

## SECTION 17770

### SOUND REINFORCEMENT SYSTEMS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. General Conditions and Requirements, Special Provisions, and applicable portions of Division I of the general contract are hereby made a part of this Section.
- B. Architectural, structural, mechanical, electrical, and other applicable documents and drawings are considered a part of the Sound Reinforcement systems (hereafter referred to as Sound Systems) documents insofar as they apply as if referred to in full.

##### 1.2 SCOPE OF THE WORK

- A. These Specifications, together with the related drawings and General Conditions of the contract, comprise the requirements for the Sound Systems for the project.
- B. Furnish, deliver, erect, install and connect completely all of the material and appliances described herein and in the Drawings, and supply all other incidental material and appliances, tools, transportation, etc., required to make the work complete, and to leave the systems in first class operating condition, excluding those items listed under Section 1.10, RELATED WORK BY OTHERS.
- C. Perform all assembly of equipment, wiring and inter-connection and soldering of wires to jacks, devices, terminals or equipment, using technical employees only, who are experienced in the installation of sound reinforcement equipment and its inter-connection. Coordinate final utility rough-in locations with actual equipment furnished.
- D. Verify dimensions and conditions at the job site prior to installation, and perform installation in accordance with these Specifications, manufacturers' recommendations and all applicable code requirements.

##### 1.3 QUALITY ASSURANCE

- A. The intent of these Specifications is to describe and provide for complete Sound Reinforcement Systems and audio-visual systems of high professional quality and reliability. Professional performance standards by the Sound Systems Contractor (hereafter referred to as Contractor) and the equipment will be required.
- B. In all cases, the Owner and Architect shall determine the acceptability of the work based upon the visits, observations, and reports of the Acoustical Consultant (hereafter referred to as Consultant).

##### 1.4 SUBSTITUTIONS

- A. Many items are listed in the Specifications by the manufacturer's type or model number, without a detailed performance specification, and may not include the phrase "or

approved equal". Where this is the case, no substitutions will be accepted, without a written request from the Contractor and the written consent of the Consultant.

- B. Where the phrase "or approved equal" appears, the item specified shall set a standard of quality and performance, based on the published specifications of the manufacturer and on the actual performance as known by the Consultant.
- C. Requests for substitution, when forwarded by the Contractor to the Consultant, are understood to mean that the Contractor represents that he has personally investigated the proposed substitute product and determined that it is equal to or superior in all respects to that specified, that the same guarantee will be provided for the substitution as for the specified product, and that the 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.
- D. Substitutions will not be considered if they are indicated or implied in Shop Drawing submissions without previous formal request, or, for their implementation, they require a substantial revision of the Contract Documents in order to accommodate their use.
- E. Space allocations and utility rough-ins have been designed on the basis of equipment items named by manufacturer and model number. If any equipment not so named is offered which differs substantially in dimension or configuration from the named equipment, provide scaled shop drawings showing that the substitute can be installed in the space available without interfering with other trades or with access for operation and maintenance in the completed project. The Contractor shall coordinate final utility rough-in locations with actual equipment furnished.
- F. Where substitute equipment requiring different arrangement or connections from those indicated in the drawings is accepted by the Consultant, install the equipment to operate properly and in harmony with the intent of the Drawings and Specifications, making all necessary incidental changes without increasing the Contract amount. Pay all additional costs incurred by adjoining or connecting trades.
- G. All requests for substitutions shall be submitted at least 7 working days before the bid opening date. Substitutions shall be requested in writing only, based upon these criteria.

## **1.5 INSTALLER QUALIFICATIONS**

- A. The work performed under this Section shall be performed by a Sound Systems Contractor, normally engaged in the business of sound reinforcement systems installation. The prospective contractor shall show proof, as part of the bid, that he has been in the sound reinforcement systems installation business for a period of not less than five years and has successfully completed projects of similar size and scope. Specifically, the prospective contractor shall provide references from convention facilities of similar size, with audio systems of similar scope and composition.

- B. The Sound-AV Contractor and Installer shall hold a current, valid franchise for the major lines of equipment furnished by him under these Specifications.
- C. The Owner and Architect reserve the right to reject any installation submitted by firms without sufficient experience in projects of similar size and scope.

#### **1.6 COOPERATION AND COORDINATION**

- A. Cooperate and coordinate as required with the other trades who are responsible for work not included in this section.
- B. Provide any and all information as required or requested by the Owner, Architect, Consultant, or other trades in order for this work to be completed to the satisfaction of the Owner, and in the best interests of the Project. Such assistance or information shall be transmitted in writing to the requesting party in all cases. All written correspondence shall be copied to the Architect.

#### **1.7 SPECIAL WARRANTY**

- A. Guarantee all labor and workmanship furnished under this Section as required by General Conditions of Agreement and Supplemental General Conditions, warranty commencing from the date of final system acceptance, or certificate of Project substantial completion, whichever occurs last.
- B. During the warranty period, report to the site and repair or replace any defective materials or workmanship without cost to the Owner. Warranty service shall be rendered within 24 hours after request by the Owner. Equivalent replacement equipment shall be temporarily provided when immediate on-site repairs cannot be made.
- C. Where warranties on individual pieces of equipment exceed twelve months, the guarantee period shall be extended to the warranty period of the particular items.
- D. Furnish complete and working Sound Systems. Be of maximum assistance to the Owner during the guarantee period of the system, to the degree that maximum Owner satisfaction is assured.
- E. After completion of the work, submit a Certificate of Warranty, stating commencement and expiration dates and conditions of the warranty, for signing by both Owner and Contractor/Installer. Incremental warranties for completed portions of the work may be negotiated at the discretion of the Owner, if delays occur beyond the control of the Contractor.

#### **1.8 SHOP DRAWINGS AND SUBMITTALS**

- A. Completely detailed shop drawings shall be prepared prior to the procurement of equipment or commencement of work. Electronic files of drawings will be made available to the installer from the Consultant at a nominal cost. Blue-line drawings shall be prepared and submitted on 30" x 42" paper. Equipment lists, data sheets, etc. shall be 8-1/2" x 11" size, properly bound into a single or multiple volumes.
- B. Within 45 days after the notice to proceed, submit in accordance with the Supplemental General Conditions or a minimum of twelve (12) identical copies of the following for approval:

1. A complete equipment list, with manufacturers' names, model numbers, and quantities of each item;
  2. Manufacturers' data sheets on all equipment items;
  3. Equipment rack layouts showing locations of all rack mounted equipment items;
  4. Floor plans, prepared at a scale of not less than 1/16"=1'-0", showing loudspeaker locations and orientation, wall plates, and all other related device locations;
  5. Proposed construction details for any custom fabricated items, including interface panels, patch panels, and wall plates. These details shall show dimensions, materials, finishes and color selection.
  6. Comprehensive system schematics, showing detailed connections to all equipment, with wire numbers, terminal block numbers, and color coding;
  7. Riser diagrams showing conduit requirements with pull boxes, outlet boxes, physical cable layouts, part numbers of cable types used, and number of circuits in each conduit;
  8. Electrical power requirements for head-end and ancillary equipment. Include diagrams for any remote control of electrical power, in sufficient detail to coordinate with the Division 16 Contractor, showing exact conduit requirements.
  9. Certain other submittals as noted elsewhere in this specification, and as may be required for various equipment items prior to construction, fabrication, or finishing of that item.
- C. All final documentation shall be submitted and approved before final acceptance by the Owner will be granted. Within 45 days after completion of the work, deliver to the Architect, four (4) sets of blue-line drawings and one (1) reproducible set of drawings prepared on 30" x 42" paper and four (4) identical copies of the following:
1. A complete as-installed equipment list, listed by room, with manufacturers' names, model numbers, serial numbers, and quantities of each item;
  2. A complete and correct system schematic, showing detailed connections for all parts of the system, including wire numbers, terminal block numbers and layouts, and other designations and codings. System performance measurements shall be documented as noted elsewhere in this specification. Include diagrams or charts showing final settings of all control knobs in the system (mixers, equalizers, power amplifiers, etc.);
  3. Complete equipment rack layouts showing locations of all rack mounted equipment items;
  4. Floor plans, prepared at a scale of not less than 1/16"=1'-0", showing loudspeaker locations and orientation, wall plates, rack locations, and all other related device locations;
  5. Riser diagrams showing as-installed conduit with pull boxes, outlet boxes, physical cable layouts, part numbers of cable types used, and number of circuits in each conduit;
  6. Repair parts lists for each and every major equipment item furnished;
  7. Service manuals for each and every major equipment item furnished;
  8. Manufacturer's warranties and operating instructions for each and every equipment item furnished. Include a copy of the certificate of warranty, signed by both parties.
  9. Technical Systems Operations Manual, custom-written by the Contractor, for the purpose of instructing the Owner's operating personnel in the detailed step-by-step operation of the system and preventive maintenance procedures. This manual shall include descriptions of the system components and their relationship to system function. This manual shall be bound separately and labeled appropriately.

10. Complete details of all rigging for cluster, including all WWL (working load limits), attachment methods, etc. Ratings for all other rigging hardware that will be used.
11. The Contractor/Installer shall videotape the entire training session(s), and submit the video tape with the Operations Manual.

## **1.9 DESCRIPTION OF THE WORK**

- A. The complete sound systems include, but are not limited to the following items:
  1. Line Arrays left and right of the proscenium opening.
  2. Under Balcony delay and side balcony loudspeaker systems.
  3. Fully intergraded 4 channel production intercom system.
  4. Stage Managers/Default mixer and auxiliary equipment.
  5. Listen-Thru system (recessed ceiling-mounted loudspeakers) for the dressing room and all back stage areas.
  6. Studio Theatre with a permanently mounted full range two-way loudspeaker system and portable equipment rack.
  7. Ancillary devices related to the input, mixing, processing, microphones, jacks, wire, and amplification of audio into the system.

## **1.10 RELATED WORK PERFORMED UNDER OTHER SECTIONS**

- A. All 120VAC power conductors and conduits associated with power circuits to all equipment locations shall be furnished under Division 16. The 120VAC power to the equipment racks shall be terminated under Division 16 inside the racks to isolated ground quad convenience outlets, furnished under this section.
- B. All conduit and electrical boxes shown on the Sound Reinforcement Documents (in Division 11) shall be furnished and installed with pull wires, under Division 16.
- C. All electrical circuits and receptacles shown on the Sound Reinforcement Documents (in Division 11) shall be furnished and installed under Division 16.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. All equipment items shall be new and unused.
- B. The following sections specifically list the acceptable equipment types and items for this project. Where quantities are not noted, they may be obtained from the drawings. In the event of a discrepancy between the specifications and the drawings, the greater quantity or better quality shall be furnished.

### **2.2 WIRE & CABLE**

- A. All wire and cables shall be new and unused. Refer to Part 3 for special wiring requirements.
- B. Wire not installed in equipment racks, not portable, or not installed in conduit shall be fire-rated and meet all applicable codes.
- C. Voice coil loudspeakers.

1. Subwoofers – 8 AWG THHN or approved equal.
  2. Low Frequency devices – West Penn Wire C210 10 AWG or approved equal.
  3. Mid Frequency devices – West Pen Wire 227 12 AWG or approved equal.
  4. High Frequency devices – West Penn Wire 226 14 AWG or approved equal.
- D. Constant voltage (70-volt) speaker cable: Belden or equal.
1. Runs of less than 300 feet: West Penn Wire 225 or equal.
  2. Runs of less than 500 feet: West Penn Wire 226 or equal.
  3. Runs of more than 500 feet. West Penn Wire 227 or equal.
- E. Microphone-level audio cable (installed in conduit, not portable): stranded twisted pair with foil shield, 22 AWG.
1. West Penn Wire #452 or approved equal.
- F. Line-level audio cable: stranded twisted pair with foil shield, 22 AWG.
1. West Penn Wire #452 or approved equal.
- G. All inter-rack audio cable: stranded 20AWG twisted pair with foil shield; or as sized for maximum 1 dB loss over long runs.
1. West Penn Wire #292 or approved equal.
- H. Digital attenuator cable: stranded 22AWG twisted pair with foil shield, or sized as required by the manufacturer, over long runs.
- I. Portable microphone cables: Star Quad black flexible cable.
- J. Other equipment control cables shall be stranded wire, appropriately shielded, of gauge and number of conductors required by the manufacturer for proper operation of the system or equipment item furnished.
- K. Wire and cable for all other devices shall be supplied in accordance with the recommendations of the device manufacturer and the National Electrical Code.
- L. Intercom cable installed in conduit: Stranded 18AWG twisted pair with foil shield, West Penn 293 or approved equal. Where multiple channels are needed at any station: Stranded 18AWG twisted pair with individual foil shield (each pair) with a single overall jacket, West Penn 440 or approved equal. Wire size may vary if it conforms to manufacturer's recommendations for runs of different lengths.
- M. Coax Video cable shall be West Penn HQ841 or approved equal.

### **2.3 JACKS, CONNECTORS, AND WALL PLATES**

- A. All plate-mounted connectors shall be ground-insulated from the plates on which they are mounted.
- B. All jacks shall be installed on black anodized plates 1/8" thick unless noted otherwise, such as single and double gang devices. Nomenclature shall be engraved into the plate with 1/8" block letters filled with white paint. All microphone jack locations shall be numbered as to room and number, in logical sequence.
1. Obtain approval of designated Owner A/V representative prior to finalizing designation of microphone jacks and other termination points.

- C. Unless otherwise specified, all jacks and connectors for the sound systems shall be as follows:
  1. Microphone and line-level input jacks: Neutrik DL-series 3-pin female XLR connectors.
  2. Audio output jacks: Neutrik DL-series 3-pin male XLR connectors and latching 1/4" jacks, as noted on the drawings.
  3. Cable-end audio connectors: Neutrik X-series 3-pin XLR connectors.
  4. Speaker level connectors: Neutrik Speakon twist and locking type connectors.
  5. Furnish and install the required number of jacks and connectors as indicated on the drawings.

## **2.4 EQUIPMENT RACKS**

- A. Furnish equipment racks for use in housing the mixers, processors, equalizers, power amplifiers and ancillary devices necessary to the operation of the system.
- B. Each equipment rack shall include a locking back door, and top and bottom panels unless otherwise noted. Provide one pair of side panels for each rack array.
- C. All heat-producing components shall be mounted with one (1) standard vent panel installed between units. Fill all other unused portions of rack front sections with matching blank panels.
- D. Furnish two keys for each equipment rack locked installed.
- E. Install required number of units, of sufficient size to accommodate the equipment specified, at the locations indicated in the drawings.
- F. Furnish and install the following:
  1. "SR1, "SR2" and "SR3" Audio Equipment Racks: Lowell L278 or approved equal. The racks shall be sized in height and number of rack spaces as shown in the drawings. Provide one (1) Lowell LWF-1912 Fan Unit, one (1) Lowell LTC-1 Fan Thermostat Control, and one (1) RL-1 Rack Utility Light with each equipment rack furnished. (Qty. as shown)
  2. Power sequencing/conditioner shall be FSR SPC-20 with FSR SPC-20x conditioned outlets. Theater sequencing system and Studio Theater systems shall be separate from each other. Coordinate with Electrical Contractor on installation of power sequencing system. (Qty: as shown)
  3. Provide L2150-61PF perforated front doors or approved equals. (Qty. 1 ea.)
  4. "PRB" portable slant face desk turret rack. Lowell L40-14, provide Furman PL-8 power strip at top of rack. (Qty: as shown)
- G. Equipment rack "TSRER", by others, will house the Stage Managers paging microphone, the intercom system and aux power supply, dressing room mixer, and video monitors.

## **2.5 DRESSING ROOM LISTEN TROUGH SYSTEM**

- A. The audio mixer located in the "TSRER" rack, stage right will have three input modules with muting capability. Three inputs shall be "program" from the "Center" output of the control console, listen through microphone via the patch bay, and paging microphone mounted in the "TSRER" rack. Install and wire as depicted in the drawings.

- B. The paging microphone shall have muting capability over the other two signal sources. This shall be accomplished by an internal mute bus in the mixer. Configure dipswitches and jumpers to accomplish the muting described above.
- C. Furnish and install the following:
  - 1. TOA M-900MK2, 8-channel mixer preamplifier. Provide the MB-25B rack mount kit. (Qty: as shown)
  - 2. TOA input modules as follows:
    - a. M-41S for the Stage Mangers paging microphone. (Qty: as shown)
    - b. B-11S for the "Program" input from the console. (Qty: as shown)
    - c. M-11S for the "Listen through" microphone. (Qty: as shown)
  - 3. Shure 527B handheld, push to talk paging microphone. Mount microphone holder clip to single rack space connector panel in "TSRER". (Qty: 1 ea.)

## 2.6 DIGITAL SIGNAL PROCESSOR

- A. The audio processing shall be in the digital domain following the input source and shall remain until power amplification is required.
- B. The system shall be able to provide a list of audio devices, which may be chosen and configured into the system at anytime, from a device menu running under the Windows environment. The list shall include, but not be limited to: Matrix mixer up to 24x24, Parametric and Graphic equalizers, Filters to include high-pass, low-pass, all pass, shelf, boost/cut, parametric, Butterworth high and low-pass, Linkwitz-Riley high and low-pass, Bessel-Thomson high-pass, low-pass magnitude mirror, Bessel-Thomson high-pass maximally-flat group delay, Bessel Thomson low-pass, Crossover, Compressors, peak limiters, dynamic blocks, pink noise, and delay.
- C. Install the digital signal processors in the equipment racks as indicated in the contract documents.
- D. Furnish and install the following:
  - 1. QSC Basis 522 or approved equal. (Qty: as shown)
  - 2. HP Procurve 2312 or approved equal 10/100baseT unmanaged Ethernet network switch with full-duplex fiber optic transceiver for connection of multiple Cobranet<sup>®</sup> Interfaces to the mainframe. (Qty: as shown)
- E. Successful Contractor will be responsible for software programming with input from the Consultant and Owners Representative. Contractor is to submit the finished software configuration to the Consultant for review thirty (30) days prior to owner occupation of the finished facility. Contractor must be factory trained and certified for this product.

## 2.7 MIXING CONSOLES

- A. Provide an audio mixing console for routing of inputs in the Theatre.
- B. The Mixing console shall be available in 24, 32, 40, 48, 56, and 64 input frames.
- C. The Mixing console shall be a dual function desk for Front of House (FOH) and Stage Monitor use.
- D. The Mixing Console shall provide 8 audio sub groups, 8 aux outputs, 12x4 matrix, 4 mute groups, Self cleaning 100mm monorail faders, and 8 multifunction inputs.

- E. Install this device Control Booth as shown in the contract documents.
- F. Furnish and install the following:
  - 1. Midas Verona 400 or approved equal. (Qty: 1 ea.)

## **2.8 MICROPHONES, SPEAKER & MICROPHONE CABLES, STANDS**

- A. Furnish various types of microphones for use in sound reinforcement.
- B. Each microphone shall be equipped with its own cable, with connectors installed on each end.
- C. Furnish and install the following:
  - 1. AKG D440 Instrument Microphone or approved equal. (Qty 4 ea.)
  - 2. AKG GN 50ES with CK80 Capsule podium microphone or approved equal. (Qty. 1 ea.)
  - 3. AKG C535 EB Handheld Microphone or approved equal. (Qty: 4 ea.)
  - 4. Atlas/Soundolier MS-20E with boom or approved equal floor stands (Qty: 4 assemblies)
  - 5. Canare L-4E6S Star Quad black flexible 25-foot microphone cable or approved equal. (Qty: 12 ea.)
  - 6. Canare 4S8 50' speaker cable with Neutrik Speakon connectors or approved equal. (Qty. 12 ea)

## **2.9 POWER AMPLIFIERS**

- A. Furnish power amplifiers for use in amplifying audio signals for distribution to the loudspeakers.
- B. Each power amplifier shall have an input connector, which is either a screw-type barrier strip or XLR type. Output connectors shall be either barrier strip, or Neutrik Speakon. Other types of connectors shall not be accepted.
- C. All power amplifiers shall be supplied with one (1) XF-1 input isolation transformer for each channel used, provide the required BSC-3 or BSC-5 bus card for internal transformer mounting. All power amplifiers shall have detented stepping input level controls. Install one 1-3/4" vent panel between each power amplifier and any other rack mounted component or as recommended by the Manufacturer. Install the units in the central racks "SR" and connect as indicated in the drawings.
- D. Furnish and install the following:
  - 1. 220 watt four channel amplifier (constant voltage): QSC CX204V or approved equal. (Qty: as shown)
  - 2. 425 watt amplifier: QSC CX702 or approved equal. (Qty: as shown)

## **2.10 LOUDSPEAKERS**

- A. Loudspeaker arrays shall be used within the facility to reinforce voice and other audio playback for the main seating area.
- B. The drawings indicate the loudspeaker positions and angles of orientation. The speakers shall be attached to the structure at the positions and angles indicated utilizing the line array rigging mechanism specified below. Suspend each component with manufactures

recommended mounting frame and hardware as detail in drawings. Secure any loose hardware to prevent vibration and rattling. Suspension hardware shall be designed for a safety factor of at least five. Orient each speaker at the location and angles indicated in the drawings. Provide shop drawings (for review by the Consultant) indicating mounting method before the installation of these loudspeakers.

- C. Each driver circuit in each speaker shall have its cable home-run to the equipment racks. Connect as indicated in the drawings.
- D. Measure and record the impedance of each driver circuit at the amplifier terminals. High frequency drivers shall be measured at 1000Hz; low frequency drivers shall be measured at 250Hz. Include the measurements in the final documentation.
- E. Furnish and install the following assemblies in the Theatre:
  - 1. Meyer M2D Compact Curvilinear Array Loudspeaker. (Qty: 12 ea.)
  - 2. Meyer M1D Ultra Compact Curvilinear Array Loudspeaker. (Qty: 6 ea.)
  - 3. Meyer M2D Compact Subwoofer. (Qty: 2 ea.)
  - 4. Meyer M2D Multipurpose Grid. (Qty: 2 ea.)
  - 5. Meyer M1D Multipurpose Grid. (Qty: 2 ea.)
  - 6. Community XLT 48E-64 Stage Monitor or approved equal. (Qty: 4 ea.)
  - 7. S3 type loudspeaker: QSC AD-S52T or approved equal. (Qty: as shown)
  - 8. Booth Monitors: Tannoy System 600A Nearfield Monitor or approved equal. (Qty: 1 par)
- F. Furnish and install the following assemblies in the Studio Theatre:
  - 1. Electro Voice SX300 or approved equal. (Qty: as shown)

## **2.11 CEILING MOUNTED LOUDSPEAKERS**

- A. Recessed mounted loudspeakers wired for constant voltage lines shall be used for voice and paging reinforcement throughout the facility.
- B. Each loudspeaker home-run shall have its cable run to the equipment racks without splices. Connect and tap loudspeakers as indicated in the contract documents.
- C. Measure and record the impedance of each home-run at 1000Hz. Include these measurements in the final documentation.
- D. Furnish and install the following assemblies:
  - 1. S1 type loudspeaker: Lowell Manufacturing CN6AT870-IX10 or approved equal. (Qty: as shown)
  - 2. S2 type loudspeaker: Community Cloud 6 or approved equal. Provide Drywall Rough In (MRC6) to electrical contractor for installation. (Qty: as shown)
  - 3. S3 type loudspeaker. QSC AD-S52T with ball mount or approved equal. (Qty: as shown)
  - 4. S5 type loudspeaker. Electro Voice SX-300 with Mb200 u-bracket or approved equal. Provide pipe bracket hanger and extension as shown in the drawings. (Qty: 4 ea.)

## **2.12 PORTABLE RACK AND EQUIPMENT**

- A. Furnish the following portable racks, equipped as shown in the contract documents for use in the Studio Theatre.

- B. Furnish and install the following:
1. SKB Gig Rig 1SKB19-R1010 portable rack with casters. Provide one (1) Furman Ps-Pro with each portable rack furnished. (Qty. 1 ea.)
  2. Allen & Heath Mix Wizard WZ 14:4:2+ rack mount mixer or approved equal (Qty 1 ea.)
  3. Denon CDR510, combination MP3/CD Player & recorder or approved equal. (Qty 1 ea.)
  4. Denon DN-780R Independent Dual Well Cassette Deck or approved equal. (Qty: 1 ea.)
  5. Sennheiser EW-345 G2 Handheld Wireless Microphone System. Supply one (1) Sennheiser SK300 Body Pack Transmitter and one (1) Countryman B6 EarSet Microphone with each system provided. Insure proper connector is provided for use with the Sennheiser Body Pack Transmitter and that operating frequency match the transmitter supplied. (Qty: to complete systems)
  6. Listen Technologies LP-8-216 or approved equal assistive listening systems. Insure interference does not occur between systems. (Qty: 1 per rack)
  7. Lowell L18-193 two space rack drawer. (Qty: 1 per rack)
  8. Fill un-used rack spaces with vent panels. (Qty: as required)

### **2.13 GRAPHIC EQUALIZERS**

- A. Provide graphic equalizers for shaping the audio response of the stage monitors.
- B. The graphic equalizer shall have two channels each having thirty boost/cut faders to control filters on standard third-octave center frequencies from 25Hz to 20kHz. Each fader shall have a 45 mm travel with a mechanical center detent and electrical centre tap which removes its filter from the signal path at the zero fader setting. A Mode switch on each channel shall allow its filters to be configured with a Normal Q-factor or Fine Q-factor. In both Modes, the Q-factor of each filter shall be constant for any fader level setting.
- C. Each channel shall have a Hi-Pass filter (18dB/Oct) variable between 20Hz-250Hz with independent bypass switch, Output Gain trim with LED Clip indicator and an EQ IN/OUT switch which defaults to a passive relay bypass in OUT mode. The relay bypass shall also operate automatically in case of power failure.
- D. Inputs and outputs shall be transformer balanced. A Tamperproof Security Cover shall be available as an option. The graphic equaliser shall be 3U (5¼"), 19" rackmount and capable of operating from a 90-120V AC power source.
- E. Furnish and install the following:
1. BSS FCS-960 or approved equal. (Qty: as shown)

### **2.14 AUDIO PATCH BAYS**

- A. Furnish and install patch panels in the quantities shown in the drawings.
- B. Each assembly shall be factory pre-wired. Install the assemblies according to Standard Broadcast Practices. Furnish any additional hardware necessary for the proper functioning of the unit.

- C. All jacks shall have "QCP" type punch-block connections, with normals brought out to "QCP" back plane. Normals that appear on the drawings shall be punched down, all other will be left un-normalled on the back plane of the patch bay.
- D. Individual jacks shall be labeled with the manufactures attached labeling strips. Labels shall be of laser printer quality.
- E. Prior to the manufacture of the labels, a drawing of the patch panel layout, showing all patch positions and exact wording of each label shall be submitted as a part of the shop drawing package. All labeling shall be printed in capital letters.
- F. All microphone jack locations shall be numbered. The number for each microphone jack shall be consistent with each patch appearance.
- G. All microphone-level inputs to the mixer shall be numbered according to its input module number.
- H. All line-level inputs shall be labeled according to the piece of equipment to which they are associated.
- I. All line-level outputs shall be labeled similarly.
- J. Provide 75 patch cords, 50 of these shall be BK2 and 25 shall be R3 types or approved equal.
- K. Patch bays shall be equal to ADC PPA3-18MKIINO or approved equal by Whirlwind (Qty: as shown)

**2.15 MULTI-PIN CONNECTORS, SNAKE UMBILICALS, FLOOR POCKETS AND PUNCH DOWN BLOCKS**

- A. Provide the types and quantities of floor pockets, back boxes, multi-pin connectors and cable with all accessories to complete the wiring as shown in the drawings. Connect as indicated on the drawings.
- B. Installation of these multi-pin connectors shall be with Whirlwind MASS Crimp Component tools only. See Whirlwind for tool types and models.
- C. Multi-pin connector to individual connector fan outs shall be constructed at the Whirlwind factory by Whirlwind. Only multi-pin connectors on plates will have the pins crimped and inserted in the field
- D. Punch down blocks for the Studio Theater microphone line and line level returns parallel shall be ADC's Quick Connect Punchdown (QCP) technology by Whirlwind
- E. Furnish and install the following:
  1. Ace Backstage 134-SL-BK Super Double Wide Floor Pocket. (Qty. as shown)
  2. Whirlwind W4RCP and W5RCP MASS 176 pin and 48 pin chassis mounted crimp type connectors. (Qty: as shown)
  3. Whirlwind W3W4AK and W5W6AK hinge kits for the above-specified connectors where the drawing indicated they are required. (Qty: as shown)
  4. Whirlwind W4IRP and W5IRP MASS MicroMASS 176 pin and 48 pin inline crimp type connectors. (Qty: as shown)

5. Whirlwind FM SERISE multipin to fanout umbilical cables for use from main Theater console to Theater Control Booth plate "8" plate and Floor Pocket "FP" alternate mixing position. A second smaller snake shall be used for the Studio Theater portable rack connection to plates "6" and plate "7".
  - a. The main Theater console snake shall be 20 feet in length with an additional 5 foot fan out. (Qty: 1 ea.)
  - b. The Studio Theater portable rack snake shall be 10 feet in length with an additional 2 foot fan out. (Qty: 1 ea.)
6. Whirlwind MASS W5IRP connector snake to 6 XLR female connector stage box, Pit and Stage plate interconnects, plate types "1" and "2".
  - a. Stage snakes shall be 75 feet in length. (Qty: 2 ea.)
  - b. Pit snakes shall be 50 feet in length. (Qty: 2 ea.)
7. Whirlwind MPB-28 MASS Punch blocks. Mount in back boxes "6" and "7". (Qty: as shown)

## **2.16 ASSISTIVE LISTENING SYSTEM**

- A. Provide assisted listening system for use in all sound reinforcement systems. Connect as indicated on the drawings.
- B. Furnish and install the following:
  1. Listen Technologies LT-800-216 or approved substitution. (Qty: 2 systems)
  2. Listen Technologies LA-122 Antenna Kit or approved substitution. (Qty: 1 ea.)
  3. Listen Technologies LA-124 Antenna or approved substitution. (Qty: 1 ea.)
  4. Listen Technologies LR-500-216 with LA-162 Dual Ear Bud (Qty: 6 ea.)
  5. Listen Technologies LA-317 Charger/Carrying Case or approved substitution. (Qty: 1 ea)
  6. Listen Technologies LA-362 NiMH Batteries or approved substitution. (Qty: 1 set for each receiver supplied)

## **2.17 WIRELESS MICROPHONE SYSTEMS**

- A. Provide wireless microphone systems for use throughout the Theatre.
- B. Install these systems in the equipment rack associated with the Control Room.
- C. Furnish and install the following:
  1. Sennheiser EW-345 G2 Handheld Wireless Microphone System. (Qty: 12 ea.)
  2. Sennheiser SK300 Body Pack Transmitter. Insure that frequencies match the transmitters associated with the Handheld system specified. (Qty: 12 ea.)
  3. Sennheiser ASP1/NT1 Antenna splitter with DC power distribution. (Qty: 4 ea.)
  4. Sennheiser AB1 Antenna booster. (Qty: 4 ea.)
  5. Sennheiser A1031-U Passive Omni-directional Antennas. Antenna shall be mount on the "W" type plates as depicted in the drawings using Atlas Soundolier AD-11B microphone flange, AD-8B tube extension, and AD-14B right angle tube. (Qty: 4 ea.)
  6. Countryman B3 Lavalier Microphone. Insure proper connector is provided for use with the Sennheiser Body Pack Transmitter. (Qty: 6 ea.)
  7. Countryman B6 EarSet Microphone. Insure proper connector is provided for use with the Sennheiser Body Pack Transmitter. (Qty: 6 ea.)

## 2.18 RECORD AND PLAYBACK THEATER SYSTEMS

- A. Provide record and playback capability for use in the main Theater.
- B. Install these systems in a slant-faced desk turret rack that will be portable. It will reside on the counter top to the right of the main console in the Control Booth or be moved to the auxiliary mixing position at the Floor Pocket (FP) in the Theater.
- C. Furnish and install the following:
  - 1. Denon CDR510, combination MP3/CD Player & recorder or approved equal. (Qty 1 ea.)
    - a. Provide a Radio Design Labs FP-UBC2 unbalanced to balanced converter with power supply included. This will be connected as indicated in the drawings. (Qty: as shown)
  - 2. Denon DN-780R Independent Dual Well Cassette Deck or approved equal. (Qty: 1 ea.)
    - a. Provide the ACD 780 XLR balancing kit for the cassette deck's inputs and outputs. (Qty: 1 ea.)

## 2.19 PRODUCTION INTERCOM SYSTEM

- A. Provide a four (4) channel production intercom system for use during formal performances within the Theatre.
- B. The Production Intercom System shall provide:
  - a. 4 independent channels.
  - b. Microprocessor controlled.
  - c. Separate Talk and Listen Buttons for each channel.
  - d. All Call Function.
  - e. Visual Call Signaling
  - f. Adjustable mic proximity compensation.
  - g. 4 separate program inputs.
- C. Furnish and install the following:
  - 1. Clear-Com MS-440 Master Station. Install this device in the Stage Managers Equipment Rack. Provide one (1) GM-9 Gooseneck Mic with this unit. (Qty. 1 ea.)
  - 2. Clean-Com PS-464 Four Channel Intercom Power Supply. Install this device in the Stage Managers Equipment Rack. (Qty: 1 ea.)
  - 3. "IC" Station – Clear-Com WP-6 or approved equal. (Qty: as shown)
  - 4. "IS" Station – Clear-Com KB-211 or approved equal. Provide one (1) HS-6 Telephone Style Handset with each KB-211 supplied. (Qty: as shown)
  - 5. "IS2" Station – Clear-Com MR-204 or approved equal. Provide one (1) HS-6 Telephone Style Handset with each MR-204 supplied. (Qty: as shown)
  - 6. Clear-Com RS-502 Two Channel Beltpack. (Qty: 12 ea.)
  - 7. Clear-Com CC-95 Single-Ear Intercom Headset. (Qty: 12 ea.)
  - 8. Neutrik NC6MD-L-B-1 shall be used where intercom jacks appear on custom plates. See drawing plate details for this information. (Qty: as shown)
- D. Provide a two (2) channel production intercom system for use during formal performances with the Studio Theatre.
- E. Intercom beltacks and headsets will be share between the Theatre and Studio Theatre.

- F. The Production Intercom System shall provide:
  - a. 2 independent channels.
  - b. Microprocessor controlled.
  - c. Separate Talk and Listen Buttons for each channel.
  - d. All Call Function.
  - e. Visual Call Signaling
  - f. Adjustable mic proximity compensation.
  - g. 2 separate program inputs.
  
- G. Furnish and install the following:
  - 1. Clear-com MS-232 Master Station. Install this device in the equipment rack associated with the Studio Theatre. (Qty: 1 ea.)
  - 2. "IC" Station – Clear-Com WP-6 or approved equal. (Qty: as shown)
  - 3. "IS" Station – Clear-Com KB-211 or approved equal. Provide one (1) HS-6 Telephone Style Handset with each KB-211 supplied. (Qty: as shown)
  - 4. Neutrik NC6MD-L-B-1 shall be used where intercom jacks appear on custom plates. See drawing plate details for this information. (Qty: as shown)

## **2.20 STAGE/ORCHESTRA PIT VIDEO OBSERVATION SYSTEM**

- A. Furnish a complete observation system consisting of cameras, monitors, and video DA for splitting and distribution of the Pit and Stage area images. These should be routed to monitors in the Stage Managers rack on stage and the Aux rack in the Control Booth.
- B. Cameras shall be equipped with the manufactures mounting hardware and the monitors shall be rack mounted.
- C. Video images shall be in NTSC/Composite format, audio will not be required.
- D. Furnish and install the following:
  - 1. Extron MDA 3V three-output composite video distribution amplifier. (Qty: as shown)
  - 2. Marshall Electronics V-R82P dual 7.9" active matrix LCD panels with loop through capability. (Qty: 2 ea.)
  - 3. Pelco CC1400HZ16-2 series digital CCD color camera. The unit shall be ¼" format, high resolution, with built in 16X optical zoom lens and 8X digital zoom capability. Provide TF2000 power supply and CM1750S universal wall/ceiling mount. (Qty: 2 ea.)

## **2.21 SUPERTITLE PROJECTION SCREEN**

- A. Furnish and install all flexible rear projection screens in the areas as indicated. Verify locations with architect prior to installation. Refer to architectural and theatrical drawings for locations and rigging.
- B. All painting, metalwork, and woodwork shall be completed prior to installation, to protect against damage by other contractors.
- C. The screen shall be delivered to the job site, still in factory crating, while access is still available for a screen of these dimensions. Store the screen in such a way as to protect it from moisture and adverse weather conditions. Take all precautions necessary to protect the screen from damage during storage and installation.

- D. Unit frames to be constructed of 1" square aluminum tubing in a double truss equipped with snaps. Screen fabric to be attached to frame with snaps. Viewing surface to conceal frame.
- E. Furnish and install the following:
  - 1. Draper Shade and Screen Co. Model Cineperm snap-on screen with aluminum truss style frame and M1300 fabric. Provide all mounting hardware as required.

## 2.22 VIDEO PROJECTOR

- A. Furnish and install rear projection high light output video projectors for projection of video, data, and graphic images on the projection screens in the areas as indicated.
- B. Perform all setup procedures and image convergence for each input according to the manufacturer's recommendations. The image shall be adjusted for full available screen width for each input.
- C. **Projectors to be attached with security hardware.**
- D. Shall be mounted to balcony fascia with **custom wall mounting accessory arm** and Chief Manufacturing UPC projector mount and suspension adapter. Secure to structure as required for rigid lateral and vertical support. Coordinate the exact locations of the projector mounts with the Architect. Provide exact mounting locations and all necessary details in shop drawings.
- E. Shall have 1024 x 768 XGA output resolution and 10,000 ANSI lumen brightness. Shall have 15-120 kHz horizontal scanning frequency, composite video BNC and RGBHV 5-BNC input connectors, wired remote and standard motorized lens, verify with field conditions.
  - 1. Provide and install Sanyo PLC-XF45 multimedia projectors with all required hardware at the locations as shown. To be supplied with LNS-S03 2.6-3.5:1 standard zoom lens. (Qty. as shown)

## 2.23 COMPUTER INTERFACE

- A. Provide and install the following computer interfaces and corresponding cables in the locations as shown and terminate as indicated.
- B. Units to be 400 MHz bandwidth, 15 pin HD type connector and BNC output connectors. To be supplied with all modular pass-through connectors as shown.
  - 1. Units to be Extron RGB 168xi rack mounted computer interface with all cables as required, or approved equal. (Qty. as shown)
  - 2. Units to be Extron RGB 460xi computer interface with all cables as required, or approved equal. (Qty. as shown)

## 2.24 STEREO LINE MIXER

- A. Provide and install the following stereo line mixer in the locations as shown and terminate as indicated.

- B. Unit shall be an eight channel stereo line-level mixer, rack mountable with balanced inputs and outputs and at least one stereo output.
  - 1. Unit to be an Ashly Model LX-308B stereo line mixer or approved equal. (Qty. as shown)

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Furnish components, racks, wire, cabinetry, connectors, materials, parts, equipment and labor necessary for the complete installation of the systems, in full accordance with the recommendations of the equipment manufacturers and the requirements of the drawings and specifications.
- B. Installation shall follow standard broadcast wiring and installation practice, and shall meet or exceed industry standards for such work, with particular attention given to any installation instructions in Part 2 of these Specifications.
- C. Equipment shall be held firmly in place with proper types of mounting hardware. All equipment affixed to the building structure must be self-supporting with a safety factor of at least three. All equipment shall be installed so as to provide reasonable safety to the operator. Supply adequate ventilation for all enclosed equipment items which produce heat.
- D. Furnish the system to facilitate expansion and servicing using modular, solid-state components.
- E. Terminate all unused inputs and outputs with proper precision shielded resistors. Build-out or terminate all link circuits containing passive components to provide matching impedances. Record all pad values in the final documentation.
- F. Provide all audio circuits balanced and floating, except as noted in the Specifications or directed by the Consultant at the time of final equalization and testing. Shields of audio cables shall be grounded at one end only, at the inputs of the various equipment items in the system.
- G. Route cables and wiring within equipment racks and cabinetry according to function, separating wires of different signal levels (video, microphone level, line level, amplifier output, 120VAC, intercom, control, etc.) by as much physical distance as possible. Neatly arrange and bundle all cables loosely with plastic cable ties. Cables and wires shall be continuous lengths without splices.
- H. Observe proper circuit polarity and loudspeaker wiring polarity. No cables shall be wired with a polarity reversal between connectors with respect to either end. Special care shall be taken when wiring microphone cables, to insure that constant polarity is maintained. Balanced audio connectors shall be wired as follows:
 

1.	WIRE	CONNECTOR	SIGNAL
2.	Black	Pin #3 or Ring	Lo or Neg
3.	Red or White	Pin #2 or Tip	Hi or Pos
4.	Bare	Pin #1 or Shield	Ground

- I. All system wire, except spare wire, after being cut and stripped, shall have the wire strands twisted back to their original lay and be terminated by approved soldered or mechanical means. No un-terminated wire ends will be accepted. Heatshrink type tubing shall be used to insulate and dress the ends of all wire and cables. Include a separate tube for the ground or drain wire.
- J. All cables in conduits shall be insulated from each other and from the conduit the entire length and shall not be spliced. All cables and wires are to be continuous lengths without splices.
- K. All solder joints and terminations shall be made with resin-core silver solder.
- L. Temperature regulated soldering irons rated at least 60 watts shall be used for all soldering work. No soldering guns or temperature-unregulated irons shall be used on the job site. The presence of such tools on the job site shall constitute evidence of solder connections made with unauthorized tools and shall provide sufficient grounds for rejection of all solder connections in the A-V system, and subsequent re-work of same.
- M. Mechanical connections shall be made using approved connectors of the correct size and type for the connection. Wire nuts will not be accepted.
- N. Each mechanical connector shall be attached using the proper size controlled-duty-cycle ratcheting crimp tool which has been approved by the manufacturer of the connectors. Conventional non-ratcheting type crimping tools are unacceptable, and shall not be used on the job site. The presence of such tools on the job site shall constitute evidence of mechanical connections made with unauthorized tools and shall provide sufficient grounds for rejection of all mechanical connections in the A-V system, and subsequent re-work of same.
- O. Label all wires in racks and console as to destination and purpose. Clearly and permanently label all jacks, controls, and connections with permanent engraved laminated plastic labels or by engraving and filling mounting plates, unless otherwise noted. Attach laminated plastic labels with contact cement, being careful to clean off excess or visible cement. Embossed or printed label tape, and press-on or lift-off lettering systems will not be accepted. All labeling shall be completed prior to final system inspection.

### **3.2 FINAL TESTING AND EQUALIZATION**

- A. The completed sound system is to be inspected and tested for compliance with the Contract Documents and is to be equalized, by BAi, LLC, Austin, Texas. The AV Contractor is to include in his bid the fee to provide this service. Contact Bai at 512-476-3464 to obtain the tuning fee prior to bid date.
- B. The testing work shall be performed after the installation work has been completed, but prior to any use of the system. During the testing and equalization work, the Installer shall have on the job site one (1) competent technicians who are familiar with the project, and who will be prepared to stay as long as services are needed. It is estimated that approximately twenty-four (24) hours will be required for this work.
- C. The process of testing the system may necessitate adjusting certain equipment settings. Adjustments shall be performed without claim for additional payment.

- D. Coordinate as necessary to ensure a totally quiet room during the sound reinforcement systems testing and balancing period.
- E. Prior to requesting systems testing, ensure that all systems are in first-class working condition and free of short circuits, ground loops, parasitic oscillations, excessive system noise beyond published specifications of the equipment, hum, RF interference, or instability of any form. All loudspeaker/power amplifier level adjustments shall be made prior to system testing by the Consultant. All system equalization will be performed by the Contractor prior to system testing by the Consultant.
- F. The final acceptance of the system by the Owner will be based upon the report of the Consultant following inspection, testing, and demonstration. A list of items in need of completion or correction shall be generated by the Consultant, which must be corrected by the Contractor before final acceptance will be granted.
- G. Should the performance testing show that the Contractor has not properly completed the systems, the Contractor shall make all necessary corrections or adjustments and a second performance demonstration shall be arranged at the Contractor's expense.

### **3.3 SYSTEM PERFORMANCE – GENERAL SYSTEMS**

- A. After equalization and testing, the Theater sound system shall meet or exceed the following specifications:
  - 1. System shall be free of short circuits, ground loops, parasitic oscillation, excessive system noise, hum, RF interference, and instability of any form.
  - 2. Maximum SPL with band-limited pink noise input to the system shall be 99Db before audible distortion occurs.
  - 3. Seat-to-seat variation in SPL at 4kHz octave band pink noise shall be within a tolerance of plus or minus 3Db SPL.
  - 4. Acoustic response of the system shall be plus or minus 1.5Db along a line which is flat from 80Hz to 4000Hz and which rolls off at 1Db per octave to 16kHz.

### **3.4 OWNER TRAINING AND FAMILIARIZATION**

- A. The Contractor shall furnish the Owner's representatives with training necessary to properly operate the systems. Demonstrate in detail all functions of the systems. Provide a minimum of 16 hours of instruction and familiarization for this purpose.
- B. The training phase shall be accompanied by complete as-built documentation and the custom technical systems operation manual, as described in Section 1.08.
- C. Videotape training sessions and turn over one copy of tape to Owner with O&M manuals for use in training future personnel.

**END OF SECTION 11770**