

a. Except when otherwise agreed in writing the Owner's Representative shall retain legal and beneficial ownership of all Intellectual Property, including source code, created by the AV Contractor, their employees, and sub-contractors.
b. The AV Contractor must allow sufficient time for the programming of all software configurable audio, video and control systems. AV Contractors must evaluate the systems functional requirements and user interface and then allow time in their bid accordingly. The system description as well as the end user interview will provide the AV Contractor with the necessary information needed to proceed with the programming. Any questions as to the systems functional requirements must be sent in written RFI form to the Owner's Representative. All programming schemes must be submitted to the Owner's Representative for approval before programming starts. This includes the appearance of all user interfaces, touch panel layouts, preset and sub-preset information (acquired through Owner's Representative interviews), and speaker control schemes. The AV Contractor will also submit a narrative for the control system concept to the Owner's Representative for approval. The AV Contractor is to interview the Owner's Representative and their representatives to acquire the necessary information needed to allow for the proper programming of this system. The AV Contractor, after interviewing the Owner's Representative, will then submit a written report stating his interpretation of the Owner's Representative's requirements. Only after the Owner's Representative has approved the programming report may the AV Contractor proceed with the programming of this system.
c. All equipment that is connected to the Owner's local area network and is configurable via the local area network must have its equipment software installed onto dedicated computers provided by the Owner. The AV Contractor is to allot time to install and test equipment software onto a minimum of two of the Owner's computers which are to be identified by the Owner's Representative and/or Owner's Representative. The computers will be programmed to emulate user interfaces throughout the facility. The AV Contractor shall coordinate all software deployment over IP with the Owner's Information technology department.

2. Control system minimum programming outlined below:
   a. The AV Contractor shall allot 4 hours for on-site control system programming with the Owner's Representative.
   b. The Control System in this project shall connect to the Owner's Local Area Network (LAN). This connection will provide desktop computers control of the audio-visual system as well as make available remote troubleshooting via the internet. The AV Contractor shall provide time to install control system interface software on at least three desktop computers. Coordinate work with the Owner's Information Services personnel.
   c. Provide password protection to each control surface in this facility. Touch panels shall be activated and deactivated by password. Upon start up a password dialog box shall be presented to the user to enter his/her password. Only after entering a password will the user have access to the system. The system shall be programmed to shut down automatically after being idle for a time to be specified by the user. Coordinate this feature with operations staff.
   d. Touch panel layout design will conform to the InfoComm International "Dashboard for Controls" guidelines. Touch panel designs are to be custom to this project. Re-purposed touch panel designs are not acceptable.
   e. Technical users shall have the ability to access individual speaker zone controls via the touch panel interface.
   f. The AV Contractor shall provide a default audio level preset button, in the control system user interface, to allow a user or technician to recall all gain levels that were set when the system was commissioned.
   g. Control Help File: Each touch panel will include a help file that will explain each layer of the touch-panel control scheme.

h. All serial controlled devices must have bi-directional communication with the control system. All control functions locally available on each device must be accessible via the remote control system. All locally gestured control functions must mirror on the control system user interface. In other words, if a volume control is adjusted on a DSP interface that adjustment must register on the control interface.
i. Control system shall be used to power up and down connected equipment at control system start up and shut down.
j. Control system shall control both lighting and motorized window shades in each room.
k. The control system shall monitor the connected power amplifiers and report overheating that may occur.

3. Complexity of Programming:
   a. It is required that the AV Contractor be experienced in programming systems of this complexity. AV Contractors shall allow enough time in their bid to permit extensive programming of all software configurable audio, video, and control systems to the requirements of the Owner's Representative. AV Contractor shall break out cost associated with programming of these systems for review by the Owner's Representative. By submitting this bid, the AV Contractor agrees that they understand systems of this type and that all programming services are included to the satisfaction of the Owner's Representative. The AV Contractor further agrees that they will not make any claim for additional monies because of misinterpretation of programming requirements.

C. System Performance Standards and Requirements (meet or exceed)
1. Audio Systems:
   a. Electrical Performance; Source Input to Power Amplifier Output:
      1) Frequency Response (Equalizer flat): +/- 0.2 dB 20 Hz to 20 kHz.
      2) Total Harmonic Distortion (THD): Less than 0.05%, 20 Hz to 20 kHz, 4 ohms.
      3) Noise: At least -105 dB, 20 Hz to 20 kHz, referenced to input of +4 dBm.
      4) Crosstalk: At least -60 dB, 20 Hz to 20 kHz.
      5) Damping Factor: Greater than 500 (below 1 kHz)
   b. Electro/Acoustic Performance; Distributed Systems: 103 dB Consistent with devices specified herein.
      1) Equipment: Specified individually.
      2) Audio signal paths: Shall not degrade performance of connected equipment.
   c. NEC - Article 640: Audio Signal Processing, Amplification and Reproduction Equipment.
2. Video Systems:
   a. Video signal system: ATSC 1.0 or 3.0, where applicable.
   b. Video signal paths: To EIA RS-250C short haul where equalized or fiber optic transmission, otherwise to the performance limit of the specified video cable.
   c. ANSI IT7.228 (ANSI Lumens): Measurement method for light output of fixed resolution video projection systems.
   d. ANSI IT7.228 (ANSI Contrast Ratio): Measurement method for the contrast ratio of fixed resolution video projection systems.
   e. JPEG: Joint Photographic Experts Group. Proposes and publishes video standards for Still Images.
   f. MPEG: Motion Picture Experts Group. Proposes and publishes video standards for Broadcast.
   g. EIA RS 170 & 170A The original specs for Monochrome and Color TV in the US. Has been replaced by SMPTE 170M.
   h. EIA 770-1: The US spec for Enhanced Component video, similar to ITU-R BT1197/ETSI 300 294 for PAL-Plus.

i. EIA 770-2: The US specs for Standard Definition TV (SDTV) Baseband Component Video.
j. EIA 770-3: The US spec for High-Definition TV (HDTV) Baseband Video.
k. ITU-R BT.470: Harmonized spec for SDTV worldwide, including NTSC, PAL, and SECAM.
l. ITU-R BT.601: Universal Sampling spec for SDTV and HDTV Broadcast Video. Similar to SMPTE125M.
m. ITU-R BT1197/ETSI 300 294: Spec for PAL Plus Enhanced TV in Europe.
n. SMPTE 125M: Similar to ITU-R BT.601.
o. SMPTE 170M: Has replaced EIA RS 170A, color spec for NTSC.
p. SMPTE 253M: RGB Analog Video Interface spec for SDTV Studio applications.
q. SMPTE 274M: Component spec for 1920x1080 HDTV.
r. SMPTE 296M: Spec for 1280 x 720 RGB and YPbPr Baseband Video. Similar to PAL Plus.

3. Data and Communications Systems:
   a. TIA/EIA 568-C series: Commercial Building Telecommunications Cabling Standard.
   b. ANSI J-STD-607-A: Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
   c. Comply with ITU-T (International Telecommunications Union – Telecom) for video conferencing systems.
4. Control Systems:
   a. RS485 (TIA-485): Electrical characteristics of generators and receivers for use in balanced digital multipoint systems.
   b. RS232 (TIA-232): Interface between data terminal equipment and data circuit-terminating equipment employing serial binary data interchange.
   c. RS 422 (TIA-422): Electrical characteristics of balanced voltage digital interface circuits.

1.5 SUBMITTALS

A. General
1. In addition to the requirements of Division 1, submit all materials for review arranged in the same order as the Specification, individually referenced to the Specification paragraph and Contract Drawing number. Submit 8 1/2" x 11" items bound in volumes and drawings in edge-bound sets. Submit all drawings on sheets of the same size.
2. The AV Contractor is to provide two copies of each hardcopy submittal and an electronic format copy (Shop drawings must be submitted as .DWF. All other submittals will be provided as .PDF). All submittals must be original files or documents, scanned copies will not be accepted.
3. Make each specified submittal as a coordinated package complete with all information specified herein. Incomplete or uncoordinated submittals will be returned with no review action.
4. Should the AV Contractor proceed with the Work of this Section in the absence of submittals for such work submitted and returned with action "No Exception Taken" or "Make Corrections As Noted", the AV Contractor proceeds at the AV Contractor's sole risk.
5. In the event that the AV Contractor deviates from the design shown on the audio-visual Contract Documents when preparing their shop drawings, the AV Contractor shall indicate with architectural style clouding, those deviations. The AV Contractor shall also submit with the Shop Drawings, a list of those deviations and substitutions, including the following:
   a. The deviation item number which shall also correspond to a number designation applied to each cloud on the shop drawings.
   b. Section of the specification that applies to these changes.
   c. The applicable shop drawing sheet number for each item.

d. The corresponding audio-visual Contract Document sheet number for each item.
e. A clear description of the deviation.
f. The AV Contractor's rational for the deviation (i.e. what benefit the deviation provides, why it is required, any cost impact, etc.).

B. Infrastructure
1. Provide drawings indicating boxes and conduit require for the AV system.
2. Coordinate, power, HVAC and structural requirements for the AV system with electrical, mechanical and structural engineers.

C. Product Data
1. Manufacturer's Product Data
a. AV Contractor is to submit submittal in electronic format (i.e. PDF)
b. List of materials (i.e. Table of Contents) categorized by room type: For each item specified in PART 2, include:
1) Drawing device ID code.
2) Manufacturer.
3) Model number.
4) Listing: UL or other lab.
5) Quantity.
c. In sequence of List of Materials, provide a data sheet for each item, including all accessories marked for the proposed product.

D. Shop Drawings
1. Field (Installation) Drawings: Collate in sequence:
a. AV Contractor is to submit shop drawings in .DWF format.
b. Drawing index/symbol sheet.
c. Floor plans. At scale of Contract Documents. Show:
1) Device rough-in boxes with ID number.
2) Mounting height.
3) Conduit size.
4) Wire type.
5) Wire fill.
d. Sections/Elevations. At scale of Contract Documents:
1) Mounting location reference to nearest gridline.
a) Provide sections for each room containing AV equipment.
b) Provide elevations for each wall in rooms containing AV equipment.
c) Show all equipment, including speakers, monitors, projectors, podium, floor boxes, facility boxes, etc.
d) Provide vertical dimensions referenced above finished floor to each piece of equipment.
e) Provide horizontal dimensions reference to gridlines.
e. Enlarged Plans. At scale of Contract Documents or larger as required for trade coordination. Show:
1) Items indicated in "floor plans" above.
2) Architectural features.
3) Rack cabinets.
a) Ventilation details.
b) Power distribution detail.
4) System furniture.
5) Clearances required by applicable Code.
f. System Conduit Riser Drawing, Show:
1) Terminal cabinets.
2) Coordination with floor plans.
3) Wire runs not shown on floor plans.

4) Wire type.
5) Wire fill.

g. Mounting details:
1) Stamped and signed by an Engineer licensed in the Project jurisdiction for work of this type, where required by code.
2) Show loads, type and strength of connections, sizes, dimensions, materials, etc.
3) Show calculations on drawings or in bound volume for review by Authorities having jurisdiction.
4) Provide details for:
a) Equipment rack anchorage.
b) TV Monitor mounts.
c) Loudspeaker mounts.
d) Video projector mounts.
e) Video displays.
f) Projection screens, both fixed and motorized.
g) Attachment to building structure.

h. Installation details as required:
1) Terminal cabinets: Terminations.
2) Audio-Visual panel details.

i. Wire run sheets. Show:
1) Wire number.
2) Source.
3) Designation.
4) Signal type.
5) Wire type.
6) Operating level or voltage.
7) Timing reference, where applicable.
8) Physical length.

2. Shop (Fabrication) Drawings: Collate in sequence:
a. AV Contractor is to submit shop drawings in .DWF format.
b. Drawing index/symbol sheet (if separate set from Field Drawings).
c. System functional drawings. Submit separate drawings for each system/subsystem. Show at least:
1) Equipment:
a) Function, make, model.
b) Rack number, module frame and slot number.
2) Field device information
a) Terminal cabinets.
b) Pull boxes.
c) Audio-visual panel connector designations.
3) Wiring
a) Wire number.
b) Wire type.
4) Shield condition at both ends (float, ground, location of ground).
5) Connector wiring details, each type.
6) Audio: Nominal operating level, Polarity. Note deliberate polarity inversions where required to maintain absolute polarity.
7) Video: Physical length. Electrical length in nanoseconds or degrees of sub-carrier, as applies. Equalization required.
8) Twisted pair, transmit and received devices: Transmission range at 60 Hz., cable length and signal quality.

d. Provide drawings for the following systems, if applicable:
1) Audio.
2) Video.

3) Control.
4) Data transmission.
5) Coordinated grounding scheme.

e. Equipment rack elevations: Show:
1) All racks scaled at 1 1/2" equals 1 foot, or larger.
2) Rack: Make, model.
3) Equipment: Function, make, model.

f. Rack wiring drawings: For each rack, show:
1) Power strip: Receptacles, circuiting.
2) Sequencing power and surge suppression systems.
3) Equipment.
4) Grounding.
5) Wiring, all systems.
6) Wiring harness scheme.
7) Ventilation detail.

g. Fabrication details: Submit for:
1) Receptacles.
2) Panels.
3) Special mounting provisions.

h. Legends/engraving details. Half or full size:
1) Receptacles.
2) Audio-visual panels.
3) Equipment designations.

E. Samples
1. Of all finishes/materials that will be visible to the public, including but not limited to:
a. Receptacles and controls with associated trim plate.
b. Each type of loudspeaker baffle and/or grille.
c. All audio-visual panels.
d. Audio-visual devices in public areas.

F. Programming
1. Control Programming Scheme Submittal
a. AV Contractor is to submit submittal in electronic format (i.e. PDF)
b. Provide a password-protected link to a folder on the AV Contractor's network to remotely access the touch panel from the Owner's Representative's computer. AV Contractor is to have a dedicated control processor utilized on their network.
c. Provide a graphic layout of each user control interface (touch panels, push buttons, etc.).
d. Provide a list of devices that are controlled by each control user interface, including:
1) Device.
2) Brand.
3) Model Number.
4) Control Method.
e. Provide a logic tree for each page for each control interface.
f. Provide a system routing sheet for each control user interface, including:
1) Source.
2) Switcher / device input.
3) Switcher / device output.
4) Final destination.
g. Provide help file content on each user interface.

G. Shop and Project Site Test Reports
1. AV Contractor is to submit in electronic format (i.e. PDF)

2. Schedule: Submit test reports in a timely manner relative to the Project schedule such that the representative of the Owner's Representative may conduct Verification of Submitted Test Data without delay of progress.
   a. Shop test report: Submit prior to shipping completed equipment racks to Project Site.
   b. Project Site test report: Submit project site test report for this section after system completion and prior to Acceptance Review and Testing.
3. Content: Include at least:
   a. Time and date of start of burn-in.
   b. Time and date of test.
   c. Personnel conducting test.
   d. Test equipment, including serial and date of calibration.
   e. Procedures used.
   f. Results of test - numerical or graphical presentation.

H. Close Out Submittal
1. AV Contractor is to submit submittals in electronic format (i.e. PDF)
2. Operation and Maintenance Manuals
   a. Index.
   b. Systems operating instructions.
   c. Reduced set of system Record Drawings.
   d. Key schedule.
   e. Maintenance and spare parts schedules.
   f. Shop and Field Test Reports.
   g. Equipment manuals. Collate alphabetically by manufacturer. Provide manufacturer's original operation, instruction and service manuals in color for each equipment item. Provide tabbed dividers between each product. Manuals provided by the Manufacturer in an individual binder may be submitted in that form.
3. Framed Operating and Maintenance Instructions: Provide adjacent to each ensemble of equipment racks. Provide sturdy frame with clear glass or non-scratching plastic cover. Provide permanent, non-fading media. Blueprints shall not be acceptable. Include:
   a. Sequence for system start-up and shutdown.
   b. System Functional Diagrams.
   c. Signal levels and impedance at accessible system signal and test ports, where applicable.
4. Record Drawings
   a. As work progresses, maintain records of "as installed" conditions. Update the set at least weekly. After successful completion of Project Site testing specified herein, and after completion of Punch List corrections, copy all records of "as installed" conditions on to final Record Document drawings, as specified in Division 1.
   b. Content: All drawings required under "Field and Shop Drawings". Show "as installed" condition. Where room designations according to Project permanent signage differ from construction designations in the Contract Documents, show both designations.
5. Provide four copies on CD-ROM containing the "as built" drawings, all manuals, training manual and programming code.
   a. Submit un-compiled programming code.
6. Training Submittal
   a. Provide all training materials for review prior to scheduling training sessions.
      1) Training manual.
      2) Agenda for the training session.
      3) The final punch list, indicating that all equipment is fully functional.
   b. See the section under Owner's Representative's Instructions for training manual requirements.

c. No training session will be scheduled until final punch list is completed and submitted.

7. Warranty Certificates
   a. Comply with Division 1.

1.6 QUALITY ASSURANCE

A. Qualifications
   1. Refer to Design Builder bidding documents instruction.
   2. Projects that include networked audio or video systems will require the AV Contractor to submit the name of the person, in their employment, qualified to perform this work. This person shall have certification in computer network technology and hold one of the following certifications:
      a. CNP – Certified Network Professional Program.
      b. Computing Technology Industry Association - Network+ certification.
      c. MCSE – Microsoft Certified Systems Engineer.
      d. CNE – Certified Systems Engineer.
      e. CCNA – Cisco Certified Network Associate.
   3. Projects that include software configurable, integrated central control systems must include, as a sub-contractor, an authorized independent programmer who is fully engaged in the work of programming. This person shall hold a CAIP - Crestron Authorized Independent Programmer or ACE – AMX Approved Certified Expert.
   4. The AV Contractor is to enter into an agreement utilizing the authorized independent programmer as a sub-contractor. Under this agreement, the AV Contractor will retain all of the responsibility for a complete and working system. The AV Contractor must include in their bid time to work out any programming glitches that may occur in the initial programming stage. These items include working through the initial and final programming stage with the authorized independent programmer to provide a functional system, testing the programmer's graphical user interface for intended functionality and provide onsite support for the programmer in the uploading and testing of programming revisions. The control systems programmer shall be present either by web meeting or in person at the end user interviews to acquire information first hand. The control systems programmer shall submit a report outlining the meeting results to AV Contractor for approval. Only when the AV Contractor approves this report shall it be submitted to the Owner's Representative for review. The AV Contractor will provide information on how and by whom the requirements of the warranty period will be fulfilled.
   5. The submittal must justify, in the judgment of the Owner's Representative, that the AV Contractor has the capability to manage and install a project of this size and scope and that he is capable of the necessary business and technical arrangements for this installation and the pursuant warranty service. AV Contractor may be disqualified as a bidder if all of the submittal does not meet the approval of the Owner's Representative.
   6. Company: Work of this Section shall be performed by a Sound or Audio-Visual Systems AV Contractor who has at least five years direct experience with the devices, equipment and systems of the type and scope specified herein, and who has a fully staffed and equipped maintenance and repair facility, and who is licensed to perform work of this type in the Project jurisdiction. The company must be NSCA R-ESI or CTS certified.
   7. Personnel: Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the Work of this Section. Supervisors shall have at least five years direct experience in similar work. Installation and maintenance personnel shall have at least three years direct experience in similar work. AV Contractors shall have at least 60% of their installation staff CTS or C-EST certified.

8. Designated Supervisor: Provide a designated supervisor present and in responsible charge in the fabrication shop and on the Project Site during all phases of installation and testing of the Work of this Section. This supervisor shall be the same individual throughout the execution of the Work unless illness, loss of personnel, or other circumstances reasonably beyond the control of the AV Contractor intervene.
9. Staff Engineer: The AV Contractor shall have on his full-time payroll at least one staff engineer having five years minimum experience as an electronics engineer covering systems and projects comparable in substance and complexity to the project described herein. The staff engineer shall have NICET certification in Electrical/Electronics Engineering Technology and Audio Systems or equivalent. The signature of that engineer shall appear on all shop drawings and submittals.
10. Coordination: Coordinate the Work of this Section with the Work of all other Separate Contracts. Comply with Division 1.
11. Help Desk: The AV Contractor must employ a fully staffed help desk department that shall provide knowledgeable responses to inquiries regarding system operation. This department must also have the ability to provide remote diagnostics to identify equipment faults for troubleshooting.

B. Cutting and Patching
1. Cut, patch and extend existing work using skilled mechanics that are capable of matching existing quality of workmanship.
2. Assign work of moving, removal, cutting and patching, to trades qualified to perform the work in a manner to cause least damage to each type of work, and provide means of returning surfaces to appearance of new work.
3. Perform cutting and removal work to remove minimum necessary, and in a manner to avoid damage to adjacent work. Cut finish surfaces such as masonry, tile, plaster or metals, by methods to terminate surfaces in a straight line at a natural point of division.
4. When new work abuts or finishes flush with existing work, make a smooth and workmanlike transition. Patched work shall match existing adjacent work in texture and appearance so that the patch or transition is invisible.
5. Protect existing finishes, equipment, and adjacent work that are scheduled to remain, from damage.
6. Promptly repair damages caused to adjacent facilities by demolition operations, at no change in Contract Amount.

C. Painting
1. Use skilled mechanics that are capable of painting audio-visual equipment and hardware to match architectural surroundings, where applicable.

D. Regulatory Requirements
1. Regulations Applicable: including but not limited to those defined in Division 1.
2. Comply with all applicable federal, state, and local labor regulations, and applicable local union and trade regulations.
3. Installation practices shall be in accordance to industry-accepted standards (ANSI, Cal-OSHA, IEC, IEEE, FCC, NEC, NFPA, ICIA, NSCA, CEDIA, BICSI) or local acts, codes and standards enforced at the place of work, whichever is most stringent.
4. Procure and pay for all necessary permits, licenses, inspections, and observe any requirements stipulated therein.
5. Provide UL/ULC fire rated enclosures around all audio-visual floor and back boxes where required by code.

E. Programming
1. User Group Interview:

a. Conduct interviews with the end-users to acquire programming requirements. Submit written results of the interview and the requirements set forth by the user group. Associate the user group requirements into the programming of each sub system. Submit to the Owner's Representative a report that outlines the interviews conducted.

F. Pre-installation Meetings
1. Attend a pre-installation meeting at the project site with the Owner's Representative and his representatives in order to coordinate related work and scheduling issues.

G. Verification
1. Verify dimensions and conditions at the Project Site. Submit any conflicts in timely manner for resolution.

H. Shop Fabrication and Testing
1. Assemble and fully wire equipment racks at a fabrication shop off the Project Site. Burn-in for not less than 120 hours. Following burn-in, perform specified adjustment procedures. Provide test equipment and test according to procedures specified herein. Submit verification of shop test in timely manner. Following verification of shop test and when installation locations are ready as specified herein, deliver equipment racks and equipment to the Project Site and install.

I. Project Site Installation and Testing
1. Install as specified herein.
a. Perform specified adjustment procedures. Provide test equipment and test according to procedures specified herein. Request verification of Project Site test in timely manner.

J. Verification of Submitted Test Data
1. Re-test in presence of designated representative(s) of the Owner's Representative at reasonable mutual convenience. Provide services of the designated supervisor and an additional technician familiar with work of this Section. Provide all test equipment. Provide complete set of latest stamped submittals of record for reference. Provide complete set of Shop and Project Site Test Reports, as applies. Provide a complete set of manufacturer's original operation, instruction and service manuals for each equipment item for reference.

K. Reference/Project Record Documents
1. At all times when the work is in progress, maintain at the workplace, fabrication shop or Project Site as applies, a complete set of the latest stamped, action submittals of record for reference. Also maintain a separate, clean, undamaged set for preparation of Project Record Documents. Also maintain at the workplace a complete set of manufacturer's original operation, instruction and service manuals for each equipment item for reference.

1.7 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading
1. Deliver materials in manufacturer's original undamaged packages or in bulk packing which provides equivalent protection from rough handling, dust and dirt.
2. Deliver all assembled equipment racks in custom manufactured wood crates to avoid damage during shipping. AV Contractor is to hire a crate manufacturer to build crates prior to delivering racks to the jobsite.

3. All packing, shipping, insurance, handling and storage costs of equipment and materials shall be the responsibility of the AV Contractor.
4. The AV Contractor shall be responsible for insuring all equipment and installation materials stored in their shop facilities until it is delivered to the Project Site and a delivery acknowledgement is received from the Owner's Representative.
5. Equipment unpacked for inspection but not ready for permanent installation must be returned into its protective packing.
6. The AV Contractor shall be responsible for furnishing a temporary substitute for equipment that could not be delivered in time for system operation. All costs associated for renting, shipping and handling temporary substitute equipment shall be the responsibility of the AV Contractor.
7. In the event the equipment or installation material delivery is delayed, the AV Contractor must employ the fastest means of delivery service available to deliver the equipment on time. All costs for expediting the delivery of equipment shall be the responsibility of the AV Contractor.
8. Store packaged materials off of the ground or slab in a manner to protect them from elements, especially moisture damage.
9. Deliver completed, wired, tested equipment racks to associated equipment rooms at the Project Site when major work of all other separate contracts is complete, equipment room ventilation is operating with clean filters in place, the area is clean and free from airborne contaminates, and continuing work of other trades will not produce airborne contaminates or permit transport of such airborne contaminates to the equipment rooms.

B. Acceptance at Site
1. All equipment and installation material delivered to the Owner's Representative shall be properly documented in the form of delivery receipts.
2. Equipment delivered to the Project Site must have a delivery acknowledgement receipt signed by the Owner's Representative. Issue a signed copy of the delivery receipt to the Owner's Representative and file the signed copy for future reference.
3. The AV Contractor shall be responsible for the insurance coverage and security of equipment delivered to the Project Site until it receives an acknowledgement of delivery from the Owner's Representative.

C. Storage and Protection
1. The AV Contractor shall provide a safe and secure storage location for all equipment and installation materials until they are delivered to the Project Site, and it receives an acknowledgement of delivery from the Owner's Representative.
2. For equipment assembled and tested at the AV Contractor's shop facility and delivered to the Project Site, ensure that the equipment is properly protected from improper handling, rain, water, humidity, moisture, heat, direct exposure to sunlight, dust and dirt during delivery and storage on or off the Project Site.
3. Do not remove protective packing from equipment until they are ready to be installed.
4. If, after equipment is installed, the Project Site cannot be cleaned or is still not clean because of on-going work by others, provide protective covering and protection to prevent airborne dust and dirt originating from damaging equipment.

1.8 PROJECT SITE CONDITIONS

A. Environment Requirements
1. The spaces where audio-visual system assemblies are installed shall meet the following requirements:
   a. Free from dust generated from construction.
   b. The room temperature shall be within the specified operating temperature recommended by the manufacturer.

1.9 SEQUENCING

A. Submit all testing documentation to the Owner's Representative for review prior to requesting the Fabrication Inspection and Substantial Completion inspections.

B. Allow adequate time for corrections to be made after inspections to maintain the Project Schedule.

1.10 SCHEDULING

A. Comply with the Project schedule.

B. Make all Submittals specified herein in a timely manner. Failure to make timely submittals complete as specified herein is considered to be lack of substantial progress of the Work of this Section. AV Contractor is to work around Owner's Representative schedule throughout the duration of the project.

C. Deliver all equipment, devices and materials required for the Work of this Section and install, test and ready all work for Acceptance Testing at least fourteen days prior to the completion date for the associated area of the Project, unless specifically instructed otherwise by the Owner's Representative.

D. Temporary Equipment: Provide and operate, without claim for additional cost or time, temporary equipment and/or systems to provide reasonably equivalent function, as determined by the Owner's Representative, in lieu of the Work of this Section which is incomplete or found not in conformance with the Contract Documents as of seven days prior to the completion date. Provide such temporary equipment until Acceptance of the Work of this Section. Thereafter, remove such temporary equipment.

E. It shall be a common understanding that there is a time constraint when executing this work. The AV Contractor shall use all means and resources to complete this project on or before the specified schedule at no additional cost to the project contract. This includes working beyond normal business hours and days, additional manpower, additional tools, etc.

1.11 WARRANTY SERVICE

A. Warrant all Work of this Section to be free from defects in materials and workmanship for a minimum of 1 year from the date of Owner's Representative acceptance of the Work of this Section.

B. All manufacturers' equipment warranties shall be activated in the Owner's name and shall commence on the date of system acceptance. In the case of AV Contractor modified equipment, the manufacturer's warranty may be voided. In such cases, provide a warranty equivalent to that of the original manufacturer.

C. All high-level software shall follow the warranty conditions specified by the manufacturer. Immediately update or upgrade the Owner's installed software as soon as new versions, updates or patches become available from the manufacturer at no additional cost to the Project within this warranty period.

D. Response Time: Provide a qualified technician familiar with the work at the Project Site within 12 hours after receipt of a notice of malfunction. Provide the Owner's Representative with the telephone number attended 8 hours a day, 5 days a week, and an answering service or equivalent facility attended 24 hours a day, 7 days a week, to be called in the event of a malfunction. Provide repairs at no expense to the Owner's Representative and at the Owner's Representative 's request, alternate facilities, services, and systems for the duration of the repairs to any defective work of this Section. Provide a complete and operational System, within 48 hours after notification of a malfunction.

E. All work requested due to warranty issues shall be performed during regular working hours unless the Project agrees to pay the difference in labor rates for overtime or nighttime work.

F. The AV Contractor shall use qualified service personnel to respond to all warranty issues or calls.

G. Off Site Service: Conduct all warranty repairs and services at the Project Site, unless in violation of manufacturer's standard product warranty. Provide substitute systems, equipment, and/or devices acceptable to the Owner's Representative for the duration of off-site repairs. Provide transportation for substitute and/or test systems, equipment, devices, materials, parts and personnel to and from the Project Site.

1.12 OWNER'S REPRESENTATIVE INSTRUCTIONS

A. General
1. Conduct training on the completed system at a reasonable convenience of the Owner's Representative during normal business hours. AV Contractor is to assess the complexity of the system and shall fully train the operation and maintenance staff named by the Owner's Representative.
2. Do not start training until all systems have been commissioned, training manuals are approved and an agenda along with schedule of each departmental training session has been submitted to the Owner's Representative.
3. Training will be conducted in the actual room that is the topic of the training session.
4. The Owner's Representative asserts legal and beneficial ownership of all training materials which are specifically commissioned for this project.

B. Operator Training – Do not start training before system is in full operation and all components have been signed off by Owner's Representative. Use the items covered in the commissioning portion of this specification as a basis for the training curriculum.
1. At least two 4-hour sessions of instruction will be given in order to familiarize the Owner's Representative with the operation of the system.

C. Maintenance Training
1. At least two 3-hour sessions of instruction will be given in order to learn how to maintain and troubleshoot the system. A maintenance binder shall be provided by the AV Contractor with all manufacturer-specific operating and maintenance information for each piece of equipment used. On large jobs, the binders will be sub-divided into individual audio, video and control binders. Provide training on at least the following system features:
   a. Firmware upgrades
   b. Helpdesk features
   c. Complete use of system as outlined in the Commissioning section plus advanced troubleshooting.

D. Training Video
1. A training video shall be produced and cover all aspects of the systems operation.

2. Each page of all user interfaces shall be explained and recorded while gestures are made on the screen. Each button on the user interface shall be explained and demonstrated.
3. All portable equipment that connects to the system shall be demonstrated both in their physical connection and routing method at the user interface.
4. All patch bays shall be explained and demonstrated.
5. All source equipment shall be explained in both physical loading of media and transport control as well as user interface control.
6. Demonstrate on basic troubleshooting.
7. Provide training on items as outlined in the Commissioning section of this document.
8. Demonstrate system start up and shut down.
9. Explain and demonstrate help files associated with touch panels.
10. Audio and video files shall be combined and burned to DVD for distribution to each department.
11. Provide professional DVD with searchable index of topics covered.
12. Provide label with the project's logo, room name/number, title, length, and topics covered.

E. A training manual specific to this system will be written covering the basic and advanced functional techniques necessary to operate the system in a reliable and fully-functional condition. The AV Contractor shall submit hard color copies of the training manual as well as a soft copy in PDF or DOC format. Provide a hard copy of the training manual for each person to be trained. This manual will include:
   1. All contact information, including emergency and after hours phone and pager numbers, for requesting service assistance from the AV Contractor.
   2. A 11x17 set of as-built drawings of the completed project (a full-sized set will be issued to the Owner's Representative for their use, a half-size set will be attached to the inside back door of the main equipment rack).
   3. A table of contents at the beginning of the manual.
      a. The manual will begin by explaining basic information such as manual references, abbreviations, any assumptions made by the author, prerequisites required, numbering convection, etc.
      b. It will then proceed to the manual objectives.
      c. Explain what the end user should understand after reading the manual.
      d. It will cover the basics of the user interface including start up and shut down procedures, log on procedures, access privileges, operator password, levels of security, file structure, etc.
      e. The manual will proceed to describe each user interface and its function. It will cover every layer of the interface and how to navigate through them.
      f. Each of the system presets will be explained and the physical setup of the equipment and floor plan during presets will be illustrated. Source equipment such as media players, blu-ray players, etc. shall have their routing scheme explained and illustrated. Portable equipment and its connection to the system shall be explained and illustrated.
      g. The manual will end by explaining basic troubleshooting procedures and equipment care instruction.
   4. The AV Contractor's maintenance instructions, which will include the manufacturer's maintenance instructions found on the factory manuals to keep the manufacturer's warranty in force.
   5. A list of consumables (fuses, batteries, etc.) required to keep the system operating over time, along with sources of supply (if not readily available).
   6. The AV Contractor will compile and submit all factory warranty registration forms or cards for each piece of equipment furnished for this project.
   7. A form requesting feedback from the end user as to how the manual should be improved and a section to report errors discovered.

a. The AV Contractor will make the corrections and improvement suggestions after receiving feedback from the users. This will be completed at no charge to the project. The manual will contain a date stamp and version number. Each feedback and error correction manual reissue will include a new version number.

F. Initial Use Support
1. Provide standby trainer/system engineer during the first two public events.

1.13 MAINTENANCE

A. The AV Contractor shall, within the warranty period, schedule two visits to inspect and perform preventive maintenance on the system. The first visit shall be six months after the commencement of the warranty period. The last visit shall be just prior to the end of the warranty period.

B. Return 90 to 120 days after the system has been turned over to the Owner's Representative for additional programming, maintenance, and system fine-tuning. Conduct interviews with the user group via telephone to acquire information needed to complete this task. Allow for one full day of programming in your initial bid to complete. Provide a per hour programming fee that will be charged if additional programming is needed.

C. Cache for event logging must be set to record unlimited events until the AV Contractor's first maintenance site visit. After the AV Contractor's first maintenance site visit, the cache can be limited to the Owner's Representative specified level.

D. The AV Contractor shall use qualified service personnel to conduct all maintenance work.

E. All maintenance work shall be performed during regular working hours unless the Owner's Representative agrees to pay the difference in labor rates for overtime or nighttime work.

PART 2 - PRODUCTS

2.1 GENERAL

A. Quality of Products
1. Materials and equipment specified herein have been selected as the basis of acceptable quality and performance and have been coordinated to function as components of the specified systems.
2. Where a particular material, device, piece of equipment or system is specified directly, the current manufacturer's specification for the same shall be considered to be a part of these specifications, as if completely contained herein in every detail.
3. Each material, device or piece of equipment provided herein shall comply with all of the manufacturer's published specifications for that item.
4. Equipment shall be from the manufacturers' current stock and shall not be stored longer than 1 year prior to installation, unless written approval to do otherwise is provided by the manufacturer and submitted for review by the Owner's Representative.
5. All products will be a product of firms regularly engaged in the manufacturing of electrical, electronic or optical equipment. The equipment will be the latest model or type offered which meets the applicable specifications at the time of the submittal. Discontinued items replaced by newer models or versions are prohibited and should not be submitted for review.

6. Quality of workmanship and fabrication of all equipment and components, which are custom fabricated, shall be comparable to professional equipment produced by specialized manufacturers of the trade involved and will be verified by inspection. Only firms having 5 years of experience in all aspects of the fabrication and installation of similar systems will be allowed to perform the work.
7. All materials and products will be new and of professional quality. Unless specifically stated in the drawings or specifications, no existing or used materials will be installed.

B. Quantity
1. Provide the quantity of products as shown on the Contract Drawings, or as otherwise indicated herein.
2. The equipment listed in section 2.2 consists of all major equipment for the project. The AV Contractor will integrate into the system design and provide any additional components, wiring, programming, etc., to complete a functional system operating as described within the specifications and the category AV drawings.
3. Components or equipment not specified or indicated on the drawings that are required to make a fully functional systems per the Owner's Representative's requirements and the design intent, shall be furnished and installed by the AV Contractor, and shall be submitted for Owner's Representative review.

C. Preference
1. Where more than one manufacturer is listed herein as acceptable or equivalent, no preference is intended or implied by the order of listing.

D. In the event that a specified piece of equipment or product has been superseded, discontinued or is no longer available from the manufacturer, the AV Contractor shall submit a request for substitution of the originally specified product. The substitute product shall be the manufacturer's most current model of the specified product, or if the line has been discontinued, a product by the same manufacturer with specifications meeting or exceeding, and as close as possible to those of the originally specified product. Refer to Alternatives and Substitutes section for clarification.

E. Provide Complete
1. Provide all auxiliary and incidental materials and equipment necessary for the operation and protection of the Work of this Section as if specified in full herein.

F. Provide New
1. All materials provided under the Work of this Section shall be new, shall be the manufacturer's latest design/model, and shall be permanently labeled with the manufacturer's name, model number and serial number.
2. Products and materials shall be clean, free of defects, damage and corrosion.

G. Similar
1. Similar devices shall be of the same manufacturer, unless specifically noted otherwise in these specifications.

H. Safety Agency Listing
1. All devices provided under the Work of this Section that are connected to the Project electrical system shall be listed by Underwriters Laboratories (UL) or other Nationally Recognized Electrical Testing Laboratory acceptable to the Authorities having jurisdiction at the Project site, and shall be so labeled. Absent such listing, comply with Regulatory Requirements applicable to Unlisted Equipment.

I. Unlisted Equipment

1. Certain equipment specified herein may not bear listing by a Nationally Recognized Testing Laboratory. Such equipment is specified herein only where no equipment is known to exist bearing such listing which that perform the function required by the Owner's Representative. In such case, apply for field inspection of such equipment. The AV Contractor is responsible for the payment of such inspection costs.

J. Power Rating
1. All devices provided under the Work of this Section that are connected to the Project electrical system shall provide stable performance in full accordance with these specifications when operated on main service which complies with ANSI standard tolerances for voltage, frequency, transients and related parameters.

K. Circuit Protection
1. All active devices shall have integral fuse or circuit breaker protection.
2. All circuit breakers shall be fully magnetic.
3. Protection devices shall be located to facilitate examination, resetting and/or replacement without the need to disassemble or demount the associated device.
4. AV Contractor-fabricated items shall be provided with either indicating type circuit breakers or fuses of the clear glass cartridge type, mounted in fuse holders which will indicate a blown or defective fuse.

L. Continuous Use
1. All active circuitry shall be solid state and shall be rated for continuous use. All circuit components shall be operated in full compliance with the manufacturer's recommendations and shall contain sufficient permanent identification to facilitate replacement.

M. Construction
1. All electronic equipment shall be of the "dead-front" type and shall be designed for standard 19" EIA rack mounting, unless otherwise indicated.
2. Steel frames and enclosures shall be designed and wired to eliminate all induced currents within both the units and the systems.
3. All bolted connections shall be made with self-locking devices.
4. Coordinate all consoles and panels so that the general appearance is similar, or as directed by the Owner's Representative.
5. All operating panels shall be at least 1/8" thick aluminum.
6. Provide locking panel covers on all recessed, semi-recessed or surface mounted control panels not located in the equipment rooms, unless specifically noted otherwise. Panel locks shall be flush with no protrusions beyond the panel face when the door is closed. Recessed control panels shall be recessed within the back box to a depth sufficient to permit a locking hinged panel cover to completely close without affecting any device within the enclosed area.

N. Circuit Boards/Modules
1. All printed circuit boards or modules shall be mechanically secured by bolt or friction-loading guide, in addition to any electrical connector attachment, and shall include an integral extraction grip.
2. Printed circuit boards shall be connected to associated circuitry via soldered connections or precious metal positively keyed card edge connectors.
3. All AV Contractor-fabricated printed circuit boards shall be at least 1/16" thick G-10 glass fabric epoxy base, copper plated to a minimum density of 2.0 oz./sq. ft. on one or both sides, and finished with 60/40 tin/lead solder either hot rolled or plated over the copper. All holes through the boards shall be plated through and solder filled. All boards shall be permanently identified with a designation that matches that of the mating connector or board position in the assembly.

O. Identification
1. Provide permanent intelligible identification on, or adjacent to, all connectors, receptacles, controls, fuses, circuit breakers, patching jacks, and the like. This identification shall clearly and distinctly indicate the function of the item and shall be numbered or lettered to correspond with the function, circuit and location consistent with field and shop drawings. Refer to section 3.5 for clarification.

P. Modular Products
1. The drawings show conventionally packaged components to convey design intent.
2. Card cages to have front and rear closure panels to provide a finished appearance.
3. Except as noted below, modules of different functional types are permitted to share the same card cage/mounting frame and/or power supplies as applicable and if mechanically and electrically compatible..
4. With amplifier input driven 10 dB beyond input level required to produce full rated output, amplifier shall withstand indefinitely any of the following load conditions without instability of operation of main over current protection (i.e. no blown fuses or circuit breakers).
   a. "Short" circuit of 0.1 ohm.
   b. Open circuit (no load).
   c. Rated load impedance.
5. Maintain sense of signal polarity from input to output.

Q. Keys
1. Key all boxes, cabinets, enclosures, panels, controls, doors and related provided for similar usage within a system identically. For each unique key type, provide a quantity of ten. Stamp each key with a reference designation.
2. Submit a schedule of keying to the Owner's Representative. Where so noted, provide Project Standard lock cylinders and keys; coordinate with the work of other Sections.

R. Lectern Power Cord
1. The power outlet connecting the lectern to the floor box must be twist-lock type. The power cord connecting the podium to the floor box must be 12 inches shorter that the low voltage cable connecting it. This will protect the low voltage cable from damage if the podium was to be moved inadvertently without disconnecting the cables. The power cable shall include a wire-rope strain relief to keep the power cord from damage. See cable detail on plan-set for more information.

S. Assistive Listening System (RF)
1. An assistive listening system using wireless radio frequency (RF) transmitter and headsets will allow personal monitoring of the audio program for the hearing impaired. The transmitter will be a frequency agile unit with no less than 30-channel capability and will broadcast the main audio program to personal headsets used by hearing impaired audience members. The system and quantity of headsets supplied shall conform to the ADA requirements (section 219 and 706) for the space. Stereo headset type and hearing aid compatible (T-Coil) listening devices are required; ear-bud type devices are not acceptable. Supply a drop-in type battery charging system capable of servicing multiple receivers, with sufficient charging capacity to charge each receiver simultaneously. Follow the table below for quantity requirements.

Capacity of Seating in Assembly Area	Minimum Number of Required Receivers	Minimum Number of Required Hearing Aid Compatible Receivers
50 or Less	2	2
51 to 200	2, plus 1 per 25 seats over 50 Seats *1	2
201 to 500	2, plus 1 per 25 seats over 50 Seats *1	1 per 4 Receivers *1
501 to 1000	20, plus 1 per 33 seats over 500 *1	1 per 4 Receivers *1
1001 to 2000	35, plus 1 per 50 seats over 1000 seats *1	1 per 4 Receivers *1
2001 and over	55, plus 1 per 100 seats over 2000 seats *1	1 per 4 Receivers *1

*1 Or fraction thereof

T. Projection Screens
   1. The bottom of the projection screen shall be no lower than 48 inches above finished floor.
   2. Verify screen drop requirements with architectural sections and elevations.
   3. Provide extra screen material drop to locate the projection screen at the optimum viewing angle where required.

U. Provide enclosure systems including, but not limited to racks, cabinets, cases and related panels and accessories as specified herein, or approved equivalent. Provide size and quantity as shown on drawings. Provide color as specified by Owner's Representative. If no color is shown on drawings, submit manufacturer's standard color chips for selection.

V. Cable Tray: Provide aluminum ladder style cable tray with flange in side rails where called out in drawings. Size the cable tray to accommodate all wire that must pass through it. Provide all supporting hardware and accessories.
   1. Ladder Style Cable Tray
      a. P-W Industries.
      b. Equal by Hubbell.
      c. Approved equal.

W. Floor Mounted Equipment Racks: Provide each bay with basic frame, vented locking rear door, top panel with single 10" fan, certified seismic floor anchor kit, ganging hardware, except where otherwise indicated, at each ensemble of bays, provide end (side) panels to provide complete enclosure.
   1. Rack cabinet, heavy duty welded 14ga. CRS, single bay of maximum dimensions 83-1/8"(H) x 24"(W) x 32.5"(D); floor supported with accessory louvered side rack side panel.
      a. Mid Atlantic WRK Series.
      b. Equal by Atlas/Soundolier.
      c. Approved equal.
   2. Turret cabinet:
      a. Mid Atlantic Slim 2 Series.
      b. Equal by Atlas/Soundolier.
      c. Equal by Hammond Manufacturing.
   3. Wall cabinet, tilt out:
      a. Atlas/Soundolier AWR Series.
      b. Mid Atlantic WRS Series.
      c. Equal by House of Metal Enclosures (HOME).
      d. Equal by Hammond Manufacturing.
   4. Wall Mounted cabinet:
      a. Atlas/Soundolier 300 Series.
      b. Mid Atlantic DWR Series.
      c. Equal by Hammond Manufacturing.
   5. Floor mounted pivoting rack:

a. Mid Atlantic SR-40-22 Swing Rack.
b. Equal by Atlas/Soundolier.

X. Rack Panels and Accessories: Rack Mounting Screws: Screws 10-32; length as required for at least 1/4" excess when fully seated; oval head with black plastic non marring cup washer or equivalent ornamental head; nickel, cadmium or black plated; Phillips, Allen Hex, Square-Tip or Torx drive. Slotted screws are not acceptable.
1. Blank Panels:
   a. Atlas/Soundolier S19 Series.
   b. Zero ZP112000 Series.
   c. House of Metal Enclosures (HOME) Series PM.
   d. Middle Atlantic Products BL, SB or HBL Series.
2. Vent Panels:
   a. Middle Atlantic ETF Series.
   b. Equal by Atlas/Soundolier.
   c. Equal by Zero.
   d. Equal by House of Metal Enclosures (HOME).
3. Shelf:
   a. Middle Atlantic Products U Series.
   b. Atlas/Soundolier SH19 Series.
   c. Zero A52 Series.
4. Drawer:
   a. Atlas/Soundolier SD Series.
   b. Middle Atlantic Products UD Series.
   c. House of Metal Enclosures (HOME) SD Series.
   d. Zero A43/A36 Series.
5. Rackmount Computer Keyboard: Middle Atlantic RM-KB.
6. Equipment Custom Rackmount Shelf: Middle Atlantic Products Model RSH-4A Series.
7. Rackmount Computer Keyboard.
   a. Mid Atlantic RM-KB series.
   b. Approved equal.
8. Computer Monitor Rackmount.
   a. Mid Atlantic RM-MM series.
   b. Approved equal.
9. Horizontal Lacer Bars
   a. Mid Atlantic LBP-IR4, LBP-1S, LBP-1P.
   b. Equal by Atlas/Soundolier.

Y. Equipment Enclosure Ventilation: Provide UL Recognized devices. Connect to enclosure power, comply with applicable Codes.
1. Fan panel, 5 1/4" high painted steel rack panel with 4" diameter fans, each fan with chrome plated finger guard, low speed air flow, two fans per panel, total 120 CFM:
   a. Mid Atlantic QFP-2 Series.
   b. Atlas/Soundolier ES/IS Series.
   c. BGW Systems.
2. Thermostatic Fan control module, user definable temperature range with status LED's, temperature sensing probe.
   a. Middle Atlantic FC Series.
   b. Atlas/Soundolier CFT Series.

Z. Equipment Enclosure Power and Signal Grounding: Comply with applicable Codes and applicable portions of Division 26. Provide UL Listed devices, Specification or Hospital Grade. Provide all junction boxes, raceway, fittings, wire, supports and fastenings as required for complete installation. Unless otherwise noted, provide receptacles of NEMA 5-15R configuration.
1. Full height receptacle strip, Isolated Ground:

a. Wiremold 3000 Plugmold IG Series.
b. Middle Atlantic PD series vertical power strips.

2. Full height receptacle strip, three or more circuits, Isolated Ground:
   a. Wiremold 3000 Series with Specification Grade IG 5262 Series receptacles.
   b. Middle Atlantic PD series vertical power strip.
3. Wireway, lay in, NEMA 1: Any meeting NEMA 1 and UL870. Size as required.
4. Flexible metal conduit: Comply with Division 26.
5. Sequencing Power System:
   a. The AV Contractor is to design and build power sequencing and surge suppression systems that will control and distribute power in the equipment racks. The system will be designed to sequentially connect power to all of the audio-visual equipment in the equipment racks. Outlets are mounted to the unit's back plate or on a remote strip. If the project utilizes a control system, the sequencing power system will be controlled by the software configurable control system. The touch panel's shut down button will prompt a second time asking "Are you sure you want to shut the system down?" A positive response will activate system shut down. A push button control station's shut down button will be pressed twice to shut down the system. If the project does not include a control system, the AV Contractor is to provide a dedicated sequential controller in the equipment racks.
      1) 15 amp or greater power capacity.
      2) 3-prong 15 amp 120VAC isolated ground outlets (provide required amount).
      3) Individual sequencing steps for each outlet.
      4) Adjustable power-up time delay and outlet sequencing intervals.
      5) Modular power raceway systems shall be constructed of 18-gauge min-spangle galvanized steel.
      6) Remote controllable via contact closures (if applicable).
      7) Status indicator on touch panel (if applicable).
   b. Approved subject to above:
      1) Middle Atlantic RLM-XX, RM-XX, R-XX or M-XX Modular Power Raceway Series.
      2) Middle Atlantic USC-6R Universal Sequencing Controller.
      3) Equal by Atlas Soundolier.
6. Signal Grounding bus bar, insulated from enclosure frame:
   a. Atlas/Soundolier BBG Series mounted on standoff insulators.
   b. Zero A32 Series.
   c. Middle Atlantic.
   d. Panelboard Isolated Ground bus kit by manufacturer of Project Panelboards specified in Division 26.
7. Multi-Outlet Assembly, Surge Suppressing, UL Listed. Comply with ANSI/IEEE C62.41-1980. Provide at least six receptacles. Provide equivalent to:
   a. Surgex SX RT series.
   b. EFI Electronics Corporation Model 153.
   c. MCG Electronics, Inc. Model 296 (subject to UL Listing).
8. Computer Grade Uninterruptible Power System, UL Listed. Provide continuous, no-break power with sine wave output. Provide Transient Over-Voltage (TOV) Surge Suppression; comply with ANSI/IEEE C62.41-1980, Category A and Category B. Provide complete isolation from Line. Provide output voltage regulation to ANSI C84.1 for computing equipment. Provide output KVA, switch-mode power supply rated, not less than 150% of connected load indicated. Provide one for each Central Processing Unit, Digital Signal Processor and automated control console. Provide equivalent to:
   a. Best Power Technology, Inc. "Micro-Ferrups" Series.
   b. Best Power Technology, Inc. "Axxium" Series.

2.2 PRODUCTS

A. Major System Components
   1. Assistive Listening System
      a. The transmitter will be a frequency agile unit with no less than 17-channel capability.
      b. Operating frequency: 72 – 76 MHz
      c. Frequency Response: 22 – 16,000 Hz, +1, -3 dB (adjustable)
      d. Signal-to-Noise Ratio: 74 dB transmitted
      e. RF Field Strength: Does not exceed 80 mV/m at 3 m
      f. The quantity of headsets supplied will conform to the ADA requirements for the space (i.e. 4% of the maximum seating capacity).
      g. Accessories
         1) Transmitters
         2) Receivers
         3) Antenna
         4) Stereo Headset
         5) Telecoil Compatible Neck Loop
         6) ALS Signage Kit
      h. Williams Sound, Listen Technologies or equal
   2. Amplifier
      a. 2, 4, or 8 Channels, 70V
      b. Frequency Response 20Hz – 20kHz
      c. Distortion: <0.01% THD
      d. Input Clipping: 10 Vms (+22 dBu)
      e. Input Sensitivity: 1.23 Vrms
      f. QSC or equal
   3. Equipment Rack – Cabinet Mounted
      a. Pulls out and rotates for equipment servicing
      a. Number of rack units: 12.
      b. Sliding rail system.
      c. Rack shall pull out 19”.
      d. Locks closed.
      e. Ball bearing slides.
      f. Cable carrier for cable management.
      g. Middle Atlantic or equal
   4. Equipment Rack – Free Standing
      h. EIA Compliant 19” gangable
      i. Number of rack units: 44.
      j. Threaded rackrail.
      k. Rack shall pull out 19”.
      l. Cable carrier for cable management.
      m. Middle Atlantic or equal
   5. HDBaseT Transmitter – Wall Mount
      a. 1-gang wall mount design
      b. Provides HDMI video input
      c. Performs automatic AV signal format management via EDID
      d. Video Format: HDMI HDCP content protection support, computer up to 4096x2160 DCI 4k & 3840x2160 4k UHD, NTSC or PAL
      e. supports up to 330 ft cable length
      f. Crestron or equal
   6. HDBaseT Transmitter – Surface Mount
      a. Surface mount design
      b. Provides HDMI video input
      c. Built-in 2x1 AV switcher
      d. Performs automatic AV signal format management via EDID

e. Video Format: HDMI HDCP content protection support, computer up to 4096x2160 DCI 4k & 3840x2160 4k UHD, NTSC or PAL
f. Includes USB HID keyboard/mouse port
g. supports up to 330 ft cable length
h. Crestron or equal

7. HDBaseT Receiver
   a. Receiver and display controller
   b. Provides HDMI video input
   c. Video Format: HDMI HDCP content protection support, computer up to 4096x2160 DCI 4k & 3840x2160 4k UHD, NTSC or PAL
   d. Supports up to 330 ft cable length
   e. Provides one HDMI output
   f. Provides 10/100/1000 Ethernet connection for display device or control system
   g. Enables device control via CEC, RS-232, IR, or Ethernet
   h. Crestron or equal
8. Loudspeaker (Pendant)
   a. 6.5” woofer
   b. Aluminum dome tweeter
   c. Frequency range: 55Hz-20kHz, + or – 10dB
   d. Sensitivity: 88dB average
   e. 70 volt taps
   f. Directivity Factor (Q): 6.5 averaged 500 Hz to 4 kHz
   g. Back can enclosure and grille
   h. QSC or equal
9. Loudspeaker (Surface/ Wall)
   i. 5.25” woofer
   j. Aluminum dome tweeter
   k. Frequency range: 65Hz-20kHz, + or – 10dB
   l. Sensitivity: 86dB average
   m. 70 volt taps
   n. Directivity Factor (Q): 6.9 averaged 500 Hz to 4 kHz
   o. Enclosure and grille
   p. QSC or equal
10. Multimedia Lectern
    a. Adjustable shelf
    b. 4” Carpet casters
    c. Floor access opening
    d. Marshall Exec series or equal
11. Microphone - Gooseneck
    a. Cardiod polar pattern
    b. Frequency Response: 50–17000 Hz
    c. Impedance 180 ohms
    d. Phantom power 11 – 52 Vdc
    e. XLR connection
    f. Shure or equal
12. Microphone Input - Lectern
    a. Millwork microphone isolator with XLR connection
    b. FSR or equal
13. Microphone - Handheld
    a. Cardioid polar pattern
    b. Frequency response: 50Hz – 15kHz
    c. Sensitivity: –54.5 dBV/Pa (1.85 mV)*
    d. Output Impedance: EIA rated at 150Ω (300Ω actual)
    e. 25’ cable with XLR connection
    f. Shure or equal

14. Network Switch
    a. 10/100/1000 auto-sensing per port
    b. PoE, PoE+, PoE++ capable
    c. Standards: IEEE 802.3i, 802.3u, 802.3ab, 802.3x, 802.3af
    d. QSC or equal
15. Portable Sel-Powered Loudspeaker
    e. 2-Way Active loudspeaker
    f. 10” woofer
    g. Titanium diaphragm compression drive
    h. Frequency range: 50Hz-20kHz, + or – 10dB
    i. Nominal Coverage: 90 Degree Axisymetric
    j. Peak: 130dB
    k. Directivity Matched Transition (DMT)
    l. Amplifier: Class D, Peak: 1800 W (LF), 225 W (HF)
    m. Enclosure: Impact Resistant ABS
    n. QSC or equal
16. Projection Screen
    a. Diagonal: See Section 2.1.T above
    b. Aspect Ratio: 16:10
    c. Screen Material: Matte White
    d. Tab-Tensioned
    e. Mount: Ceiling Recessed
    f. Electrically operated roll-down
    g. Low Voltage Control
    h. Draper or equal
17. Proximity Sensor
    a. Method of detection: Diffuse Reflective
    b. Infrared LED
    c. IR Sensitivity Adjustable
    d. Sensing Distance up to 4 feet.
    e. Crestron or equal
18. Video Presentation System (8x2)
    a. 4096x2160 DCI 4k & 3840x2160 4k UHD
    b. Inputs: HDMI & HDBaseT
    c. Outputs: HDMI & HDBaseT
    d. Control processor
    e. Audio DSP
    f. Automatic Mixer
    g. 6-Channel Microphone/Line Mixer
    h. Digital Video over Twisted Pair
    i. HDCP Compliant
    j. CEC Embedded Device Control
    k. Performs automatic AV signal format management via EDID
    l. Built-in 50W Power Amplifier
    m. Audio Frequency Response: 20Hz to 20kHz
    n. Memory: SDRAM – 512 MB, Flash 4 GB
    o. Communications: Ethernet, HDBaseT, HDMI, USB, RS-232, IR/Serial
    p. Crestron or equal
19. Touch Panel
    a. 5" touchscreen (Color LCD)
    b. 1280 x 720 resolution
    c. HTML5 and Smart graphics
    d. Dynamic menu objects
    e. Streaming video
    f. Programmable pushbuttons

g. Single-wire Ethernet connectivity
h. PoE network powered
i. Crestron or equal

20. Video Display
    a. 4K Crystal UHD TFT LED
    b. 3840x2160 UHD resolution
    c. Energy Star qualified
    d. IP control
    e. (2) HDMI HDCP connections
    f. RF In/Antenna connection
    g. Stereo Speakers
    h. Miscellaneous Parts: Appropriate Wall Mount
    i. Samsung, NEC or equal
21. Video Projector (Ultra short-throw)
    a. Native Aspect Ratio: 16:10
    b. Connections: HDMI (HDCP Compliant)
    c. Resolution 1280x800
    d. Contrast Ratio 14,000:1
    e. Lamp light source
    f. SD/HD Signal Compatibility 480i, 480p, 576i, 576p, 720p
    g. PC Signal Compatibility VGA, SVGA, XGA, SXGA, SXGA+, WXGA, UXGA
    h. Epson or equal
22. Video Projector
    a. Native Aspect Ratio: 16:9
    b. Connections: HDMI (HDCP Compliant) and serial control port
    c. Resolution 3840x2160
    d. Contrast Ratio 500,000:1
    e. Laser light source
    f. Variable Zoom Lens
    g. SD/HD Signal Compatibility 480i, 480p, 576i, 576p, 720p, 1080i, 1080p, 4K UHD
    h. PC Signal Compatibility VGA, SVGA, XGA, SXGA, SXGA+, UXGA, WUXGA
    i. Lens Shift
    j. NEC or equal
23. Video Projector Enclosure
    a. Weatherproof
    b. Outdoor Rated
    c. Bluetooth capable
    d. RJ-45 LAN capable
    e. Ventilation System
    f. Heating System
    g. App Capable
    h. Proietta or equal
24. Wireless Bodypack RF Transmitter
    a. RF transmitter output: 30mW max
    b. Frequency Response: 45 Hz – 15 kHz
    c. 8 hours continuous use
    d. 300 foot operating range
    e. Shure or equal
25. Wireless Lavalier Microphone
    a. Cardioid condenser microphone
    b. Includes miniature four-pin mini connector
    c. Impedance: 800 Ohms
    d. Frequency Response: 50 Hz – 17 kHz
    e. Output Level: -45.5 dBV/Pa
    f. Shure or equal

26. Wireless Handheld Microphone
    a. Handheld RF transmitter
    b. Cardioid dynamic microphone
    c. RF transmitter output: 30mW max
    d. Effective Range: 300 ft.
    e. Operating Range: 470 - 782 MHz
    f. Frequency Response: 50 Hz – 15 kHz
    g. Total Harmonic Distortion (ref. +/– 38 kHz deviation, 1 kHz tone) 0.5%, typical
    h. Audio Input Level: 8 dBV maximum at 0dB position
    i. Shure or equal
27. Wireless Microphone Receiver
    a. Wideband UHF FM modulation between 524 MHz and 865 MHz.
    b. Effective Range: 300 ft.
    c. Frequency Response: 45 Hz – 15 kHz
    d. Total Harmonic Distortion (ref. +/– 38 kHz deviation, 1 kHz tone) 0.5%, typical
    e. Preset frequency selection.
    f. True diversity receiver.
    g. Shure or equal

B. The above list of Major System Components only outlines the major items necessary to allow the system to function as designed. It lists no power supplies, balancing transformers, power splitters, modular cards or other auxiliary components required to achieve a functioning system. AV Contractor is required to supply all components needed to provide a complete and operable system as outlined in the contract documents. The full set of construction documents are to be used when preparing a bid. This list is not intended to provide a full bill of materials.

C. Patch bays shown on plans and elevations are for placeholder information only. AV Contractor is to determine the exact amount of patch needed as per single line diagrams.

2.3 FINISHES

A. Any item or component of the Work of this Section which is visible shall comply with the following. Finishes noted or scheduled on the Contract Drawings shall take precedence. Submit all color samples of all items visible to public for approval.
    1. Where finishes are not noted or otherwise defined in the Contract Documents, submit manufacturer's standard finish samples for selection by the Owner’s Representative.
    2. Paint loudspeaker cabinets to match exactly the surrounding and adjacent surfaces. Submit paint sample to Owner’s Representative for approval.
    3. Unless otherwise noted, receptacle or device plates subject to connection or operating force shall be stainless steel or hard anodized aluminum. Provide plates which generally match the appearance of project standard receptacle or device plates in view in the same area. For anodized aluminum, submit samples of standard colors for selection by Owner’s Representative.
    4. Operating panels shall be steel, primed, painted with thermosetting epoxy paint, with legends silk-screened in contrasting color, and coated with clear epoxy thermosetting coating; or aluminum, hard anodized, with legends engraved and filled with contrasting color, all coated with clear epoxy thermosetting coating.
    5. All steel surfaces shall be treated with primer equivalent to zinc phosphate and finish painted with baked enamel or painted with a thermo setting epoxy paint.
    6. All aluminum surfaces, except those used as operating surfaces, shall be anodized and then painted with a thermo setting epoxy paint.

B. Custom Fabricated Plate Screws
    1. Match the finish of the screws used to mount the custom fabricated plates with the finish of the custom fabricated plate.

C. Ceiling Loudspeaker Grilles
   1. Paint loudspeaker grilles to match exactly the surrounding and adjacent surfaces (when speakers are recessed). Apply paint to permit servicing of loudspeakers without damage to finish of adjacent or adjoining surfaces. Provide uniform appearance. Do not obstruct grille openings with paint. Submit paint sample to Owner's Representative for approval.

D. Manufacturer's logos
   1. Remove all manufacturers' names, logos, or other symbols from speakers or other objects placed in view of the public.

2.4 ALTERNATIVES AND SUBSTITUTES

A. Substitutions of equal equipment beyond the alternatives listed will be permitted only in accordance with Division 1. If a requested substitution requires a change in any of the contract drawings, a revised drawing must be submitted as part of the substitution request. The Owner's Representative will be the final judge of the acceptability of substitutions. The burden of proof of equivalence is the responsibility of the AV Contractor.

B. Acceptance of a product shall not, in any form or manner, relax the system performance requirements of this Specification and the performance characteristics of the product.

C. The AV Contractor shall submit for review a complete list of proposed substitutions for approved equipment listed in Part 2.

D. For all substitutions, the AV Contractor shall provide the manufacturer's independent test data to demonstrate that the proposed alternatives to the approved equipment comply with the specifications. Specifications shall contain at least all information available for the specified product.

E. The AV Contractor shall submit a description and drawings showing all changes to the Contract Documents that the proposed substitution will require for proper functionality and operation.

F. Proposed substitutions shall not affect dimensions shown on the Contract Document except as submitted for review and approved by the Owner's Representative.

G. Any redesign or construction costs required to integrate the proposed substitution shall be the responsibility of the AV Contractor. Any costs incurred by the Owner's Representative attributable to the integration of a proposed substitution shall be borne by the AV Contractor.

H. Any proposed substitution shall have no adverse effect on other trades, the construction schedule or specified warranty requirements.

I. The functionality, performance, general appearance and quality of the proposed substitution are equivalent to or superior to those of the specified item.

J. Any change to the Contract (deductive or additive cost) associated with a proposed substitution shall be submitted to the Owner's Representative for review at the time the substitution is proposed and accompanying a substitution request documentation.

K. The AV Contractor will provide the same warranty for the substitution that the AV Contractor would for the specified product.

L. The AV Contractor will coordinate the installation of the accepted substitute, making such changes as may be required for the Work to be complete in all respects equal to the designed system before the substitution was made. In the event that the substituted material or equipment fails to meet performance testing standards after installed, the AV Contractor will replace substituted material or equipment with those initially specified.

PART 3 - EXECUTION

3.1 GENERAL

A. Perform the Work of this Section in accordance with acknowledged industry and professional standards and practices, and the procedures specified herein.

B. Furnish and install (herein, "provide") all materials, devices, components, and equipment required for complete, operational systems.

C. AV Contractor is to supervise the installation of back boxes and terminal cabinets installed by the Division 26 Contractor. AV Contractor is to verify that correct boxes are installed in their proper locations before any drywall has been installed.

3.2 EXAMINATION

A. Immediately report to the Owner's Representative any discrepancies between the specifications and drawings. This includes discrepancies between the technical specification documents and actual field dimensions or findings that may hinder installation work, conflict with other trades, or cause delays.

B. Carefully examine all details that affect all aspects of the systems described in the specifications and drawings.
1. Examine, coordinate and confirm all drawings and details.
2. Examine, coordinate and confirm all electrical power requirements, conduits, raceways, boxes, and etc.
3. Examine, coordinate and confirm work of other trades that may influence the outcome of the design, specification, and performance of the systems.

3.3 PREPARATION

A. This installation section is only meant as a guideline for the AV Contractor. The AV Contractor shall be responsible for executing all installation work in a manner that is in accordance to industry-accepted standards or governing codes, whichever is more stringent. Installation activities shall be executed in an organized and orderly manner. These steps include, but are not limited to, pre-delivery testing, delivery, unloading, installation, equipment / cable labeling, programming, set-up / calibration / alignment / adjustment, testing, commissioning, training, and documentation.

B. Protect all existing work surfaces, furniture, equipment, fixtures and etc. before commencing installation work. Any damage to the existing physical and electrical property due to installation work shall be the responsibility of the AV Contractor.

C. Immediately hand over any de-installed equipment to the Owner's Representative for disposal or safe-keeping.

D. Carefully remove any obstructions such as fixed seating, ceiling tiles, furniture, equipment and etc. that would obstruct or hinder the installation work. Damage caused by undue care in moving these items shall be responsibility of the AV Contractor.

E. Examine, coordinate, and confirm the cleanliness of the work site before commencing the portion the installation work that involves dust-sensitive electronic or electrical equipment such as audio mixers, switchers, projectors, control processors, computers, cameras, etc. Dust-sensitive equipment that is installed in a work site with a lot of air borne dust and dirt shall be properly protected. For example, a video camera on a wall-mounted bracket is protected by a clean plastic bag to prevent dust from contaminating it. Seal the bag's opening using adhesive tape.

F. Prior to commencing installation work, ensure that the surrounding areas are clean and promote ease of installation work.

G. Ensure that all equipment rack and equipment locations are clean before commencing installation work.

H. Unless specified otherwise, furnished products / equipment shall be tested, delivered and installed. And, all systems shall be tested and commissioned to fully operational and properly configured condition.

I. All electrical equipment shall be burned-in or tested at the AV Contractor's shop before delivery. This pre-installation test shall reveal any equipment that is faulty, malfunctioning or dead out of the box ahead of time.

J. All radio frequency (RF) operated devices shall be tested on-site prior to installation to determine blind spots, RF interference, or any other transmission / reception problems. The AV Contractor shall be responsible for costs associated with providing additional support or accessory equipment (antennas, amplifiers, cables, etc.) and / or services to improve signal transmission / reception.

K. Provide all support equipment (ladders, man-lifts, tools, etc.) required to complete the installation work in a safe and expeditious manner.

L. Obtain any plan approvals, permits and licenses required by inspection authorities prior to execution of any installation work. The AV Contractor shall be responsible for all associated fees and costs incurred while fulfilling this requirement.

M. Ensure that all equipment is accessible for operation and maintenance work. Under no circumstance shall equipment be inaccessible or inconveniently located.

N. Aside from the systems' operational features, provide equal attention to the overall aesthetics of the installed equipment and cabling. Special attention to aesthetics shall be extended to equipment or cabling in public spaces.

O. Firmly secure all fixed equipment and hardware in place and ensure that they are plumb and / or square. An exception to this shall be portable or movable equipment.

P. Structurally mounted equipment: All equipment shall be mounted in accordance to all applicable safety codes, standards and practices. The one that provides for the most stringent rule shall prevail. All mounting hardware shall have a load rating by, at least, a factor of 5 (500% or greater) in reference to the weight of the equipment to be mounted or suspended. An exception to the rule shall be existing local safety codes or standards requiring greater load capacities.

Q. Seismic restraints: Abide by all the seismic restraint requirements described in all applicable building codes in force at the work site. If no provisions exist for a particular situation, follow these minimal recommendations.
   1. Fixed equipment: Mount and brace to the building structure to minimize potential hazards to personnel and damage to property during any kind of seismic event.
   2. Floor mounted equipment: Bolt equipment securely to the floor to prevent from toppling during any kind of seismic event
   3. Vertical-mounted columns: Apply braces to the vertical column in four opposing directions back to the mounting surface. This will minimize sway in any direction. Provide a separate, flexible restraint (e.g. aluminum braided aircraft cable) with a capacity of 5 times the weight of the total mounting system. The same applies to the anchor to which the flexible restraint is attached and the method of attachment to the structure.
   4. No equipment, equipment supports, or mounts must fail before the structure fails.
   5. Seismic restraint measure must not interfere with fire stopping.
   6. Notwithstanding compliance with these minimum recommendations, it is the AV Contractor's responsibility to ensure that the seismic restraint measures taken are adequate for the circumstances, including, if required, verification by an independent structural engineer. The cost of all such engineering shall be the responsibility of the AV Contractor.
   7. Penetration of the Slab: Verify that any mounting or restraint work that requires deep or thorough penetration of the slab shall not damage embedded materials including, but not limited to, slab tensioning devices or conduit. Verify the slab by X-ray or other method before proceeding. The AV Contractor shall be responsible for all costs associated with this investigation.

3.4 INSTALLATION

A. Follow manufacturer's instructions for installing, operating, configuring, and programming their equipment. Do not perform modifications to equipment that would void its warranty.

B. Pull and terminate all cables, and interconnect all equipment and components in accordance with approved drawings. Install audio-visual cover plates and faceplates onto all boxes.

C. Loudspeaker Assembly Installation
   1. Loudspeakers:
      a. Verify proper installation of loudspeaker enclosures and related support.
      b. Verify that no loudspeaker assembly is subjected to stresses or loading effects in any way contributing to possible extraordinary failure.
      c. Connect loudspeaker assemblies to the appropriate 70 volt-line transformer tap as applies. Verify specified polarity. Use insulated crimp connectors or insulated "bobtail" splices applied with manufacturer's recommended ratchet tooling. Wago Wall-Nuts 773 Series or equal are acceptable. Wire nuts or "Scotchlock" connectors shall not be acceptable.
      d. Verify that loudspeaker grille openings and loudspeaker components are clear of paint after finishing.
      e. Perform preliminary loudspeaker tests specified herein. Correct non-conforming conditions.
      f. Adjust 70 volt-line transformer taps as required to realize uniform sound pressure level as specified herein. Document final 70 volt-line transformer taps on the Record Drawings.
      g. Correct all conditions giving rise to noise, rattle or other extraneous sounds owing to operation of a loudspeaker assembly under any specified operating condition.

D. Video Projectors
   1. Projectors shall be centered laterally to the projection screens.

2. AV Contractor shall use lens shifting when projector cannot be aligned properly to the screen. Use of keystone correction is not allowed.
3. Selected projectors shall have lamp replacement and filter cleaning doors located in such a way that these items may be serviced while the projector is installed.
4. Projectors shall be mounted such that their optical zoom settings shall not be set at either their widest nor narrowest extreme, but shall be used in their mid-range.

3.5 Labeling and Identification

A. All cables and connecting blocks shall be clearly, logically and permanently marked and identified by the following means:
   1. Use cable labels similar to the Panduit Polyolefin Self-laminating Labels for inkjet or laserjet printers or any other means acceptable to the Owner's Representative. Cable labels should be machine printed and not handwritten.
   2. Cable labels should be placed approximately 12 cm. from each end of the cable.
   3. Labeling conventions shall be clear, logical, and must be acceptable to the Owner's Representative.
   4. Include all cable identification numbers on all wiring diagrams and cable schedules.
   5. For fiber optic cables, use cable identification products such as the Panduit Labelcore series or any other means acceptable to the Owner's Representative.
   6. For connector and terminal blocks, label using any means acceptable to the Owner's Representative.

B. All cover plate, switches, panels, outlets, etc. labeling shall be engraved and filled, or silk-screened or by any other means acceptable to the Owner's Representative. Do not use Dymo, Brother, or other similar labeling products.

C. Protective Devices
   1. Identification of fuses and circuit breakers shall indicate protected circuitry, rating of protective device and voltage across open circuited protected device.

D. Panels and Receptacles
   1. Panel surfaces shall be engraved and filled or silk screened with identification, or shall be provided with 1/16 inch (minimum) thick laminated plastic labels with engraved block characters at least 1/8 inch high fastened to the equipment by stainless steel screws or rivets. Provide white characters on black background unless otherwise noted. Embossed plastic (Dymo) labels shall not be acceptable.

E. All equipment shall be labeled in a clear, logical manner or by any other means acceptable to the Owner's Representative.
   1. For Control Knobs and Sliders: Use 6mm (1/4") round labels, such as the Avery 057xx series, to indicate level settings. Neatly draw an arrow on the label using a fine tip permanent marker to accurately indicate the position of the control knob. If a control knob or slider has multiple level settings, use a logical and consistent color scheme to identify each setting. Illustrate all equipment settings in the Operation Manual.
   2. For equipment identification, use 'badges' made of aluminum or plastic or any other acceptable material with engraved and filled, or silk-screened labeling. Stick these badges using industrial-strength doubled-sided 3M adhesive tape. Note: Labels made using Brother-type label maker or similar machines can be used as long as industrial-strength double-sided tape is used to hold the label in place. Label schemes should be clear, logical, and simple or by any other means acceptable to the Owner's Representative. Indicate equipment labeling schemes on all elevation and plan drawings showing the front and / or rear of the equipment racks. The reader should be able to easily reference the label description to specific equipment in the Operation and / or Maintenance Manuals.

3.6 WIRING

A. General
1. This section does not apply if the drawings incorporate a wire schedule.

B. Audio Signal Wiring Classification:
1. Type A-I: Microphone level wiring less than -30 dBu, 20 Hz to 20 kHz.
2. Type A-2: Line level wiring -30 dBu to +24 dBu, 20 Hz to 20 kHz.
3. Type A-3: Loudspeaker level or circuit wiring greater than +24 dBu, from 20 Hz to 20 kHz.

C. Video/Graphics and Related Signal Wiring Classification:
1. Type V-1: Baseband and composite video wiring 1 volt peak-to-peak into 75 ohms, 0 to 100.0 MHz.
2. Type V-2: Synchronization and switching pulse wiring 4 volts peak-to-peak into 75 ohms, 15.62 to 15.75 kHz.
3. Type V-3: Color subcarrier wiring 0 to 4 volts peak-to-peak into 75 ohms, 3.57 to 4.43 MHz.

D. Control Signal Wiring Classifications:
1. Type C-1: DC control wiring 0 to 50 volts.
2. Type C-2: Synchronous control or data wiring 0 to 40 volts, peak-to-peak.
3. Type C-3: AC control wiring 0 to 48 volts, 60 Hz.

E. Additional Wiring Classifications:
1. Type M-1: DC power wiring 0 to 48 volts.
2. Type M-2: AC power wiring greater than 50 volts, 60 Hz.

F. Wiring Combinations: Except as indicated herein, conduit, wire ways and cable bundles shall contain only wiring of a single classification. The following combinations are acceptable in conduit, or cable harnesses. Additional acceptable combinations may be indicated on the Contract Drawings.
1. Types A-1, C-1, and M-1.
2. Types A-2, C-I, C-2, and M-I, runs less than 20 feet.
3. Types A-2, C-1, and M-1.
4. Types A-3, C-1, C-2, and M-1.
5. Types A-2, V-1, and V-3.
6. Types V-1, V-2, V-3, and C-1.
7. Types M-2 and C-3.

3.7 WIRE AND CABLE INSTALLATION

A. Provide permanent identification of run destination at all raceway terminations.

B. All wire and cable shall be continuous and splice-free for the entire length of run between designated connections or terminations.

C. All shielded cables shall be insulated. Do not permit shields to contact conduit, raceway, boxes, panels, connector shell or equipment enclosures.

D. Within buildings, make splices only in designated terminal cabinets and/or on designated equipment backboards. Outside buildings, make splices only in designated manholes and/or hand holes. Protect splices outside of buildings with splicing kits equivalent to Scotch-cast Re-enterable. Make splices only with connectors or terminal devices specified herein. Document all splices on Record Drawings.

E. Verify that all raceway has been de-burred and properly joined, coupled, and terminated prior to installation of cables. Verify that all raceway is clear of foreign matter and substances prior to installation of wire or cable.

F. Inspect all conduit bends to verify proper radius. Comply with Code for minimum permissible radius and maximum permissible deformation.

G. Apply a chemically inert lubricant to all wire and cable prior to pulling in conduit. Do not subject wire and cable to tension greater than that recommended by the manufacturer. Use multi-spool rollers where cable is pulled in place around bends. Do not pull reverse bends.

H. Provide a box loop for all wire and cable routed through junction boxes or distribution panels. Provide tool formed thermal expansion loops at cable at manholes, handholes and at both sides of all fixed mounted equipment. Cable loops and bends shall not be bent at a radius greater than that recommended by the manufacturer.

I. Secure all wire and cable run vertically for continuous distances greater than 30 feet. Secure robust non-coaxial cables with screw-flange nylon cable ties or similar approved devices appropriate to weight of cable. For all other cables, provide symmetrical conforming nonmetallic bushings or woven cable grips appropriate to weight of cable.

J. All Category type cable, connectors and plugs shall be color coded for easy visual distinction. Color coded insert type boots shall be installed on all Category type plugs. A colored coded ring will be provided on all chassis connectors (i.e., Neutrik ACRF-#). Cable connecters shall be equipped with Neutrik BSE-# color coded bushings. Coordinate and verify with Owner's Representative the color code scheme, if there is no standard or preference, the color code scheme shall be as follows:

1.	Data LAN	=Yellow
2.	HDBaseT	=Green
3.	Audio Network	=Red
4.	AV LAN	=Orange
5.	KVM-USB Extenders	=Grey
6.	AV UTP	=White
7.	AV STP	=Blue

3.8 CONNECTOR AND SIGNAL POLARITY CONVENTION

A. Maintain consistent absolute signal polarity at all connectors, patch points and connection points accessible in the system. Where applicable, a positive polarity electrical signal shall yield positive acoustic pressure from the loudspeakers.

B. Audio signal connector convention: AES14-1992 (ANSI S4.48-1992) AES standard for professional audio equipment - Application of connectors, Part 1, XLR-type polarity and gender.

Signal	Connector	Wire
Signal Phase	Pin 2	Red or White
Signal Anti-Phase	Pin 3	Black
Signal Ground	Pin 1	Drain Wire

C. Video and RF/MATV Connector Convention:

Signal	Connector	Wire

Signal Phase	Center Pin	Center conductor
Signal Anti-Phase	Shell	Shield
Signal Ground	Shell	Shield

D. Voice/Data Connector Convention: Comply with EIA/TIA-568C.

3.9 WIRING PRACTICE

A. Land all non-coaxial field wiring entering each equipment rack at specified terminal devices prior to connection to any equipment or devices within racks. At AV Contractor's option, such terminals may be located in the equipment racks or at backboards provided. Coordinate such selection with Project construction sequence and test procedures specified herein.

B. Identify all wire and cable clearly with permanent labels wrapped about the full circumference within one inch of each connection. Indicate the number designated on the associated field or shop drawing or run sheet, as applies. Assign wire or cable designations consistently throughout a given system. Each wire or cable shall carry the same labeled designation over its entire run, regardless of intermediate terminations. Provide any of the following:
1. Continuous permanent imprint; equivalent to Clifford of Vermont, Inc. "Quik-Pull".
2. Direct hot stamp.
3. Heat shrinkable factory hot stamped; equivalent to Brady sleeve Heat shrink.
4. Adhesive strip printed labels wrapped the full circumference of the wire and sealed with clear heat shrink tubing; equivalent to Thomas and Betts or Panduit Insta-code with clear heat-shrunk tubing equivalent to Alpha.

C. Apply all crimp connectors only with manufacturer's recommended ratchet type tooling and correct crimp dies for connector and wire size. Plier type crimp tooling shall not be acceptable.

D. Coordinate insulation displacement (quick connect) terminal devices with wire size and type. Comply with manufacturer's recommendations. Make connections with automatic impact type tooling set to recommended force.

E. Make all connections to screw-type barrier blocks with insulated crimp-type spade lugs. Lugs are not required at captive compression terminal type blocks. Provide permanent designation strips designed for use with the terminal blocks provided. Make neat, intelligible markings with indelible markers equivalent to "Sharpie".

F. Tin terminated shield drain wires and insulate with heat shrinkable tubing.

G. Use only rosin core 60/40 tin/lead solder for all solder connections.

H. Dress, lace or harness all wire and cable to prevent mechanical stress on electrical connections. No wire or cable shall be supported by a connection point. Provide service loops where harnesses of different classes cross, or where hinged panels are to be interconnected.

I. Termination and build out resistors and related circuit correction components shall be visible. Do not install in connector shells or internally modify equipment. Show locations on Record Drawings.

J. Correct any and all of the following unacceptable wiring conditions:
1. Deformed, brittle or cracked insulation.
2. Insulation shrunken or stripped further than 1/8-inch away from the actual point of connection within a connector, or on a punch block.
3. Cold solder joints.

4. Flux joints.
5. Solder splatter.
6. Non-grommet, non-bushed, or non-insulated wire or cable entries.
7. Deformation or improper radius of wire or cable

3.10 SIGNAL GROUNDING PROCEDURES

A. Comply with National Electrical Code.

B. Unless otherwise noted maintain a unipoint ground scheme.

C. Signal and electrical system grounds shall be isolated except at the Project ground field connection.

D. Equipment enclosures shall not be permitted to touch each other unless bolted together and electrically bonded.

E. Ground and bond equipment racks and similar equipment enclosures containing powered equipment exclusively via the Isolated Ground conductors provided under Division 26. INSULATE RACK MOUNTING, ANCHORAGE, AND RACEWAY CONNECTIONS.

F. At each rack, provide an Isolated Ground bus within the rack. At each rack, provide a lug bonded to the rack frame with a #8 TW stranded wire to the rack Isolated Ground bus.

G. At each ensemble of racks, provide a single labeled Isolated Ground tubular-clamp bus bar terminal strip to land the individual rack Isolated Ground bus ground conductors. Connect the main Isolated Ground conductor from the Technical Power panel board at this point.

H. Equipment signal ground shall be to the Isolated Ground System via the green wire of the equipment power cord. Where equipment uses two wire power cord, provide #12 green bond wire to rack IG bus bar. At equipment, provide crimp lug and suitable hardware for bonding.

I. Shielded cables of this section shall be grounded exclusively to Isolated Ground by a single path. Shield shall be tied to Isolated Ground at one end only, i.e., at the low potential (receiving) end of run, unless otherwise noted.

J. Unless otherwise noted, at audio jackfields, tie source shield at jackbay frame. Float shields at connections to output jacks. Bus each row of jack frames and run individual #12 green ground wire for each row to rack IG bus bar.

K. Signal Ground provisions shall realize less than 0.15 ohms to the primary ground connection.

3.11 EQUIPMENT ENCLOSURE (RACK) AND EQUIPMENT BACKBOARD FABRICATION

A. Combustible material, other than incidental trim of indicated equipment, is prohibited within equipment racks.

B. Within each equipment enclosure, provide a full-height multi-circuit ISOLATED GROUND outlet strip with branch circuit count as shown on drawings; locate on the left side of the equipment enclosure, as viewed from the rear. In each enclosure provide number of receptacles required by present and future equipment indicated on drawings, plus at least two spare receptacles. Provide flexible steel raceway and junction box for connection of power service. Bond internal raceway to rack frame.

C. Provide a permanent label on the front of each equipment rack including the rack designation, and the circuit breaker number and associated electrical distribution panel designation servicing same.

D. Maintain separation of wiring classifications as specified herein. Separately dress, route and land microphone and line level cables and related on the right side of the equipment enclosure, as viewed from the rear; dress, route, and land loudspeaker level and control cables on the left side of the equipment enclosure, as viewed from the rear.

E. Access shall not require demounting or de-energizing of equipment. Install access covers, hinged panels, or pull-out drawers to insure complete access to terminals and interior components.

F. Fasten removable covers containing any wired component with a continuous hinge along one side, with associated wiring secured and dressed to provide an adequate service loop. Provide an appropriate stop locks to hold all hinged panels and drawers in a serviceable position.

G. Provide permanent labels for all equipment and devices. Where possible, fasten such labels to the rack frame or to blank or vent panels which will remain in place when active equipment is removed for possible service.

H. At jackfields, provide service loop to permit removal of jackfields from rack sufficient to conveniently access all jack contacts for routine cleaning and maintenance. Organize the service loop and harness such that reasonable reconnection of jacks and jack normals is possible without cutting apart the harness.

I. Coordinate the design and execution of wire harnessing of multi-bay rack ensembles with conditions of delivery to installation locations at Project Site, and with the requirement herein for test of the completely wired system in the shop prior to delivery to the Project Site. Organize the wiring harnesses such that they will fold within one shippable unit without risk of damage, or provide polarized multipin connectors and related interconnect systems as specified elsewhere herein.

J. At each equipment backboard, provide UL Listed surge suppressing multi-outlet assembly with at least six receptacles.

3.12 ADJUSTING AND TESTING

A. Test Equipment
1. Furnish, store and maintain test equipment at the fabrication shop and the job site for both routine and Acceptance Testing of the Work of this Section. Maintain all test equipment at the job site while work is in progress from installation of equipment racks until Owner's Representative Acceptance of this Work; thereafter remove all of this test equipment from the job site. Provide all required test cables, jigs and adapters. Provide at least one of the following items or approved functional equivalents:
2. Audio Systems:
    a. Wide Band Oscilloscope (Tektronix THS700 Series).
    b. True RMS Analog / Digital Volt-Ohm Multimeter (Fluke 187 Series or equal).
    c. Low Distortion Audio Frequency Sine Wave Oscillator (Gold Line TS1).
    d. Measurement Microphones (Earthworks M30, Bruel & Kjaer 4007, Josephson 550).
    e. Sound System Optimization and Acoustic Measurement Analyzer (Goldline TEF, Meyers SIM, SIA Smaart, WinMLS, EASERA).
    f. Harmonic Distortion Analyzer (Sound Technology or Tektronix AA 501A) or Swept Spectrum Analyzer, HP 3580A, or Swept Test System, Audio Precision or Neutrik).
3. Video Systems:

a. Wide Band Oscilloscope (Tektronix THS700 Series).
b. Sync & Test Generator (Tektronix 1470).
c. Waveform/Vector Monitor (Tektronix 1740).
d. Color Picture Monitor, Precision.

4. MATV Systems:
   a. MATV Spectrum Analyzer (Sadelco DisplayMax 800CLI).
5. Communications and Related:
   a. Level II, Cat5e Cable Pair Tester (Microtest, HP, Scope, Fluke or Siemons set up to meet Category 5e parameters).
   b. Outside Plant Voice Cabling Plant Tester – capable of detecting shorts, opens, reversals, mis-wiring and crosstwists (Siemon STM-8 or equal by Mod-Tap).
   c. Metallic cable pair tester (Wavetek Corporation, Instruments Division, model LANTech 100).
   d. Tone Test Set.
   e. Optical Time Domain Reflectometer (OTDR) for fiber optics.
   f. Any other items of equipment or materials required to demonstrate conformance with the Contract Documents.

B. System Performance Testing and Adjusting Procedures
1. Upon completion of the installation of all equipment in an area, perform the following tests and record results. Verify safe and proper operation of all components, devices, or equipment, establish nominal signal levels within the systems and verify the absence of extraneous or degrading signals. Make all preliminary adjustments and document the setting of all controls, parameters of all corrective networks, voltages at key system interconnection points, gains and losses, as applicable. Submit test report. Correct all non-conforming conditions prior to requesting Acceptance Review and Testing. Perform at least the following procedures:
2. Mechanical: Verify:
   a. Integrity of all support provisions.
   b. Absence of debris of any kind, tools, etc.
3. Power and Isolated Ground: Verify:
   a. Isolation of Isolated Ground system from raceway and related ground.
   b. Grounding of devices and equipment. Integrity of signal and technical power system ground connections.
   c. Proper provision of power to devices and equipment.
4. Signal Wiring: Verify:
   a. Integrity of all insulation, shield terminations and connections.
   b. Integrity of soldered connections. Absence of solder splatter, solder bridges.
   c. Routing and dressing of wire and cable.
   d. Continuity, including conformance with wire designations on running sheets, field and shop drawings.
   e. Absence of ground faults.
   f. Polarity.
5. Use the proper sequence of energizing systems to minimize the risk of damage.
6. Audio Systems:
   a. Electronic Tests; confirm:
      1) Gain at 1 kHz.
      2) Maximum output.
      3) Input clipping level.
      4) Frequency response.
      5) Total harmonic distortion.
      6) Signal-to-Noise ratio.
      7) Signal-to-Crosstalk ratio.
   b. Electro/Acoustic Tests:
      1) Uniformity of coverage.

2) Electronic and acoustic frequency response/one-third octave equalization. Transfer function measurement shall be as close to flat as possible. Measure at ear level. Owner's Representative will direct final adjustment.
3) Maximum continuous sound pressure level (in the reverberant field). Drive systems with broadband pink noise. Sustain for at least five minutes with no system damage. Measure for "A" and "C" weightings at ear level on loudspeaker axis. Turn off noise.
4) Acoustic signal-to-noise ratio referenced to the specified maximum continuous sound pressure level in the reverberant field. Measure for "A" and "C" weightings at ear level on loudspeaker axis with mechanical systems operating. Present comparison with previous measurement.
5) Acoustic gain before feedback. Locate acoustic source (4 inch loudspeaker/pink noise generator) two feet from system microphone. Measure at system microphone position and at most distant listener position at ear level. Present comparison.

7. Video Systems:
   a. Video Monitors:
      1) Apply crosshatch. Verify linearity.
      2) Apply red field. Adjust purity.
      3) Apply SMPTE bars and PLUGE. Adjust to standards.
   b. Video Path Test: Use NTC-7 procedures. Use full field or line signals. Alternately, conduct copper time domain reflectometer test.
8. Diagnostic Monitoring System:
   a. Demonstrate complete operation.
9. System Overall:
   a. Verify levels.
   b. Provide permanent "wedge" type labels on all controls, as applies, to indicate correct settings after systems performance testing and adjustment procedures have been successfully completed.

C. Loudspeaker Assembly Testing and Adjusting Procedures
1. Upon completion of the installation of all loudspeakers in an area, perform the following tests and record results. Correct non-conforming conditions, unless the cause is clearly outside the Work of this Section, in which case submit the apparent cause to the Owner's Representative.
2. Loudspeaker Line Impedance: At terminal cabinets at equipment rooms, measure the impedance of each loudspeaker line. Sweep from at least 20 Hz to at least 16 kHz.
3. Loudspeaker Polarity: Test the acoustic polarity of all loudspeakers using an Acoustic Polarity Tester.
4. Freedom From Buzzes, Rattles and Objectionable Distortion: Individually apply to each loudspeaker line a slow sine wave sweep from 50 Hz to 5 kHz at a level of 6 dB below rated power amplifier output voltage. Listen carefully for buzzes, rattles and objectionable distortion.
5. Uniformity of Coverage: Apply broadband Pink Noise. Adjust level to approximately 70-80 dBA at measurement locations. Measure in 4 kHz octave band at ear level. Adjust loudspeaker aiming and 70 Volt loudspeaker taps for uniformity of coverage.

D. Equipment Rack and Equipment Testing and Adjusting Procedures
1. Conduct procedures in fabrication shop. Verify safe and proper operation of all components, devices, or equipment, establish nominal signal levels within the systems and verify the absence of extraneous or degrading signals. Make all preliminary adjustments and document the setting of all controls, parameters of all corrective networks, voltages at key system interconnection points, gains and losses, as applicable. Submit test report with color photographs of each equipment rack, front and back. Perform at least the following procedures:

2. Preliminary: Verify:
   a. Grounding of devices and equipment. Integrity of signal and electrical system ground connections.
   b. Proper provision of power to devices and equipment.
   c. Integrity of all insulation, shield terminations and connections.
   d. Integrity of soldered connections. Absence of solder splatter, solder bridges.
   e. Absence of debris of any kind, tools, etc.
   f. Routing and dressing of wire and cable.
   g. All wiring, including polarity and continuity, including conformance with wire designations on running sheets, field and shop drawings.
   h. Mechanical integrity of all support provisions.
3. Rig temporary power and grounding: Comply with all applicable Codes, regulations and ordinances.
4. Determine the proper sequence of energizing systems to minimize the risk of damage. Energize. Burn in for at least 120 hours.

E. Telecommunications Cabling Testing
1. Perform telecommunications cabling inspection, verification, and performance tests in accordance with TIA-568-C.1, TIA-568-C.2 and TIA-568-C.3. Perform optical fiber field inspection tests via attenuation measurements on factory reels and provide results along with manufacturer certification for factory reel tests. Remove failed cable reels from project site upon attenuation test failure.
2. Visually inspect UTP and optical fiber jacket materials for UL or third party certification markings. Inspect cabling terminations in telecommunications rooms and at workstations to confirm color code for T568A or T568B pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1, TIA-568-C.2 and TIA-568-C.3. Visually confirm Category 6 marking of outlets, cover plates, outlet/connectors, and patch panels.
3. UTP backbone copper cabling shall be tested for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors, and between conductors and shield, if cable has overall shield. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connected.
4. For multimode optical fiber, perform optical fiber end-to-end attenuation tests in accordance with TIA-568- C.3 and TIA-526-14-A using Method A, Optical Power Meter and Light Source for multimode optical fiber. For single-mode optical fiber, perform optical fiber end-to-end attenuation tests in accordance with TIA-568- C.3 and TIA-526-7 using Method A, Optical Power Meter and Light Source]. Perform verification acceptance tests.
5. Perform testing for each outlet as follows:
   a. Perform Category 6 link tests in accordance with TIA-568-C.1 and TIA/EIA-568-B.2. Tests shall include wire map, length, insertion loss, NEXT, PSNEXT, ELFEXT, PSELFEXT, return loss, propagation delay, and delay skew.
   b. Optical fiber Links. Perform optical fiber end-to-end link tests in accordance with TIA-568-C.3. E. Final Verification Tests
   c. Perform verification tests for UTP and optical fiber systems after the complete telecommunications cabling and workstation outlet/connectors are installed.

3.13 CLEANING

A. Clean each section or area of where the work was conducted after completion to permit immediate use of the area. Remove and discard all refuse, rubbish, and debris.

B. The AV Contractor shall ensure that all recyclable and environmentally hazardous waste materials are disposed properly.

C. Make good all existing structures, surfaces, and utilities affected by cutting, coring, mounting, drilling, or other new work.

D. Clean all furnished equipment of dust, dirt, finger prints, smudge, and other material prior to calling for a Substantial Performance of Work Review or Completion of Work Review.

3.14 PROTECTION

A. During the installation phase and up to the date of achieving Substantial Performance of Work, protect finished or unfinished work against damage or loss. In the event of such damage or loss, immediately replace or repair such work or equipment at no cost to the Owner.

3.15 ACCEPTANCE REVIEW, TESTING PROCEDURES AND COMMISSIONING

A. Complete all Work of this Section. Submit Test Report. Submit review copies of Operating and Maintenance Manuals, less reduced set of Record Drawings. Notify the Owner's Representative in writing that the Work of this Section is complete and fully complies with the Contract Documents. Request Acceptance Review and Testing by returning Attachment "A" to the Owner's Representative. The representative of the Owner's Representative will conduct Verification of Submitted Test Data, and otherwise direct testing and adjustment of this Work. These Procedures may be performed at any hour of the day or night as required by the representative of the Owner's Representative to comply with the Project Schedule and avoid conflict with these procedures from possible ongoing work of other Separate Contracts and/or the Owner's Representative's operations. Provide all specified personnel and equipment at any time without claim for additional cost or time.

B. Personnel: Provide services of the designated supervisor and additional technicians familiar with work of this Section. Provide quantity of technicians as required to comply with Project Schedule.

C. In Addition, Provide:
   1. Set of hand and power tools appropriate for performance of adjustment of and corrections to this Work.
   2. Include spare wire and connectors and specified tooling for application.
   3. Ladders, scaffolding and/or lifts as required to access loudspeakers and other high devices.
   4. Test equipment to include but not limited to:
      a. Dual channel FFT-based audio analyzer
      b. Video test generator with color bars, grayscale, alternating pixel, multi-burst, crosshatch and % windows.
      c. InfoComm Projection Shoot-Out DVD
      d. Digital Video Essential Professional DVD
      e. Category cable tester, cable length, short, open and miswire test.
   5. Complete set of latest stamped, actioned submittals of record for reference.
   6. Complete set of Shop and Project Site Test Reports.
   7. Complete set of manufacturer's original operation, instruction and service manuals for each equipment item for reference.

D. Demonstrate: Complete operation of all systems and equipment, including Portable Equipment.
   1. General
      a. Configure room for each type of event and demonstrate audio-visual system.
      b. Connection of portable equipment. (Laptop, document camera, etc.)
      c. Demonstrate to the Owner's Representative that all functions and equipment for the system work properly when installed as a complete system.
      d. The AV Contractor shall demonstrate the satisfactory operation of all controls and adjustment circuits of the system.

e. Demo room scheduling software where applicable.
f. Room combining and dividing presets.
g. Demonstrate system startup and shut down procedures.

2. Audio
   a. Route audio to program speakers.
   b.
   c. Connect microphone to each panel input and route through system.
   d. Demonstrate and document gain structure through the system.
   e. Demonstrate and document with a dual channel FFT-based audio meter the following:
      1) Polarity of each driver in each cabinet.
      2) Crossover point of high, mid and low section of each loudspeaker.
      3) dB SPL levels from 1-4 kHz at various position in the audience area.
      4) dB SPL level of high, mid, low and sub frequency bandwidth at crossover.
   f. Audio routed to ceiling speakers.
   g. Wireless microphones.
   h. Demonstrate that the audio system is properly time aligned and equalized.
   i. Assistive listening system.
3. Video
   a. Route source equipment (DVD, Blu-ray Player, TV tuner, test generators, etc.) to video displays and projector.
   b. Set up rooms for each type of event that may take place and demonstrate each.
   c. Recording of a videoconferencing session.
   d. Recording of a distance learning session.
   e. Videoconferencing and distance learning presets.
4. Control
   a. Communication between control system and AV equipment, including feedback if device supports 2-way communication
   b. User interface operation.
   c. Password protection of user interface.
   d. Touch panel features and each page of control.
   e. Touch panel help file.
   f. Help desk features.
   g. All programmed presets.
   h. Lighting and window shade control.
5. The AV Contractor 's personnel and test equipment shall be made available to the Owner's Representative in order that:
   a. Selected tests and measurements previously made by the AV Contractor can re-run.
   b. Other tests may be made at Owner's Representative's discretion.
   c. Additional tests or measurements may be made due to changes in field conditions.
6. It is estimated that the acceptance tests and demonstrations will require approximately four hours unless construction or installation problems or deviations from the specifications are discovered.

E. Adjust: As directed by the Owner's Representative.

F. Correct: In timely manner, failure to comply with the Contract Documents, as reasonably determined by the representative of the Owner's Representative.

G. Acceptance Documentation
   1. Official acceptance of the system covered by this specification will occur when the Design-Builder receives the following written documents:
      a. A letter from the Owner's Representative acknowledging Final Acceptance of the system stating compliance with all articles of the specifications.

b. A letter from the Owner's Representative to the AV Contractor stating that all related work has been completed to his satisfaction. Until these documents are received, the installation is not formally complete. The official date of acceptance shall be the date of the letter from the Owner's Representative to the AV Contractor described above.

3.16 CLOSEOUT

A. Punch List: Perform any and all remedial work, at no claim for additional cost or time. Where required, retest and submit Test Report. Notify Owner's Representative of completion of Punch List.

B. Portable Equipment: Furnish all portable equipment and spares to the designated representative of the Owner's Representative, along with complete documentation of the materials presented. Where applicable, furnish portable equipment in the original manufacturer's packing.

C. Operating and Maintenance Data: Install framed operating and maintenance instructions. Submit Manuals.

D. Project Record Documents: Submit.

E. Keys: If applicable, replace construction locks with permanent locks. Transmit keys to Owner's Representative.

F. Training: Conduct specified training and submit training manuals.

G. Warranty: Submit Warranty dated to run from date of Acceptance of the Work of this Section.

3.17 OWNER'S REPRESENTATIVE RIGHT TO USE EQUIPMENT

A. Acceptance of the Work of this Section will be after completion of corrections and adjustments required by the "Punch List" which results from Acceptance Review and Testing of the completed installation. The Owner's Representative reserves the right to use equipment, material and services provided as part of the Work of this Section prior to Acceptance without incurring any obligation to Accept any equipment or completed systems until all Punch List work is complete and all systems comply with the Contract Documents; or accept any claim for additional cost or time.

END OF SECTION

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