

## SECTION 11132

### AUDIO VIDEO SYSTEM

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. The Drawings, General, Special, and Supplementary Conditions of the Contract and Division 01 apply to the Work of this Section.
- B. All work shown on Contract Drawings AV series drawings is provided under this section. Refer to these drawings for plans, graphic representations, schedules, and notations showing Audio Video System work.
  - 1. Refer to 'AE' Audio Visual infrastructure sheets (AE100) for related work provided under Division 16.
  - 2. Refer to 'AV' Audio Visual infrastructure sheets (AV100 series) for related work provided under Division 11.
  - 3. Switches, switchboards, contactors, panel boards, transformers, conduit, wire, outlets, connectors and other electrical devices specified herein or on accompanying drawings shall conform to provisions of other sections of Division 16 of these specifications unless otherwise noted.

##### 1.2 SCOPE

- A. Section Includes supply, delivery, supervision, coordination, installation of equipment items specified herein and shown on drawings as well as testing, documentation, and instruction related to complete Audio Video Systems, Equipment Racks, Consoles, Cables, and Control wiring for the following systems:
  - 1. Audio Video Systems Electronics and Wiring.
  - 2. Control Systems Electronics and Wiring, including connections to control system network.
  - 3. Miscellaneous portable equipment and accessories.
  - 4. Coordination with other trades.
- B. Provision of system testing and demonstration, system documentation and instruction of Owner Personnel.

##### 1.3 REFERENCES

- A. National Electric Code (N.E.C.).
- B. National Electric Safety Code (N.E.S.C.).
- C. Davis, Don, Sound System Engineering, Second Edition, Howard W. Sams and Co., Indianapolis, Indiana, 1986.
- D. Society of Cable Telecommunications Engineers (S.C.T.E).
- E. National Fire Protection Association (N.F.P.A.).
- F. American National Standards Institute (A.N.S.I.).
- G. Electronics Industries Association (E.I.A).
- H. Telecommunications Industries Association (T.I.A.).
- I. Audio - Design and Installation, Giddings, Howard W. Sams, 1990.
- J. Society of Motion Picture and Television Engineers (S.M.P.T.E.)
- K. American Society for Testing Materials (A.S.T.M.).

- L. Building Seismic Safety Council (B.S.S.C.)

## 1.4 SYSTEM DESCRIPTION

- A. Fellowship Hall Audiovisual Systems under this specification are as described below:
1. Visual Systems
    - a. A projection screen (60" H X 107" W) will be located in the ceiling near the fireplace and will display video images projected from a portable video projector that will be located on a cart. The video projection equipment will be a high light output device (4000 ANSI Lumens) to provide a bright image on the screen and capable of displaying computer images from OFE computer, portable DVD player and other video sources as required and provide for auxiliary input
    - b. No other installed video equipment is part of this scope.
  2. Audio Systems
    - a. A digital signal processor (DSP) will provide mixing, equalization, room combining, volume control and other related audio functions.
    - b. The audio system will utilize high quality, ceiling mounted loudspeakers distributed and zoned for reinforcement. Microphones plates will be located in the floor boxes and wall panels.
    - c. The ceiling mounted loudspeakers will be utilized for speech reinforcement and program audio from the portable video player and auxiliary sources via an input plate in the floor boxes and also the aux feed from the existing sanctuary.
    - d. An audio feed for the existing sanctuary will be part of the scope of work. The line feed will be located at or near the existing foyer ceiling area. Conduit will be provided from the Foyer ceiling area to the AV rack location in the Fellowship Hall.
  3. Control System
    - a. A centralized microprocessor-based programmable control system will provide for remote control of all audio/visual functions and related "room functions" such as operation of projection screen, drapes, DSP, room combining and CD player
    - b. The system will be expandable to allow for the installation of control devices to accommodate all future additions to the system.
    - c. Control connection points for a wired keypad located in the AV rack and one wall mounted keypad.
    - d. The control equipment will be located in the equipment rack and through low voltage interfaces, connected to all the related audiovisual equipment.

## 1.5 SUBMITTALS

- A. Product Data: In addition to the quantities required by "Division 01, Submittal Procedures" and before ordering, submit one (1) additional sets of catalog data sheets, neatly bound with title page, space for submittal stamps, and tabbed dividers between sections. List all proposed equipment with reference to corresponding specification paragraph numbers or equipment title. Indicate all accepted substitutions.
1. Submit a schedule of finishes indicating proposed materials and color selections for all exposed items subject to Architect's selection.
  2. Submit a list showing coordination of selected frequencies for all wireless transmitters.
- B. Shop Drawings: In addition to the quantities required by "Division 01, Submittal Procedures", submit one (1) additional bond sets of drawings showing 'Submittal for Construction' work to the Architect for its Consultant review. If 'Submittal for Construction' documents are rejected, correct and resubmit in the manner specified
1. Provide Shop Drawings and Record Drawings using the following scales:
  2. Plans - not less than 1/8" = 1'-0"
  3. Details - not less than 1/4" = 1"
  4. Submit point-to-point wiring diagrams and typed wire lists identifying every connection for information. Include electronic devices such as switches,

- transformers, and terminal blocks. Indicate locations of all components. Identify cables by types, colors, and wire numbers.
5. Submit system plans showing all device locations and ceiling distributed loudspeaker layouts with wattage tap settings.
  6. Submit conduit riser diagrams showing connection of all devices, required conduit sizes along with types and quantities of cables to be used and cable identification tags.
  7. Submit rack layouts indicating the proposed arrangement of mounted equipment including junction boxes and locations of conduit penetrations.
  8. Submit fully dimensioned construction details of all panels, plates and other custom fabricated items or modifications (e.g. installation of audio/visual equipment in lecterns). Include complete parts lists and, as required, schematic diagrams.
  9. Submit mounting and support details for distributed ceiling loudspeakers, and all other items mounted overhead complete with parts lists and dimensions. Include a full plan view, front elevation, and side elevation of each item with corresponding support structure and mounting hardware. Verify load ratings of all hanging components including attachment hardware.

## 1.6 CLOSEOUT SUBMITTALS

- A. Drawings: Maintain a full set of shop drawings at the project site marked up to indicate actual locations, wattage tap settings and, in general, the true state of the installation. Furnish one initial set of record drawings along with the results of all source quality control tests specified in Part 2 and field quality control tests specified in Part 3 to the Consultant for use during acceptance testing and equalization. Submit one (1) bond black line set. If 'as installed' documents are rejected, correct and resubmit in the manner specified.
  1. After approval of 'as installed' documents, submit five (5) sets of record drawings each consisting of the following:
    - a. One (1) set of full size prints
    - b. One (1) set of CAD drawing files on CD-ROM media.
- B. Manuals: Furnish one initial set of product manuals to the Consultant for use during acceptance testing and equalization. At the time of contract closeout, submit the system Operation Manual and the Maintenance Data Manual. Neatly bind each with tabbed dividers between sections and include a title page with space for submittal stamps.
  1. Operation Manual
    - a. Table of Contents
    - b. Typed description of each system including key features and operational concepts (e.g. remote control features, switching or routing functions, patch points, mixing and linking capabilities).
    - c. Setup diagrams and typed instructions for use in typical situations as directed by the Consultant.
    - d. Small scale plans showing locations and circuit numbers for all system outlets and receptacles.
    - e. Single-line block diagrams showing all major system components.
    - f. Two sets of A size drawings showing the components and wiring in each individual rack. One drawing of each rack shall be mounted in a plastic jacket to the rear door of the associated rack. The other complete drawing set shall be included in the manual.
    - g. Manufacturer's operation manuals for equipment intended for operation by system users (e.g. tape decks, VCRs, communication equipment).
    - h. A properly licensed working copy of the latest version of any and all software required to operate or configure the systems specified herein shall be a part of the system supplied. This includes, but is not limited to, all software, firmware and hardware required for configuration, adjustment, diagnosis and repair.
    - i. All software shall be fully documented, and that documentation included.
    - j. Software shall be included in its "installable" state on industry standard 3.5" 1.44MB IBM format disks, CD-ROM, or other appropriate format. Back up of the working

- software may be provided as an additional inclusion. Disk images are unacceptable.
- k. All user definable software configurations and/or programming shall become the sole property of the owner. This includes all source code, source code copyrights, and related documentation.
  - l. Software compiler shall be property of the owner with all related documentation.
  - m. Key schedule cross-referencing all keys to their respective functions.
2. Maintenance Data Manual
- a. Table of Contents
  - b. Company name, address, telephone number and contact name for system service or maintenance.
  - c. Listing of all equipment and materials with names of manufacturers and model numbers or part numbers.
  - d. Catalog data sheets displaying manufacturer's names, addresses, and telephone numbers.
  - e. Product manufacturers' warranties and a typed one-year system warranty explicitly covering all materials and labor.
  - f. Manufacturers' service manuals for all major equipment items.
  - g. Test documentation showing results of source quality control tests, field quality control tests, acceptance testing, and equalization. Document final settings for all non-user devices and controls after completion of acceptance testing and equalization including raw and equalized house curves. Document the physical position of settings as well as input and output signal levels measured in dbmV.
  - h. Provide a recommended preventative maintenance schedule with reference to the applicable pages in the manufacturer's maintenance manuals. Where the manufacturer provides inadequate information, provide the information necessary for proper maintenance.

## 1.7 QUALITY ASSURANCE

- A. Qualifications
- 1. Submit the following contractor qualifications:
    - a. Evidence of an in-house electronic service department:
    - b. List names and certifications of full-time service technicians.
    - c. List in-house electronic test equipment meeting the following minimum specifications for use during the source quality control tests specified in Part 2 and field quality control tests specified in Part 3 as well as use by the Architect's Consultant at the project site during acceptance testing and equalization.
    - d. Evidence of full-time personnel with experienced on projects of similar size, scope, and construction schedule to the Work of this Section.
    - e. List the name, date of employment, qualifications and experience of the installation supervisor for this project.
    - f. List the company's drafting capabilities including the name, date of employment, qualifications and experience of the employee who will draft shop drawings and project record drawings for this installation.
    - g. List the names, dates of employment, qualifications and experience of all other personnel to be used on this project.
  - 2. Submit a statement that the bid is based upon specified products or accepted Substitutions by systems design consultant.
  - 3. Submit a work plan indicating scheduling of employees and time frames for shop drawings, ordering of equipment, installation, testing, punch-list correction, and instruction.
- B. Regulatory Requirements
- 1. Obtain all required permits and inspections.
  - 2. Furnish material and workmanship for this work in conformance with all code requirements.

3. Obtain review from compliance officials responsible for enforcement of applicable codes and regulations to establish that the work complies with all requirements of reference codes indicated herein. Make corrections, changes acceptance, operation, and/or compliance with the final submittal as described herein.
- C. Field Samples
1. Before delivery of equipment to the job site, submit test reports for all measurements specified under Source Quality Control Tests.
  2. Before delivery to the job site, submit photographs depicting the quality of wiring and grounding within equipment racks.

## **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Packaging, Shipping, Handling, and Unloading
1. Coordinate with Owner's Representative for any equipment and materials to be delivered or stored on site.
- B. Storage and Protection
1. Provide appropriate protection of stored and/or installed equipment from both damage to the item or damage to other work, or finishes.

## **1.9 PROJECT CONDITIONS**

- A. Existing Conditions
1. Verify all project site conditions applicable to the Work of this Section. Notify the Architect in writing of any discrepancies, conflicts, or omissions prior to bid opening. Otherwise, correct these at no additional cost to the Owner.
  2. Continue to monitor the project site. If conditions develop requiring a need to vary from the Specifications or Drawings, notify the Architect's Consultant immediately in writing. Otherwise, make recommendations, submit drawings showing how the Work may be installed, and on approval, proceed with the necessary changes without additional cost to the Owner.

## **1.10 WARRANTY**

- A. Provide system warranty for a period of one (1) year against faulty materials and defects in workmanship. In addition to the above warranty, honor any manufacturer warranties that exceed this period of time.
- B. During the system warranty period, answer all service calls and requests for information within 24 hours. Repair or replace faulty materials and correct faulty workmanship within 24 hours of all service calls.

## **PART 2 - PRODUCTS**

### **2.1 AUDIO EQUIPMENT:**

- A. Digital Signal Processor (DSP) Provide 8 mic/line inputs and 8 line outputs. Uses modular expansion cards. 24-bit A/D audio resolution. RS232 and network controlled. Approved Products:
1. Ashley ne8800M 8x8
  2. Approved Equal
- B. Amplifier (AMP) Two channel 70-volt output device. Rack mounted. Provides 200 watts per channel. Approved Products:
1. QSC CX302V
  2. Approved Equal

- C. Portable microphones. Cardioid dynamic element. Includes 25' XLR cable and microphone stand. Approved Products:
  - 1. AudioTechnica PRO 41
  - 2. Ultimate Support MC-78B
  - 3. Quantity: 2
  - 4. Approved Equal
  
- D. Wireless Microphone System . Includes true diversity UHF receiver, handheld and lavalier microphone. Approved Products:
  - 1. AudioTechnica ATW-R2100 (Qty: Two)
  - 2. AudioTechnica ATW-T210 with AT892cW
  - 3. AudioTechnica ATW-T220
  - 4. Approved Equal
  
- E. Portable Mixer Approved Products:
  - 1. Mackie 402-VLZ3
  - 2. Approved Equal
  
- F. Ceiling Speakers. Approved Products:
  - 1. Tannoy CMS801 DC Speaker
  - 2. Tannoy CMS801 PI Back Can
  - 3. Approved Equal

## 2.2 VIDEO EQUIPMENT:

- A. Video Projector. 4000 lumen projector with UXGA resolution capability. Approved Products:
  - 1. Christie LX400
  - 2. Christie spare lamp
  - 3. Approved Equal
  
- B. Motorized Projection Screen. 60" x 107" image size with 84" black drop. Includes LVC. Approved Products:
  - 1. Da-Lite Boardroom (Re: Da-Lite quotation #DA269777)

## 2.3 CONTROL EQUIPMENT:

- A. Controller. Approved Products:
  - 1. AMX NI-2100
  - 2. Approved Equal
  
- B. Keypad. Approved Products:
  - 1. AMX MIO-DMS
  - 2. Approved Equal

## 2.4 MISC EQUIPMENT:

- A. Equipment Rack. Approved Products:
  - 1. Mid Atlantic ERK-2120
  - 2. Approved Equal
  
- B. AV Cart. Approved Products:
  - 1. Da-Lite AV5W-54J
  - 2. Approved Equal

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Execute all work in accordance with the NEC, NESC, and with all local and state codes, ordinances, and regulations.
- B. Install all rack mounted equipment with stainless steel 10-32 pan head machine screws with flat black plastic washers protecting equipment panel.
- C. Provide rack slides and mounts equal to those of the original manufacturer for the OFE requiring rack mounting. Where no same manufacturer mount is available, contractor shall supply custom mounts as manufactured by Middle Atlantic Audio Products.
- D. Mount all equipment to be installed over public areas in a manner adequate to support the equipment loads with a minimum safety factor of five, using methods recommended in the referenced Handbook for Riggers and in JBL Technical Notes Volume 1, Number 19. Use attachment hardware with a minimum SAE Grade 5 load rating. Do not use formed eyebolts or lag screws for support of suspended equipment.
- E. Firmly and permanently, attach electrical boxes, enclosures, and permanent equipment to the building. Rigidly mounted equipment and devices shall be plumb and square.
- F. Choose colors and finishes of all exposed and custom fabricated items and labels to blend in with the surroundings as approved by the Architect.
- G. Install equipment in accordance with manufacturers' recommendations. Ensure that levels and impedances are properly matched between components. Verify that projector distances and lensing are appropriate for the corresponding screen sizes.
- H. Provide shaft locks or security covers on all non-user equipment as directed by the Architect's Consultant during acceptance testing and equalization.
- I. Grounding and Shielding
  - 1. Mount and enclose all electrical and electronic equipment in metal enclosures or equipment racks.
  - 2. Use EMT type conduit for all wiring outside of equipment racks.
  - 3. Mount equipment racks in a manner, which provides electrical isolation from the building structure and electrical raceways. Use flexible conduits and PVC fittings to provide insulated connections between equipment racks and the building electrical raceways.
  - 4. Ground the chassis of all rack-mounted components in accordance with the Drawings and verify a D.C. resistance between each chassis and the rack ground bus of no more than 0.01 ohms.
  - 5. Ground the shields of interconnecting wires on one end only in accordance with the Drawings and treat the unused opposite ends as described below under Wiring Practices. Shield drain wires shall be insulated in all instances by use of appropriately sized black heat shrink tubing equal to Alpha FIT-221 series.
- J. Wiring Practices
  - 1. Where specific instructions are not given, perform all wiring in strict adherence to standard broadcast and sound engineering practices as described in the referenced Broadcast Audio Equipment for AM, FM, Television and in Sound System Engineering.
  - 2. Group all wiring into the following classifications by power level or signal type:
    - a. Microphone Level: less than -20 dBm.
    - b. Line Level Audio and DC Control Circuits: -20 dBm to +30 dBm.

- c. Speaker Level: greater than +30 dBm.
- d. Video/RF Circuits
- e. AC Power Circuits

K. Audio System

1. Maintain a minimum six-inch separation between wiring of different level classifications wherever possible. Otherwise, cross them perpendicular to each other. Where wiring of different level classifications share a common enclosure or junction box, provide metallic isolation barriers to completely electrically separate wiring groups.
2. Neatly harness wires together within racks by power level classification using horizontal and vertical wiring supports as required. Rigidly support all wires within twelve inches of connection points.
3. Observe consistent polarity throughout the audio systems as follows:
  - a. XLR Type Connectors
    - 1) Positive = Pin 2
    - 2) Negative = Pin 3
    - 3) Common = Pin 1
  - b. TRS Type Connectors
    - 1) Positive = Tip
    - 2) Negative = Ring
    - 3) Common = Sleeve
4. Use only balanced differential inputs throughout all sound systems unless noted otherwise. Use approved transformers to convert all unbalanced inputs to balanced inputs. Output signals may be unbalanced if inputs of subsequent devices are within the same rack. Otherwise use approved transformers to balance the outputs.
5. Exercise care in wiring to avoid damaging the cables and equipment. Use grommets around cut-outs and knock-outs where conduit or chase nipples are not installed.
6. Cut off unused wire ends approximately one-half inch ( $\frac{1}{2}$ " ) past the wire jacket. Fold them back over the jacket, and secure in place with heat-shrink tubing.
7. Make connections using rosin-core solder or approved mechanical connectors.
8. Terminate all field wiring in terminal boxes mounted to the walls in each equipment room prior to connection to any equipment or devices unless otherwise noted. All equipment in each equipment room shall connect to the field wiring at the appropriate terminal box. Field wiring shall not terminate directly in equipment racks unless otherwise noted. Provide 10% spare terminals at each location. Label each terminal with a unique number. Video, RGBS, and RF cables are exempted from this requirement.

L. Video System

1. All cables shall originate and terminate at active or passive devices; cables shall not be spliced. Where several devices are in close proximity, utilize approved housing-to-housing connectors and adapters.
2. All cables terminated in a connection plate mounted in an enclosure shall be dressed to allow removal from the enclosure and sufficient cable length for service or re-termination. Plate shall set on floor or freely swing clear.
3. Splices in any cable - Baseband or RF - are not acceptable.

M. Cable Installation in Conduit and Duct Banks

1. Pull mandrel one size smaller than the conduit, through entire length of all underground conduits.
2. Cable pulling lubrication shall be utilized when pulling cable.
3. A dynamometer shall be used to measure pulling tension during long or difficult runs. The dynamometer is to be placed between the cable puller and the pull line to monitor pulling tension. The manufacturer's pulling tension maximum range shall not be exceeded.

4. Pulling grips suitable for use with fiber cables shall be applied to the ends of the cable. Consult cable manufacturer to determine appropriate pulling grip and method of attachment. Breakaway or fuse links shall be used at the pulling grip. Insure that the correct "fuse pin" is installed in the fuse link.
5. Cable caps (heat-shrinking type) shall be used to seal the ends of the cable to protect the cable ends prior to terminating.
6. Use of cable blocks shall facilitate the bending of cable. For bends between 5 degrees and 45 degrees, a 45-degree cable block shall be utilized. For 45 degree to 90 degree bends, utilize a 90-degree cable block.
7. The bend radius for all cables shall conform to manufacturer's specifications.
8. Provide spare cables between terminal cabinets equal to 10% of the installed cables or a minimum of two cables of each type cable installed. Provide spare cables between terminal cabinets and equipment racks/consoles equal to 15% of the installed cables or a minimum of five cables of each type cable installed. Label all spare cables as spares with unique identifiers. Do not use any spare cables without prior approval from the Architect's Consultant.

N. Labeling

1. Label products in a logical, legible, and permanent manner corresponding to the Drawings using wording, format, style, color, and arrangement of text approved by the Architect.
2. Label all panels and wall plates using 1/8" engraved lettering. On dark panels and plates, fill engraving with white paint, and on aluminum or stainless steel panels and plates, fill engraving with black paint.
3. Provide engraved plastic labels similar to Lamicoid, squarely and permanently attached, to label patch panels, barrier strips, terminals, transformers, switches, relays and similar devices as well as the front and rear of all signal processing equipment (e.g., PA, LIM, EQ). Label all controls on distribution amplifiers, mixers, etc. as to the function of each.
4. Label push-button switches with engraved lettering filled with contrasting color paint.
5. Label all permanent wiring on both ends with approved permanent clip-on type or sleeve type markers. Wrap-around adhesive labels will not be accepted unless completely covered with clear heat shrink tubing.

### 3.2 FIELD QUALITY CONTROL

A. General Testing

1. Maintain a competent supervisor and supporting technical personnel, acceptable to the Owner during the entire installation. Change of supervisor during the project shall not be acceptable without prior written approval from the Owner.
2. Before connecting any equipment to electrical power outlets, measure and record the A.C. voltages between hot, neutral, and ground and verify correct outlet polarity. Verify, test and document correct and safe function of isolated ground power systems.
3. Determine the best sequence of energizing systems to minimize the risk of damage.
4. After successfully energizing the systems, make preliminary adjustments and document the settings of all controls, parameters of corrective networks, voltages at key interconnection points, gains and losses as applicable. Replicate the unity gain tests performed at the shop and document the absence of any waveform distortion, interference signals, or oscillations.
5. Upon completion of the system installation, it shall be the responsibility of the Contractor to perform the necessary adjustments and balancing of all signals, amplifier gain, and other level controls to ensure proper system operation. The system shall be physically inspected by the Owner to assure that all equipment is installed in a neat and workmanlike manner as called for by the plans and specifications.
6. Verify the performance parameters of the individual systems following established professional procedures, in addition to those specified herein. Document all

acceptance testing, calibration and correction procedures described herein, being careful to include the following information:

- a. Performance date of the given procedure.
- b. Condition of performance of procedure.
- c. Type of procedure, and description.
- d. Parameters measured and their values, including values measured prior to calibration or correction, as applicable.
- e. Parameters associated with calibration or corrective networks, components, or devices.
- f. The names of personnel conducting the procedure.
- g. The equipment used to conduct the procedure

B. Audio Testing

1. Before connecting loudspeaker lines to power amplifiers, measure and record the impedance curves of all lines using a sweep test or impedance bridge at least six frequencies from 125 Hz through 8,000 Hz.
2. Test all low-level audio cables and connections for continuity and ground faults and correct polarity.
3. Apply a sine-wave sweep signal to each loudspeaker system, sweeping from 50 Hz to 5,000 Hz at a sound pressure level that is 10 dB below the loudspeaker's rated electrical input power. Listen for rattles or objectionable noise and correct if apparent.
4. Check for proper polarity of loudspeakers by applying music program or pink noise to each system and walking through the transition areas of coverage from one loudspeaker to the next. Transition should be smooth with no apparent shifting of source back and forth from one loudspeaker to the next.
5. Achieve uniform distribution of sound from each loudspeaker system after all interior furnishings are in place. Drive each system with one full octave of noise centered at 4000 Hz at a level of 85 to 90 dB. Use a sound level meter that meets ANSI ST 4-1971 Type 2 standards set for slow meter damping and "A" weighting. Take all readings at seated ear height. Adjust speaker angles as necessary to achieve  $\pm 3$  dB over entire seating area. Provide plan of achieved sound distribution from each system, plotted with 4kHz pink noise levels as measured on a 10-foot square grid pattern. The process of equalizing and testing the Sound Systems may necessitate moving and adjusting certain component parts, e.g., loudspeakers. This shall be done without claim for additional payment.
6. Provide a list showing all build-out, termination, and pad resistor calculations. List to include measured line and source impedances used in calculations and results of tests after installation, and impedance of all inputs to equipment brought up on patch bay. Impedances in ohms are to be within  $\pm 10\%$  of design value. Levels in dB are to be within  $\pm 1$  dB of design value.
7. Upon completion of initial tests and adjustments, submit written results of tests to Architect/Consultant. In addition, submit written notification that the installation has been completed in accordance with the requirements of the Contract Documents, and is ready for equalization and inspection by representatives of the Architect/Consultant and Owner.

C. Test Equipment

1. Provide the following test equipment on site during construction and available to the Owner during final adjustment and acceptance testing:
  - a. Laptop computer with all installed software

D. Inspection

1. Provide a statement of completion certifying that the system is installed and is ready for acceptance testing and equalization to the Architect's.
2. Schedule a time for the Architect's Consultant to perform system acceptance testing and equalization with at least 14 days advance notice.
3. Designate technicians who are familiar with and qualified to operate the systems for instruction of the Owner. Provide instruction of Owner-designated personnel in the

design features and proper operation of the systems. Provide a minimum of 40 hours for on-site instruction and videotape the training sessions. Make any Owner requested changes to the control system programming during this time. Coordinate instruction times through the Architect.

4. Under the direction of the Architect's Consultant, adjust signal levels and loudspeaker aiming as required to achieve the uniform sound distribution within a tolerance of +2dB.
5. System flatness test shall employ an approved sweep transmitter receiver pair. Sweep measurements shall be taken at the termination of every cable termination in the system. Where possible, record sweep results by photographic means.
6. Record the final settings on all equipment and submit with contract closeout documents.
7. Record final settings on all equipment and submit with contract closeout documents.
8. Heat shrinking tubing shall be shrunk to cover the external connection to amplifier/passive components only after system alignment and acceptance has been completed.
9. If the system does not meet criteria or if additional trips to the job site for testing or equalization are required, the Contractor shall reimburse the owner for all expenses and professional time encountered by the Architect and its Consultant.

### **3.3 CLEANING**

- A. Remove all unnecessary tools and equipment, unused materials, packing materials, and debris from each area where Work has been completed unless designated for storage.
- B. Clean all areas around system equipment and be sure that the inside of each equipment rack is free of wire stripping and other debris.

### **3.4 DEMONSTRATION**

- A. Upon completion of the Work, the Owner may elect to verify test data as part of the acceptance procedure. Provide personnel and equipment, at the convenience of the Owner, to reasonably demonstrate system performance and to assist with such tests without additional cost to the Owner.
- B. Within three months after final acceptance, the Owner reserves the right to direct changes to the control system software. Such changes shall be made without additional cost to the Owner.

END OF SECTION

## SECTION 11132

### AUDIO VIDEO SYSTEM

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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- A. Fellowship Hall Audiovisual Systems under this specification are as described below:
1. Visual Systems
    - a. A projection screen (60" H X 107" W) will be located in the ceiling near the fireplace and will display video images projected from a portable video projector that will be located on a cart. The video projection equipment will be a high light output device (4000 ANSI Lumens) to provide a bright image on the screen and capable of displaying computer images from OFE computer, portable DVD player and other video sources as required and provide for auxiliary input
    - b. No other installed video equipment is part of this scope.
  2. Audio Systems
    - a. A digital signal processor (DSP) will provide mixing, equalization, room combining, volume control and other related audio functions.
    - b. The audio system will utilize high quality, ceiling mounted loudspeakers distributed and zoned for reinforcement. Microphones plates will be located in the floor boxes and wall panels.
    - c. The ceiling mounted loudspeakers will be utilized for speech reinforcement and program audio from the portable video player and auxiliary sources via an input plate in the floor boxes and also the aux feed from the existing sanctuary.
    - d. An audio feed for the existing sanctuary will be part of the scope of work. The line feed will be located at or near the existing foyer ceiling area. Conduit will be provided from the Foyer ceiling area to the AV rack location in the Fellowship Hall.
  3. Control System
    - a. A centralized microprocessor-based programmable control system will provide for remote control of all audio/visual functions and related "room functions" such as operation of projection screen, drapes, DSP, room combining and CD player
    - b. The system will be expandable to allow for the installation of control devices to accommodate all future additions to the system.
    - c. Control connection points for a wired keypad located in the AV rack and one wall mounted keypad.
    - d. The control equipment will be located in the equipment rack and through low voltage interfaces, connected to all the related audiovisual equipment.

## 1.5 SUBMITTALS

- A. Product Data: In addition to the quantities required by "Division 01, Submittal Procedures" and before ordering, submit one (1) additional sets of catalog data sheets, neatly bound with title page, space for submittal stamps, and tabbed dividers between sections. List all proposed equipment with reference to corresponding specification paragraph numbers or equipment title. Indicate all accepted substitutions.
1. Submit a schedule of finishes indicating proposed materials and color selections for all exposed items subject to Architect's selection.
  2. Submit a list showing coordination of selected frequencies for all wireless transmitters.
- B. Shop Drawings: In addition to the quantities required by "Division 01, Submittal Procedures", submit one (1) additional bond sets of drawings showing 'Submittal for Construction' work to the Architect for its Consultant review. If 'Submittal for Construction' documents are rejected, correct and resubmit in the manner specified
1. Provide Shop Drawings and Record Drawings using the following scales:
  2. Plans - not less than 1/8" = 1'-0"
  3. Details - not less than 1/4" = 1"
  4. Submit point-to-point wiring diagrams and typed wire lists identifying every connection for information. Include electronic devices such as switches,

- transformers, and terminal blocks. Indicate locations of all components. Identify cables by types, colors, and wire numbers.
5. Submit system plans showing all device locations and ceiling distributed loudspeaker layouts with wattage tap settings.
  6. Submit conduit riser diagrams showing connection of all devices, required conduit sizes along with types and quantities of cables to be used and cable identification tags.
  7. Submit rack layouts indicating the proposed arrangement of mounted equipment including junction boxes and locations of conduit penetrations.
  8. Submit fully dimensioned construction details of all panels, plates and other custom fabricated items or modifications (e.g. installation of audio/visual equipment in lecterns). Include complete parts lists and, as required, schematic diagrams.
  9. Submit mounting and support details for distributed ceiling loudspeakers, and all other items mounted overhead complete with parts lists and dimensions. Include a full plan view, front elevation, and side elevation of each item with corresponding support structure and mounting hardware. Verify load ratings of all hanging components including attachment hardware.

## 1.6 CLOSEOUT SUBMITTALS

- A. Drawings: Maintain a full set of shop drawings at the project site marked up to indicate actual locations, wattage tap settings and, in general, the true state of the installation. Furnish one initial set of record drawings along with the results of all source quality control tests specified in Part 2 and field quality control tests specified in Part 3 to the Consultant for use during acceptance testing and equalization. Submit one (1) bond black line set. If 'as installed' documents are rejected, correct and resubmit in the manner specified.
  1. After approval of 'as installed' documents, submit five (5) sets of record drawings each consisting of the following:
    - a. One (1) set of full size prints
    - b. One (1) set of CAD drawing files on CD-ROM media.
- B. Manuals: Furnish one initial set of product manuals to the Consultant for use during acceptance testing and equalization. At the time of contract closeout, submit the system Operation Manual and the Maintenance Data Manual. Neatly bind each with tabbed dividers between sections and include a title page with space for submittal stamps.
  1. Operation Manual
    - a. Table of Contents
    - b. Typed description of each system including key features and operational concepts (e.g. remote control features, switching or routing functions, patch points, mixing and linking capabilities).
    - c. Setup diagrams and typed instructions for use in typical situations as directed by the Consultant.
    - d. Small scale plans showing locations and circuit numbers for all system outlets and receptacles.
    - e. Single-line block diagrams showing all major system components.
    - f. Two sets of A size drawings showing the components and wiring in each individual rack. One drawing of each rack shall be mounted in a plastic jacket to the rear door of the associated rack. The other complete drawing set shall be included in the manual.
    - g. Manufacturer's operation manuals for equipment intended for operation by system users (e.g. tape decks, VCRs, communication equipment).
    - h. A properly licensed working copy of the latest version of any and all software required to operate or configure the systems specified herein shall be a part of the system supplied. This includes, but is not limited to, all software, firmware and hardware required for configuration, adjustment, diagnosis and repair.
    - i. All software shall be fully documented, and that documentation included.
    - j. Software shall be included in its "installable" state on industry standard 3.5" 1.44MB IBM format disks, CD-ROM, or other appropriate format. Back up of the working

software may be provided as an additional inclusion. Disk images are unacceptable.

- k. All user definable software configurations and/or programming shall become the sole property of the owner. This includes all source code, source code copyrights, and related documentation.
  - l. Software compiler shall be property of the owner with all related documentation.
  - m. Key schedule cross-referencing all keys to their respective functions.
2. Maintenance Data Manual
- a. Table of Contents
  - b. Company name, address, telephone number and contact name for system service or maintenance.
  - c. Listing of all equipment and materials with names of manufacturers and model numbers or part numbers.
  - d. Catalog data sheets displaying manufacturer's names, addresses, and telephone numbers.
  - e. Product manufacturers' warranties and a typed one-year system warranty explicitly covering all materials and labor.
  - f. Manufacturers' service manuals for all major equipment items.
  - g. Test documentation showing results of source quality control tests, field quality control tests, acceptance testing, and equalization. Document final settings for all non-user devices and controls after completion of acceptance testing and equalization including raw and equalized house curves. Document the physical position of settings as well as input and output signal levels measured in dbmV.
  - h. Provide a recommended preventative maintenance schedule with reference to the applicable pages in the manufacturer's maintenance manuals. Where the manufacturer provides inadequate information, provide the information necessary for proper maintenance.

## 1.7 QUALITY ASSURANCE

### A. Qualifications

- 1. Submit the following contractor qualifications:
  - a. Evidence of an in-house electronic service department:
  - b. List names and certifications of full-time service technicians.
  - c. List in-house electronic test equipment meeting the following minimum specifications for use during the source quality control tests specified in Part 2 and field quality control tests specified in Part 3 as well as use by the Architect's Consultant at the project site during acceptance testing and equalization.
  - d. Evidence of full-time personnel with experienced on projects of similar size, scope, and construction schedule to the Work of this Section.
  - e. List the name, date of employment, qualifications and experience of the installation supervisor for this project.
  - f. List the company's drafting capabilities including the name, date of employment, qualifications and experience of the employee who will draft shop drawings and project record drawings for this installation.
  - g. List the names, dates of employment, qualifications and experience of all other personnel to be used on this project.
- 2. Submit a statement that the bid is based upon specified products or accepted Substitutions by systems design consultant.
- 3. Submit a work plan indicating scheduling of employees and time frames for shop drawings, ordering of equipment, installation, testing, punch-list correction, and instruction.

### B. Regulatory Requirements

- 1. Obtain all required permits and inspections.
- 2. Furnish material and workmanship for this work in conformance with all code requirements.

3. Obtain review from compliance officials responsible for enforcement of applicable codes and regulations to establish that the work complies with all requirements of reference codes indicated herein. Make corrections, changes acceptance, operation, and/or compliance with the final submittal as described herein.
- C. Field Samples
1. Before delivery of equipment to the job site, submit test reports for all measurements specified under Source Quality Control Tests.
  2. Before delivery to the job site, submit photographs depicting the quality of wiring and grounding within equipment racks.

## **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Packaging, Shipping, Handling, and Unloading
1. Coordinate with Owner's Representative for any equipment and materials to be delivered or stored on site.
- B. Storage and Protection
1. Provide appropriate protection of stored and/or installed equipment from both damage to the item or damage to other work, or finishes.

## **1.9 PROJECT CONDITIONS**

- A. Existing Conditions
1. Verify all project site conditions applicable to the Work of this Section. Notify the Architect in writing of any discrepancies, conflicts, or omissions prior to bid opening. Otherwise, correct these at no additional cost to the Owner.
  2. Continue to monitor the project site. If conditions develop requiring a need to vary from the Specifications or Drawings, notify the Architect's Consultant immediately in writing. Otherwise, make recommendations, submit drawings showing how the Work may be installed, and on approval, proceed with the necessary changes without additional cost to the Owner.

## **1.10 WARRANTY**

- A. Provide system warranty for a period of one (1) year against faulty materials and defects in workmanship. In addition to the above warranty, honor any manufacturer warranties that exceed this period of time.
- B. During the system warranty period, answer all service calls and requests for information within 24 hours. Repair or replace faulty materials and correct faulty workmanship within 24 hours of all service calls.

## **PART 2 - PRODUCTS**

### **2.1 AUDIO EQUIPMENT:**

- A. Digital Signal Processor (DSP) Provide 8 mic/line inputs and 8 line outputs. Uses modular expansion cards. 24-bit A/D audio resolution. RS232 and network controlled. Approved Products:
1. Ashley ne8800M 8x8
  2. Approved Equal
- B. Amplifier (AMP) Two channel 70-volt output device. Rack mounted. Provides 200 watts per channel. Approved Products:
1. QSC CX302V
  2. Approved Equal

- C. Portable microphones. Cardioid dynamic element. Includes 25' XLR cable and microphone stand. Approved Products:
  - 1. AudioTechnica PRO 41
  - 2. Ultimate Support MC-78B
  - 3. Quantity: 2
  - 4. Approved Equal
  
- D. Wireless Microphone System . Includes true diversity UHF receiver, handheld and lavalier microphone. Approved Products:
  - 1. AudioTechnica ATW-R2100 (Qty: Two)
  - 2. AudioTechnica ATW-T210 with AT892cW
  - 3. AudioTechnica ATW-T220
  - 4. Approved Equal
  
- E. Portable Mixer Approved Products:
  - 1. Mackie 402-VLZ3
  - 2. Approved Equal
  
- F. Ceiling Speakers. Approved Products:
  - 1. Tannoy CMS601
  - 2. Approved Equal
  
- G. Ceiling Speaker Enclosure. Paint to match lighting fixtures. Approved Products:
  - 1. Atlas X8409
  - 2. Approved Equal

**2.2 VIDEO EQUIPMENT:**

- A. Video Projector. 4000 lumen projector with UXGA resolution capability. Approved Products:
  - 1. Christie LX400
  - 2. Christie spare lamp
  - 3. Approved Equal
  
- B. Motorized Projection Screen. 60" x 107" image size with 84" black drop. Includes LVC. Approved Products:
  - 1. Da-Lite Boardroom (Re: Da-Lite quotation #DA269777)

**2.3 CONTROL EQUIPMENT:**

- A. Controller. Approved Products:
  - 1. AMX NI-2100
  - 2. Approved Equal
  
- B. Keypad. Approved Products:
  - 1. AMX MIO-DMS
  - 2. Approved Equal

**2.4 MISC EQUIPMENT:**

- A. Equipment Rack. Approved Products:
  - 1. Mid Atlantic ERK-2120
  - 2. Approved Equal

- B. AV Cart. Approved Products:
  - 1. Da-Lite AV5W-54J
  - 2. Approved Equal

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Execute all work in accordance with the NEC, NESC, and with all local and state codes, ordinances, and regulations.
- B. Install all rack mounted equipment with stainless steel 10-32 pan head machine screws with flat black plastic washers protecting equipment panel.
- C. Provide rack slides and mounts equal to those of the original manufacturer for the OFE requiring rack mounting. Where no same manufacturer mount is available, contractor shall supply custom mounts as manufactured by Middle Atlantic Audio Products.
- D. Mount all equipment to be installed over public areas in a manner adequate to support the equipment loads with a minimum safety factor of five, using methods recommended in the referenced Handbook for Riggers and in JBL Technical Notes Volume 1, Number 19. Use attachment hardware with a minimum SAE Grade 5 load rating. Do not use formed eyebolts or lag screws for support of suspended equipment.
- E. Firmly and permanently, attach electrical boxes, enclosures, and permanent equipment to the building. Rigidly mounted equipment and devices shall be plumb and square.
- F. Choose colors and finishes of all exposed and custom fabricated items and labels to blend in with the surroundings as approved by the Architect.
- G. Install equipment in accordance with manufacturers' recommendations. Ensure that levels and impedances are properly matched between components. Verify that projector distances and lensing are appropriate for the corresponding screen sizes.
- H. Provide shaft locks or security covers on all non-user equipment as directed by the Architect's Consultant during acceptance testing and equalization.
- I. Grounding and Shielding
  - 1. Mount and enclose all electrical and electronic equipment in metal enclosures or equipment racks.
  - 2. Use EMT type conduit for all wiring outside of equipment racks.
  - 3. Mount equipment racks in a manner, which provides electrical isolation from the building structure and electrical raceways. Use flexible conduits and PVC fittings to provide insulated connections between equipment racks and the building electrical raceways.
  - 4. Ground the chassis of all rack-mounted components in accordance with the Drawings and verify a D.C. resistance between each chassis and the rack ground bus of no more than 0.01 ohms.
  - 5. Ground the shields of interconnecting wires on one end only in accordance with the Drawings and treat the unused opposite ends as described below under Wiring Practices. Shield drain wires shall be insulated in all instances by use of appropriately sized black heat shrink tubing equal to Alpha FIT-221 series.
- J. Wiring Practices
  - 1. Where specific instructions are not given, perform all wiring in strict adherence to standard broadcast and sound engineering practices as described in the referenced

Broadcast Audio Equipment for AM, FM, Television and in Sound System Engineering.

2. Group all wiring into the following classifications by power level or signal type:
  - a. Microphone Level: less than -20 dBm.
  - b. Line Level Audio and DC Control Circuits: -20 dBm to +30 dBm.
  - c. Speaker Level: greater than +30 dBm.
  - d. Video/RF Circuits
  - e. AC Power Circuits

K. Audio System

1. Maintain a minimum six-inch separation between wiring of different level classifications wherever possible. Otherwise, cross them perpendicular to each other. Where wiring of different level classifications share a common enclosure or junction box, provide metallic isolation barriers to completely electrically separate wiring groups.
2. Neatly harness wires together within racks by power level classification using horizontal and vertical wiring supports as required. Rigidly support all wires within twelve inches of connection points.
3. Observe consistent polarity throughout the audio systems as follows:
  - a. XLR Type Connectors
    - 1) Positive = Pin 2
    - 2) Negative = Pin 3
    - 3) Common = Pin 1
  - b. TRS Type Connectors
    - 1) Positive = Tip
    - 2) Negative = Ring
    - 3) Common = Sleeve
4. Use only balanced differential inputs throughout all sound systems unless noted otherwise. Use approved transformers to convert all unbalanced inputs to balanced inputs. Output signals may be unbalanced if inputs of subsequent devices are within the same rack. Otherwise use approved transformers to balance the outputs.
5. Exercise care in wiring to avoid damaging the cables and equipment. Use grommets around cut-outs and knock-outs where conduit or chase nipples are not installed.
6. Cut off unused wire ends approximately one-half inch ( $\frac{1}{2}$ " ) past the wire jacket. Fold them back over the jacket, and secure in place with heat-shrink tubing.
7. Make connections using rosin-core solder or approved mechanical connectors.
8. Terminate all field wiring in terminal boxes mounted to the walls in each equipment room prior to connection to any equipment or devices unless otherwise noted. All equipment in each equipment room shall connect to the field wiring at the appropriate terminal box. Field wiring shall not terminate directly in equipment racks unless otherwise noted. Provide 10% spare terminals at each location. Label each terminal with a unique number. Video, RGBS, and RF cables are exempted from this requirement.

L. Video System

1. All cables shall originate and terminate at active or passive devices; cables shall not be spliced. Where several devices are in close proximity, utilize approved housing-to-housing connectors and adapters.
2. All cables terminated in a connection plate mounted in an enclosure shall be dressed to allow removal from the enclosure and sufficient cable length for service or re-termination. Plate shall set on floor or freely swing clear.
3. Splices in any cable - Baseband or RF - are not acceptable.

M. Cable Installation in Conduit and Duct Banks

1. Pull mandrel one size smaller than the conduit, through entire length of all underground conduits.
2. Cable pulling lubrication shall be utilized when pulling cable.

3. A dynamometer shall be used to measure pulling tension during long or difficult runs. The dynamometer is to be placed between the cable puller and the pull line to monitor pulling tension. The manufacturer's pulling tension maximum range shall not be exceeded.
4. Pulling grips suitable for use with fiber cables shall be applied to the ends of the cable. Consult cable manufacturer to determine appropriate pulling grip and method of attachment. Breakaway or fuse links shall be used at the pulling grip. Insure that the correct "fuse pin" is installed in the fuse link.
5. Cable caps (heat-shrinking type) shall be used to seal the ends of the cable to protect the cable ends prior to terminating.
6. Use of cable blocks shall facilitate the bending of cable. For bends between 5 degrees and 45 degrees, a 45-degree cable block shall be utilized. For 45 degree to 90 degree bends, utilize a 90-degree cable block.
7. The bend radius for all cables shall conform to manufacturer's specifications.
8. Provide spare cables between terminal cabinets equal to 10% of the installed cables or a minimum of two cables of each type cable installed. Provide spare cables between terminal cabinets and equipment racks/consolas equal to 15% of the installed cables or a minimum of five cables of each type cable installed. Label all spare cables as spares with unique identifiers. Do not use any spare cables without prior approval from the Architect's Consultant.

N. Labeling

1. Label products in a logical, legible, and permanent manner corresponding to the Drawings using wording, format, style, color, and arrangement of text approved by the Architect.
2. Label all panels and wall plates using 1/8" engraved lettering. On dark panels and plates, fill engraving with white paint, and on aluminum or stainless steel panels and plates, fill engraving with black paint.
3. Provide engraved plastic labels similar to Lamicoid, squarely and permanently attached, to label patch panels, barrier strips, terminals, transformers, switches, relays and similar devices as well as the front and rear of all signal processing equipment (e.g., PA, LIM, EQ). Label all controls on distribution amplifiers, mixers, etc. as to the function of each.
4. Label push-button switches with engraved lettering filled with contrasting color paint.
5. Label all permanent wiring on both ends with approved permanent clip-on type or sleeve type markers. Wrap-around adhesive labels will not be accepted unless completely covered with clear heat shrink tubing.

### 3.2 FIELD QUALITY CONTROL

A. General Testing

1. Maintain a competent supervisor and supporting technical personnel, acceptable to the Owner during the entire installation. Change of supervisor during the project shall not be acceptable without prior written approval from the Owner.
2. Before connecting any equipment to electrical power outlets, measure and record the A.C. voltages between hot, neutral, and ground and verify correct outlet polarity. Verify, test and document correct and safe function of isolated ground power systems.
3. Determine the best sequence of energizing systems to minimize the risk of damage.
4. After successfully energizing the systems, make preliminary adjustments and document the settings of all controls, parameters of corrective networks, voltages at key interconnection points, gains and losses as applicable. Replicate the unity gain tests performed at the shop and document the absence of any waveform distortion, interference signals, or oscillations.
5. Upon completion of the system installation, it shall be the responsibility of the Contractor to perform the necessary adjustments and balancing of all signals, amplifier gain, and other level controls to ensure proper system operation. The system shall be physically inspected by the Owner to assure that all equipment is

installed in a neat and workmanlike manner as called for by the plans and specifications.

6. Verify the performance parameters of the individual systems following established professional procedures, in addition to those specified herein. Document all acceptance testing, calibration and correction procedures described herein, being careful to include the following information:
  - a. Performance date of the given procedure.
  - b. Condition of performance of procedure.
  - c. Type of procedure, and description.
  - d. Parameters measured and their values, including values measured prior to calibration or correction, as applicable.
  - e. Parameters associated with calibration or corrective networks, components, or devices.
  - f. The names of personnel conducting the procedure.
  - g. The equipment used to conduct the procedure

B. Audio Testing

1. Before connecting loudspeaker lines to power amplifiers, measure and record the impedance curves of all lines using a sweep test or impedance bridge at least six frequencies from 125 Hz through 8,000 Hz.
2. Test all low-level audio cables and connections for continuity and ground faults and correct polarity.
3. Apply a sine-wave sweep signal to each loudspeaker system, sweeping from 50 Hz to 5,000 Hz at a sound pressure level that is 10 dB below the loudspeaker's rated electrical input power. Listen for rattles or objectionable noise and correct if apparent.
4. Check for proper polarity of loudspeakers by applying music program or pink noise to each system and walking through the transition areas of coverage from one loudspeaker to the next. Transition should be smooth with no apparent shifting of source back and forth from one loudspeaker to the next.
5. Achieve uniform distribution of sound from each loudspeaker system after all interior furnishings are in place. Drive each system with one full octave of noise centered at 4000 Hz at a level of 85 to 90 dB. Use a sound level meter that meets ANSI ST 4-1971 Type 2 standards set for slow meter damping and "A" weighting. Take all readings at seated ear height. Adjust speaker angles as necessary to achieve  $\pm 3$  dB over entire seating area. Provide plan of achieved sound distribution from each system, plotted with 4kHz pink noise levels as measured on a 10-foot square grid pattern. The process of equalizing and testing the Sound Systems may necessitate moving and adjusting certain component parts, e.g., loudspeakers. This shall be done without claim for additional payment.
6. Provide a list showing all build-out, termination, and pad resistor calculations. List to include measured line and source impedances used in calculations and results of tests after installation, and impedance of all inputs to equipment brought up on patch bay. Impedances in ohms are to be within  $\pm 10\%$  of design value. Levels in dB are to be within  $\pm 1$  dB of design value.
7. Upon completion of initial tests and adjustments, submit written results of tests to Architect/Consultant. In addition, submit written notification that the installation has been completed in accordance with the requirements of the Contract Documents, and is ready for equalization and inspection by representatives of the Architect/Consultant and Owner.

C. Test Equipment

1. Provide the following test equipment on site during construction and available to the Owner during final adjustment and acceptance testing:
  - a. Laptop computer with all installed software

D. Inspection

1. Provide a statement of completion certifying that the system is installed and is ready for acceptance testing and equalization to the Architect's.

2. Schedule a time for the Architect's Consultant to perform system acceptance testing and equalization with at least 14 days advance notice.
3. Designate technicians who are familiar with and qualified to operate the systems for instruction of the Owner. Provide instruction of Owner-designated personnel in the design features and proper operation of the systems. Provide a minimum of 40 hours for on-site instruction and videotape the training sessions. Make any Owner requested changes to the control system programming during this time. Coordinate instruction times through the Architect.
4. Under the direction of the Architect's Consultant, adjust signal levels and loudspeaker aiming as required to achieve the uniform sound distribution within a tolerance of +2dB.
5. System flatness test shall employ an approved sweep transmitter receiver pair. Sweep measurements shall be taken at the termination of every cable termination in the system. Where possible, record sweep results by photographic means.
6. Record the final settings on all equipment and submit with contract closeout documents.
7. Record final settings on all equipment and submit with contract closeout documents.
8. Heat shrinking tubing shall be shrunk to cover the external connection to amplifier/passive components only after system alignment and acceptance has been completed.
9. If the system does not meet criteria or if additional trips to the job site for testing or equalization are required, the Contractor shall reimburse the owner for all expenses and professional time encountered by the Architect and its Consultant.

### **3.3 CLEANING**

- A. Remove all unnecessary tools and equipment, unused materials, packing materials, and debris from each area where Work has been completed unless designated for storage.
- B. Clean all areas around system equipment and be sure that the inside of each equipment rack is free of wire stripping and other debris.

### **3.4 DEMONSTRATION**

- A. Upon completion of the Work, the Owner may elect to verify test data as part of the acceptance procedure. Provide personnel and equipment, at the convenience of the Owner, to reasonably demonstrate system performance and to assist with such tests without additional cost to the Owner.
- B. Within three months after final acceptance, the Owner reserves the right to direct changes to the control system software. Such changes shall be made without additional cost to the Owner.

END OF SECTION