

**NEW HAVEN UNIFIED SCHOOL DISTRICT
REQUEST FOR PROPOSALS #776**

Audio Video Systems

REQUEST FOR PROPOSAL

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I. SCHEDULE OF EVENTS

The following are key dates for this RFP. The District is committed to adhering to this schedule, but reserves the right to make modifications.

- A. Publication in Newspapers: April 14 and April 21, 2017
- B. Potential Walkthrough Date: April 25, 2017 at 2:30 p.m. Educational Service Center.
- C. Vendor Questions Due: April 28, 2017
- D. Responses to Vendor Questions: May 2, 2017
- E. Proposals Due Date: **2:00 p.m. Friday, May 5, 2017**
- F. Vendor Selection/Staff Recommendation to Board: May 16, 2017
- G. Estimated Completion Date: July 31, 2017

All Proposals must include timelines for the start and end dates for the project, including major milestones.

II. SCOPE OF WORK

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope of Work: This specification section defines certain audiovisual systems to be installed in the New Haven Educational Services Center.

B. Definition of Terms:

- 1. The term "Owner" shall refer to New Haven Unified School District (NHUSD).

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2. The term "Contractor" shall refer to the Systems Contractor who has responsibility for performance of the work specified herein.
3. The term "shall" is mandatory; the term "will" is informative; the term "should" is advisory; and the term "provide" means furnish and install.
4. The term "custom" indicates systems or components that shall be fabricated by the Contractor based on these specifications and drawings.
5. The term "OFE" refers to Owner Furnished Equipment. Provide for removal, relocation and testing prior to installation. Coordinate the integration of existing components or new components, provided by the Owner into the sound system. Provide required mounting hardware, rack panels, cable, connectors, etc. to ensure proper operation of the OFE systems as specified.
6. The term "A/R" indicates component quantities as required. Quantities not explicitly indicated shall be determined from the drawings.
7. The term "NIC" refers to work or equipment that is not in contract covered in this section.
8. The term "future" indicates equipment that will be added to the systems by the Owner or Owner representative at a later date. Provisions shall be made for this equipment.
9. The term "or pre-approved equal" indicates equal in materials, size, color, design, function, efficiency, and all operational capacities conforming to the base bid manufacturer/model specified.

C. Section Includes:

1. Supply and install turnkey audiovisual systems, to include equipment and materials, whether specifically mentioned herein or not, to ensure a complete and operating system.

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2. Generate submittal information for the complete fabrication, installation and wiring of the system. Provide (or sub-contract for) the on-site installation and wiring, and provide on-going supervision and coordination during implementation.
3. Provide for the adjustment of the systems as herein prescribed and provide test equipment for the system checkout and acceptance tests. Prior to the systems acceptance tests submit a testing and tuning report showing methods and results for tests performed.
4. Provide on-the-job training in the operation and maintenance of the systems for personnel designated by the Owner.
5. Provide equipment manuals and complete system operation manuals. Provide complete and accurate as-built drawings.
6. Provide two-year warranty for systems installed.

D. Substitutions:

1. Submit bids on the basis of the specified equipment. Submit all proposals for "substitutions" with equipment costs shown separate and apart from the costs of the equipment "as specified". All requests for Substitutions shall be submitted with the original bid.
2. Proposals for alternate equipment will receive careful and equitable consideration in the differences do not depart from the overall intent of the design and operation of the system, and are in the best interests of the Owner.
3. All such proposals for alternate equipment shall be accompanied by full technical information, "cuts", and specifications for the equipment proposed.
4. Submit a written request for modification to any installation practice desired or required which is contrary to these specifications or drawings. Modifications shall not commence

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without written approval from the Architect and the Consultant.

5. Submit recommendations that will enhance the performance of the system, or reduce costs without loss of performance, in the bid submission. All suggestions that are of value to the Owner will be taken into consideration in the evaluation of the bid returns. All such proposals shall be made as "substitution", with the appropriate cost modifications shown separate and apart from the costs of the system "as specified".
6. Make any and all exceptions to these specifications and related drawings with the bid submission. In the absence of exceptions, these specifications and related drawings shall be binding in letter and intent. It will further be assumed that the design and specifications have been examined in detail, and full responsibility for the performance of the complete installation as designed and specified is accepted.

1.2 SYSTEM DESCRIPTION

A. Video System

1. Install three (3) manual projection screens in the Board Room walls as shown in the drawings. Locate the screens and coordinate with the existing (OFE) projectors to optimize the projector image with the projection screens.
2. Install three (3) new cameras as shown in the drawings. Coordinate exact location with Owner and Consultant based on available space in the rear upper wall.
3. Install new AV components into the existing equipment rack in the adjacent equipment room. Remove all unused equipment and wiring and provide to the Owner. Provide an equipment rack elevation of the new AV system as part of the shop drawing submittal.
4. Install AV input/output plates on the rear wall of the Board Room in "Home" and "Visitor" positions and the Dais-Right

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position for feeding AV signals to/from the equipment rack in the adjacent equipment room. Provide plate details as part of the shop drawing submittal

5. Provide AV signal connectivity from the existing floor box to the equipment rack for use by the mobile lectern. Outfit the lectern with a mounted AV transmitter box for sending AV source inputs from the mobile lectern to the floor box via shielded CAT6 cabling satisfying the AMX DXLink signal criteria. Provide a dressed DXlink umbilical cable for facilitating AV connection from the lectern to the floor box.
6. Provide a portable/mobile rack at the back of the room for connection to the equipment rack via AV wall plates at the back of the room. Relocate existing (OFE) DVD, Blu-ray, and confidence monitor into the portable rack.
7. Relocate the existing composite video distribution amplifier (DA), RF modulator, and composite video monitor (all OFE) into the main AV equipment rack. Extend the output of the RF modulator to the existing feed as is currently connected. Provide a composite video feed from the output of the composite video DA to the wall plate at the back of the Board Room (designated for connection to a new video monitor in the mobile rack).

B. Audio System

1. Install new microphones into the dais. Provide the ability for the users to locally mute on/off microphones as well as the ability to control the muting remotely from the touch panel(s).
2. Install new program loudspeakers designated for stereo program audio from AV sources; remove the old/existing mounts.
3. Reconnect all existing ceiling-recessed loudspeakers to the new amplifiers as shown in the drawings.
4. Configure an Audio DSP for the audio connectivity as shown in the audio functional drawings. Provide room combine/divide capability of the A and B room subsections with the ability to

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add/remove room subsections C and D from the combined A and B spaces.

5. In the audio DSP, follow the existing audio routing scheme where all speech signals are sent to the ceiling-recessed loudspeakers, and stereo program sources are sent to the program loudspeakers.
6. Install a wireless microphone system as shown in the drawings. Ensure that wireless frequencies are coordinated with the area RF traffic to provide adequate wireless transmission with no audible crosstalk between wireless channels/frequencies.
7. Install a new RF assisted listening system (ALS). Ensure that there is adequate RF coverage in the Board Room area.
8. Install audio input plate in the existing floor box for connectivity to the AV equipment rack. Install two (2) new gooseneck microphones into the existing (OFE) mobile lectern for connection into the floor box. Provide a dressed umbilical connection for the microphones, separate from the AV source connection to the AV transmitter.

C. Control System

Provide a touch panel to be connected at the rear Board Room technician “Home” position. Provide and program a control system emulating the existing control in the Board Room with the addition of the following (if not already included): Make an investigation of the existing AMX control system in order to emulate the functionality that is currently in place.

Additionally, provide the following functions on the touch panel(s):

1. Projector power/mute control
2. Video source select to multiple destinations
3. Camera PTZ control and participant preset selection for each of the two (2) rear cameras
4. Camera preset saving control

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5. Lighting control by interfacing with the existing (OFE) lighting controller
6. Audio room combine/divide control: Room A, Room B, Room A & B combine, Add audio to Room C, Add audio to Room D.
7. Individual dais and lectern microphone mute & volume control
8. Overall speech and program source volume control
9. Transport control of main equipment rack-mounted equipment: audio recorder, video recorder, Blu-ray (OFE).
10. Provide AV source queueing control with a preview and program monitor video window on the touch panel.
11. Provide a preview monitor window on the touch panel showing the video recorded to the solid state video recorder.
12. Provide touch panel pages on the ipad for wireless control mirroring the control provided by the wired touch panel.

D. Wall Plates

Provide wall plates with appropriate labels for making all connections as depicted in the functional diagrams. Provide wall plate details with the shop drawing submittal. The following wall plates apply to the design:

1. Install camera plates at the three (3) camera positions. Coordinate mounting and exact positions based on field conditions with the Owner and Consultant.
2. Install connectors/plates into the existing wall box at the rear of the Board Room in the "Visitor" position including two (2) DXLink HDMI/VGA combo transmitter plates, and a composite video BNC for the video confidence monitor.
3. Install connectors/plates into the existing wall box at the rear of the Board Room in the "Home" position including a DXLink (CAT6) ethercon, and an Ethernet (CAT6) for the tech touch panel connection. Provide "strong" labeling as the connectors can easily be incorrectly switched.

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4. Install a DXLink HDMI/VGA combo transmitter into the dais-right plate. Retain the existing XLR microphone input.
5. Install a DXLINK (CAT6) ethercon into the existing floor box for connection to the lectern mounted DXLink transmitter box. Retain and verify the continuity of the two (2) existing microphone XLR connections for the two (2) lectern microphones.

1.3 SUBMITTALS AND SHOP DRAWINGS

A. General: Provide submittals and shop drawings as defined in this section and the corresponding bid documents. All electronic drawings shall be original drawings by the audiovisual contractor. The consultant will not be providing electronic drawing files.

B. Bid Information Submittal:

1. Equipment Costs: Include detailed lists of all equipment to be supplied. Each piece of equipment shall be individually priced. Equipment costs shall reflect all required modifications and accessories.
2. Non-Equipment Costs: Furnish separately non-equipment costs for each of the following categories:
 - a. Engineering: Including all required design, drawings, run sheets, instruction manuals, etc.
 - b. Pre-Installation: Including all fabrication, modification, assembly, rack wiring, etc., performed on the Contractor's premises.
 - c. Installation: Including all on-site installation and wiring, coordination and supervision, testing, checkout, Owner training, etc., performed on the Owner's premises.
 - d. General and Administrative: Including all G & A expenses, shipping, insurance, and guarantees.
 - e. Taxes: Including all applicable Local, State, and Federal taxes.

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- f. Hourly Rates: For standards rates, evening hours and weekend hours.
3. Audiovisual System Service Contract:
- a. Submit a separate one-year service contract, covering all installed systems. This service contract shall commence immediately after expiration of the warranty period. The cost for this service contract shall not be commingled with the costs for the systems base bid.
 - b. Submit separate costs for "on-call" service, both in-house and in-shop.
4. Schedule of Implementation:
- a. Submit a scheduling plan with the bid return indicating the various pertinent terminal dates after award of contract for completion of design, pre-installation work, on-site installation work, and testing and acceptance.
 - b. Obtain projected dates when the relevant areas will be available for the on-site installation.
 - c. Investigate all potential contract, union, and scheduling questions, and guarantee compliance with all requirements and regulations in effect on the job site.
5. Sub-Contract Information:
- a. Identify sub-contractors and their responsibilities and qualifications in the bid submission.
 - b. Because of the complexity of the systems, the supervision of such sub-contracted work cannot be intermittent. Provide virtually continuous supervision of subcontractors during the installation.
 - c. List of Replacement Parts: Provide a list of necessary and recommended replacement parts for a normal maintenance period of one year.
- C. Prior to Fabrication - Submittal 1:
- 1. Sample panels, plates, and designation strips, including details and samples relating to terminology, engraving, finish and color.

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2. Custom designed consoles, tables, carts, support bases, and shelves.
3. Schematic drawings of circuitry.
4. Unusual equipment modifications.
5. Loudspeaker mounting hardware details showing coordination with physical elements, stamped and signed by a licensed structural engineer.
6. Specific loudspeaker locations, angles, and orientation.

D. At the Completion of the Installation - Submittal 2:

1. Notification: Provide written notification to the Owner and General Contractor when checkout is complete, normal settings are documented, as-built and operational documentation are complete, and systems are available for final acceptance tests. Provide a completed copy of the testing report in accordance with Part 3.
2. Submit equipment manufacturer's operation and maintenance manuals for each piece of equipment.
3. Submit "as-built" drawings for systems and items indicated as "Custom" in both electronic and paper format.
4. Submit System Operations and Maintenance Manuals:
 - a. Describe in the "Operation" section, typical procedures necessary to activate each system to provide for the functional requirements as listed under the System Description. Include normal settings for equalizer, amplifier, signal processing, and user-operated controls (as established during system check-out) in tabular or pictorial form.
 - b. Provide in the "Maintenance" section, a recommended 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.

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- c. List of Replacement Parts: Provide a list of necessary and recommended replacement parts for a normal maintenance period of one year.
 - d. Assume the reader of this manual to be technically competent, but unfamiliar with this particular facility.
5. System Software: Provide copy of all software associated with any device or component in the system. All system software, including control system software program containing source code and comments shall be submitted on CDROM disk. Provide CDROM copies of all sound system software furnished by manufacturers.

1.4 PERFORMANCE STANDARDS

A. Meet the following performance standards for each system, unless restricted by the published specifications of a particular piece of equipment:

B. Audio Signal:

1. Signal-to-Noise Ratio (including crosstalk): 85dB minimum.
2. Total Harmonic Distortion: 0.1% maximum from 20 Hz to 20,000 Hz.
3. Frequency Response: +/- 3.0 dB, 20 Hz to 20,000 Hz.

C. Audio Reproduction:

1. Signal-to-Noise Ratio (including crosstalk): 65dB minimum.
2. Total Harmonic Distortion: 1% maximum from 60 Hz to 15,000 Hz.
3. Frequency Response: + 2 dB, a flat response from 125 Hz to 5 kHz, decreasing uniformly from a relative level of 0 dB at 5 KHz to a relative level of -3 dB at 15 kHz and decreasing 3 dB from 125 Hz to 50 Hz as measured on axis of loudspeakers.

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4. Sound Output Capability: Provide program levels of not less than 100 dB and speech reinforcement levels of not less than 90 dB in the seating area without objectionable distortion, rattles, or buzzes, employing as test signals several different samples of recorded music and microphones applied at each system input.
5. Hum and Noise: Hum and noise shall be inaudible (below the background noise level of the space) under normal operation and as observed in normal seat locations.
6. Wireless systems shall neither be the source of, nor be affected by, radio-frequency interference to/from external signal devices.

D. Video Signal:

1. Signal-to-Noise Ratio (peak to RMS) Un-weighted DC to 4.2 MHz: 55 dB minimum
2. Crosstalk: Crosstalk (Un-weighted DC to 4.2 MHz): 45 dB minimum
3. Frequency Response: Within plus-or-minus 0.5 dB to 4.2 MHz
4. Line and Field Tilt: 2% minimum
5. Differential Gain: 3% maximum
6. Differential Phase: 2° maximum
7. No video or grounding roll is acceptable

E. Video Timing:

1. System Timing: Sync coincidence in 50 nanoseconds
2. Color Timing: Within 2° at 3.58 MHz

F. The following guidelines should be followed:

1. Refer to section 1.2, for system description.
2. Verify functional operation for specified control operations.
3. The following guidelines should be followed:
 - a. Touch panel graphical interfaces and programming shall be produced by a certified programmer.

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- b. Maintain background to lettering contrast
- c. Timing: Avoid the possibility for two or more serial macros or actions being sent simultaneously to the same piece of equipment through flag checking/setting routines.
- d. Defaults: Establish default conditions for the system at power-up including device audio levels, warm-up routine, power conditions, receiver status and other default conditions as required by the Owner or Owner's representative.

1.5 DELIVERY, STORAGE AND HANDLING

Bear costs of shipping to the site, and of unusual storage requirements. Make appropriate arrangements, and coordinate with authorized personnel at the site, for the proper acceptance, handling, protection, and storage of equipment so delivered.

1.6 WARRANTY

- A. Warranty the entire system for a minimum of two years from the date of system acceptance by the Owner. Component warranties shall be honored for the term established by the manufacturer, if greater than two years. Include in the warranty quarterly site visits to check and adjust equipment and restore systems to original performance standards.
- B. Activate manufacturer's equipment warranties in Owner's name to commence on the date of acceptance. In the case of Contractor- modified equipment, the manufacturer's warranty is normally voided. In such cases, provide the Owner with a warranty equivalent to that of the original manufacturer.

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PART 2 PRODUCTS

2.1 SUPPLIERS AND INSTALLERS

- A. Provide information proving the firm has been in business providing similar service required by this section for not less than five consecutive years.
- B. Firm can outline the general scope of past projects, normal staffing levels, and union status of shop and field installation personnel.
- C. Firm can list a minimum of three (3) projects of similar scope successfully completed, indicating the location, type of system installed, total contract amount, date completed, and include persons and telephone number to contact.
- D. Firm can submit confirmation of current state or local contracting licenses, as required to perform the work under this section.
- E. Firm shall submit confirmation of shop & drawing submittal capabilities.
- F. Firm shall submit confirmation of factory approved & qualified control system programming and graphic layout capabilities as outlined in this specification.

2.2 EQUIPMENT

- A. Provide equipment as specified in the Equipment Schedule submitted during project Phase 3.
- B. To ensure that the latest technology equipment is provided to the project, at the time of installation supply the latest model of the product which is available for each piece of equipment.
- C. Materials: Verify that supplied materials and equipment are new and shall meet or exceed the latest published specifications of the manufacturer.

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- D. Should there be a difference in pricing between the equipment model cost at the time of bid and the pricing of that same model or the latest equipment model to be provided at the time of installation, the price differential will be compensated accordingly. The contractor will need to provide detailed pricing invoices to demonstrate the change in costs from bid to installation.

2.3 CUSTOM FABRICATION

- A. Electrical Power Connections: Electrical power, junction boxes, and circuits will be provided by others. Provide required interconnections to the power system from these junction boxes to the equipment and equipment racks.
- B. Seismic Safety: Mount and brace permanently installed equipment to the building structure to minimize potential damage to personnel or equipment from foreseeable seismic events. Secure all hanging equipment such as loudspeakers, graphic cameras, et cetera, both to minimize sway and to prevent detachment from the overhead structure. All supports require review by a structural engineer with their stamp, certifying acceptance of the proposed mounting design.
- C. Remote Control Panels and Receptacle Plates: Fabricate with 1/8-inch thick #6061-T6 aluminum material. Finish brushed with 150 grit paper. Anodized finish is to be approved by the General Contractor.
- D. Equipment Rack: Provide power receptacle strips, with "U" ground outlets. Power receptacle strips shall be mounted on the rear interior of the rack space on the left side as viewed from the rear. Insulate power receptacle strips from the rack. Power receptacle strips shall be SGL Waber Company or approved equal. Provide UL-approved incandescent work light mounted on the upper left interior panel of each rack space.
- E. Project Information Label: Permanently mount, at the top facing edge of each equipment rack, an engraved plastic laminate plate, with filled lettering on contrasting background. Plate shall identify "Designed by: Rosen Goldberg, Der & Lewitz, Inc., Larkspur, CA. (415) 464-0150; Installation by: Contractor, City, ST, Phone."

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- F. Audio Transformers: Provide appropriate impedance ratio and power handling capacity for the function intended of audio transformers specified in the system.
- G. Networks and Pads: Provide networks and pads as shown on the drawings or as required to achieve proper impedance matching and levels. Networks and pads shall be balanced. 0.5 watt, 5% composition resistors shall be soldered to fixed connection points at each end.
- H. Loudspeakers: Guarantee that there are no rattles or buzzes from the tile loudspeakers. Trouble shoot and remedy any buzzes or rattles caused by ceiling loudspeakers emitting audio.
- I. Labeling: Provide permanently mounted 1/32" thick by 1/4" high black lamicoïd or anodized, brushed aluminum labels with 1/8" engraved lettering for each piece of equipment and every user-adjustable control and input on the audiovisual equipment.
- J. Rack Mount Adapters and Security Covers: Provide the appropriate factory or custom rack mount adapters for equipment installed in the audiovisual equipment rack, whether specifically itemized or not. Provide security covers for equalizers, crossovers, signal delays, and other adjustable signal processors.
- K. System Functional Diagrams: Provide reduced-size as-built functional diagram for the control and audio system. Frame with acrylic cover, or laminate drawing, and mount in the equipment rack closet.

PART 3 EXECUTION

3.1 EXAMINATION

Verify that electrical requirements including junction boxes, floor boxes, ceiling loudspeaker enclosures, empty conduit and power circuits and receptacles are in place as shown on the drawings.

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3.2 INSTALLATION

A. General: Include the delivery, unloading, setting in place, fastening to walls, floors, ceilings, counters, or other structures where required, interconnecting wiring of the system components, equipment alignment and adjustment, and other work, whether or not expressly required, which is necessary to result in complete operational systems.

B. Physical Installation:

1. Firmly secure equipment in place unless requirements of portability dictate otherwise.
2. Provide adequate support for fastenings and supports with a safety load factor of at least three.
3. Secure plumb and square boxes, equipment, etc.
4. Give consideration, not only to operational efficiency, but also to overall aesthetic factors in the installation of equipment and cable.

C. Loudspeaker Enclosure Mounting and Preparation:

1. Mount the loudspeakers so that each unit may be reoriented slightly for optimum coverage, but will maintain its precise location and orientation after the system has been adjusted. Alternatively, mount the loudspeakers using industry standard portable rigging methods, such as rated hanging devices.
2. Verify that line-of-sight to the column array is not broken by lighting components, building structure, or other. Report any conflicts in writing to the Owner.
3. Allow no bracing or support members greater than 1/4" in front of the loudspeaker components where they would interfere with proper sound coverage.
4. Provide shop drawings of the loudspeaker framing and mounting arrangements (stamped and signed by a licensed

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structural engineer, and any other special construction, for approval by the Owner and Consultant prior to fabrication.

D. Projector or Flat Panel Display Mounting Systems:

1. Mount the individual projector displays on an architectural frame system. Provide a copy of reviewed and stamped drawing from a Structural Engineer showing details and calculations of mount connection to support structure. AVC is responsible for complying with all local codes and permit drawing requirements with respect to all hung devices.
2. Mount the projector or flat panel displays using rigid supports that will maintain its precise location and orientation as shown on the AV drawings.
3. Pay particular attention to arranging the projector or flat panel display components exactly as indicated on the AV drawings to ensure proper viewing angles and relationship to the seating areas. Projector or flat panel display aiming angles, dimensions, and location shall be exactly as shown on AV drawings.
4. Provide shop drawings of the projector or flat panel display mounting arrangements for approval by the Owner, General Contractor and Consultant prior to fabrication/installation.
5. Work out all mounting detail issues with the General Contractor and their structural engineer to ensure a safe and secure and aesthetically pleasing AVC installation. All special installation requirements such as “Genie Lifts”, scaffolding, special ceiling work, and any structural mounting hardware will be the responsibility of the AV contractor. This work can be subcontracted if desired with the approval of the General Contractor but must be done in accordance with structurally engineered drawings.

E. Cable Installation:

1. Mark cables, regardless of length, with permanent, non-handwritten number or letter cable markers within six inches of both ends. All shall be marked within the system.

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Marking codes used on cables shall correspond to codes shown on drawings and/or run sheets.

2. Furnish screw-type terminal blocks, boards, strips, or connectors, for cables that interface with racks, cabinets, consoles, or equipment modules. Terminate wires terminating at screw-type terminals with crimp-on lugs. "Telephone-style" punch-down blocks are not acceptable for signal or data wiring.
3. Group cables according to the signals being carried. . In order to reduce signal contamination, form separate groups for the following cables:
 - a. Power cables
 - b. Video cables/ Broadband RF cables/ Data Lines/Control cables
 - c. Audio cables carrying signals less than minus 30 dBm. (Microphone Level)
 - d. Audio cables carrying signals above plus 30 dBm. (Line Level and Intercom)
4. As a general practice, run power cables, control cables, and high-level cables on the left side of an equipment rack as viewed from the rear. Run other cables on the right side of an equipment rack, as viewed from the rear.
5. Unless otherwise called for in these specifications and drawings, use the following cables, or their approved equals, in these systems:
 - a. Individual microphone and line-level audio cable in conduit: Belden 1800F, 9451, or pre-approved equal.
 - b. Multi-channel (8/9-pair) microphone audio cable in conduit: Belden 1219B or pre-approved equal
 - c. Multi-channel (24-pair) microphone audio cable in conduit: Belden 1427B or pre-approved equal
 - d. Microphone and line-level audio cable for rack wiring: Belden 8761, 9451 or pre-approved equal
 - e. Microphone and line-level audio cable for plenum wiring: Belden 82761

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- f. DC Control cable: Belden 9740, 9156, 8690, 9157, 9159, 8691, 9161 or pre-approved equal
- g. Intercom cable: Belden 8760 or pre-approved equal
- h. Low-impedance speaker cable, Monitor loudspeaker receptacles: 14 AWG, Belden 8473 or pre-approved equal
- i. Individual 12 gauge low-impedance speaker cables, Main Loudspeaker runs: 12 AWG Belden 8477 or pre-approved equal
- j. Multi-channel speaker cable: 12 AWG, 2 pair, Whirlwind W12/4 or pre-approved equal
- k. Whirlwind snakes or cables for all audio signals not in conduit.
- l. Composite video cable runs: Belden 1505A, 1506A or Extron RG59
- m. SDI video cable runs: Belden 1505A, 1506A
- n. Component video cable runs: <100' Belden 1164B and Extron MHR-3 (P) or >100' Belden 1824A or Extron M59-3
- o. RGBHV video cable runs >100': Belden 1418B or Extron M59-5
- p. RGBHV video cable runs <100': Extron MHR-5 (P)
- q. RGBHV video cable runs >150': Extron RG59 (P) x5
- r. Infrared/Serial Digital: Belden 1583 or Equal
- s. 70-volt speaker cable: <200' Non-Plenum Belden 5300UE, Plenum Belden 6300UE, >200' Non-Plenum Belden 5100UE, Plenum Belden 6100UE
- t. Loudspeaker cable <50' Non-Plenum Belden 5100UE, Plenum Belden 6100UE
- u. Loudspeaker cable >50' Non-plenum Belden 5000UE, Plenum Belden 6000UE
- v. RS232: Belden 9538 or Equal
- w. Data Cable, CAT5e: Belden 1872A, 1874A, 1700A, 1701A or Equal

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- x. DTP, shielded twisted pair: Extron XTP DTP 24 or Equal

- 6. Cut cables to the length dictated by the run. For equipment mounted in drawers or on slides, provide the interconnecting cables with a service loop of appropriate length.

- 7. Install no cable with a bend radius less than that recommended by the cable manufacturer.

- 8. Clearly identify cable terminated in a floor pocket with permanent, indelible labels within 6" of the cable connector. Provide strain relief for cables. Provide connectors with metal shell/casing. Provide a minimum of 3' of free cable coiled in the floor pocket. Use spiral wrap to group similar cable types.

- 9. Use plenum-rated cable in plenum-rated spaces. Where plenum-rated cable is used, provide plenum-rated and approved tie-wraps and supports (Thomas & Betts #TYV525M, or pre-approved equal).

- 10. Where cable is used above accessible ceilings, provide tie-wraps and supports (Thomas & Betts #TYV525M, or approved equal).

F. Receptacle Plate Connectors:

- 1. Unless otherwise detailed herein, use the following types of panel receptacles on *connection boxes, panels, plates, and wireways*:
 - a. Audio (microphone): Neutrik XLR-3 (female) type.
 - b. Audio input/output (line level): Neutrik 1/4-inch diameter tip/ring/sleeve type. Insulate from panel.
 - c. Audio (loudspeaker level): Neutrik NL4MP.
 - d. Intercom: Neutrik XLR-3 (male) type.
 - e. Audio input (line level): Neutrik RCA

- 2. Receptacle Plate Designation: Clearly engrave wall mounted receptacle plates with alphanumeric identification of input type

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(i.e., mic, line, loudspeaker, etc) and corresponding audio patch field designation.

G. Grounding Procedures: In order to minimize problems resulting from improper grounding, and to achieve maximum signal-to-noise ratios, adhere to the following grounding procedures:

1. General: Because of the great number of possible variations in grounding systems, follow good engineering practice, as outlined above, and deviate from these practices only when necessary to minimize crosstalk and to maximize signal-to-noise ratios in the audio, and control systems.
2. System Grounds: Establish a single primary "system ground" for the systems in each particular area. Connect grounding conductors in that area to this primary system ground. Provide the system ground in the audio equipment rack for the area. The ground shall consist of a copper bar of sufficient size to accommodate secondary ground conductors.
3. Rack Ground: Connect the No.2 insulated copper wire connected to the earth ground to the primary system ground busbar in the Equipment Rack.
 - a. Bond a No.12 TW stranded wire from the Equipment Rack frame to the primary system ground bus bar.
4. Equipment Grounds: Grounding methods used will be dependent upon individual equipment interconnection of chassis ground, circuit common, and power supply common within the units. Provide ground method for equipment types as follows:
 - a. Equipment having a 3-wire power cord with green wire of the power cord connected to chassis (Signal common is not internally connected to chassis): Make no connection from chassis ground to primary systems ground busbar in Equipment Rack.
 - b. Equipment having a 3-wire power cord with green wire of the power cord connected to chassis: Make no connection from chassis ground to primary system busbar, but do make connection with 14AWG insulated

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wire from circuit common to primary system ground busbar in Equipment Rack. Separate circuit common from chassis ground.

- c. Equipment having a 2-wire power cord, no green wire, neutral is not tied to chassis, and circuit common is tied to chassis: Make connection from chassis to primary system ground busbar using 14AWG insulated wire.
5. Audio Cable Shields: Ground audio cable shields at one point only. There are no exceptions. For inter- and intra-rack wiring connect the shield at one end only. For ungrounded portable equipment, such as microphones, connect the shield at both ends but grounded at only one end.

3.3 FIELD QUALITY CONTROL

- A. Tests and Measurements: Before final acceptance tests are scheduled, perform system checkout, including tuning, balance, adjustment, and equalization. Furnish required test equipment and perform work necessary to determine and/or modify performance of the system to meet the requirements of this specification. Include the following:
1. Test audio, RF, and remote control systems for compliance with the functional requirements and Performance Standards.
 2. Adjust, balance, and align equipment for optimum quality and to meet the manufacturer's published specifications including equalization, delays, and crossovers.
 3. Prepare and maintain documentation of performance tests, including numerical values of established equipment settings, for reference during the System Acceptance Tests. Submit final results prior to scheduling Final Acceptance Tests Manual.
 4. Install 1/8" diameter vinyl "map dots" as indicators for nominal operating positions of rotary, slider, or switch controls available for operator adjustment. Provide multiple indicators, adequately distinguished, for controls having more than one nominal operating position.

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5. Follow Electronic Industries Association Standards RS 219 and RS 160 in performing these tests.

B. Audio System:

1. Loudspeaker-Line Impedance: Measure the impedance at 250 Hz, 1 kHz, and 4 kHz and the resistance of each loudspeaker line leaving the sound equipment rack with the line disconnected from its normal driving source. For lines to full-range distributed loudspeaker systems, measure the magnitude of impedance at 1 kHz.
2. Hum and Noise Level:
 - a. Measure the hum and noise levels of the overall system for each line-level input channel.
 - b. Adjust gain controls for optimum signal-to-noise ratio so that full amplifier output will be achieved with 0 dBm at a line-level input.
 - c. Terminate line-level inputs with shielded resistors of 150 and 600 ohms, respectively, for these measurements.
 - d. Disconnect the loudspeaker lines and terminate the power-amplifier outputs with power resistors for these measurements. The value of the load resistor shall be within 5% of the nominal load impedance of the amplifier under test. The power rating of the resistor shall equal the power rating of the amplifier.
3. Frequency Response of the System: Measure the frequency response using the audio systems as described in Part 1. Adjust gain controls and equalizers to provide the octave-band sound levels as specified.
4. Uniformity of Coverage: Measure octave band of pink noise test signal, centered at 4 kHz, played through loudspeaker system.

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5. Power-Output and Signal-Level Adjustment within System:

- a. Measure the electrical distortion of the overall system for each line-level input channel.
- b. Adjust gain control as for the tests specified herein.
- c. Apply a 1-kHz sine-wave signal from an oscillator having less than 0.5% total harmonic distortion at the input tested, at a level required to produce full amplifier output. Note that a pad with 150-ohm output impedance is required for driving the microphone-level input in accordance with the EIA standard.
- d. Use a distortion analyzer to measure the output level and the total harmonic distortion of the amplification and control equipment. In the absence of a distortion analyzer, a high input impedance, measuring device such as a DMM may be used to measure the output level. Lack of clipping or apparent deformation of a sine-wave input signal at the power-amplifier output, as seen on the oscilloscope, may serve as evidence that distortion of amplification and control equipment is within acceptable limits.
- e. Make measurements with loads actually incurred in the system operation. Power-amplifier loads shall be power resistors equal to the nominal load impedance of the output terminals used in the system.

6. Loudspeaker Polarity:

- a. Perform polarity checks of loudspeaker lines by means of a polarity tester or use DC source at one end of each line and a voltmeter at the other end. Loudspeaker lines shall be identically polarized with respect to color-coding.
- b. Test polarity of the loudspeakers using a sine-wave test signal warbled about 500 Hz. The listener shall be located on axis of the loudspeaker. Switch the loudspeakers from nominally in polarity to nominally out of polarity with respect to the selected loudspeaker. With the loudspeakers in proper polarity, the quality and clarity of the music or speech should be

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greater, and the warble test signal should clearly come to the surrounding space from the loudspeaker.

7. Freedom from Parasitic Oscillation and Radio-Frequency Pickup:
 - a. With systems set up for each mode of operation specified in the functional requirements, check to ensure that systems are free from spurious oscillation and radio-frequency pickup, in the absence of audio input signal and when the system is driven to full output at 100 Hz.
 - b. Employ an oscilloscope having at least a 50 MHZ bandwidth for these checks.
 - c. Apply slow sine-wave sweep from 50 Hz to 5 kHz at a level of 6 dB below rated power-amplifier output voltage to each system. Listen carefully for buzzes, rattles and objectionable distortion.
 - d. Correct causes of these defects unless the cause is clearly from other than the sound amplification system's equipment and installation, in which case bring the cause to the attention of the General Contractor.

8. Audio Test Signal Paths: Verify operation from source inputs (for microphones, audio tape units, tape units, etc.) through audio distribution amplifiers, mixers, switchers, etc., to signal destinations.

3.4 OWNER TRAINING

- A. Provide on-the-job training by a suitably qualified instructor, to designated personnel, to instruct them in the operation and maintenance of the systems.

- B. Arrange with the equipment manufacturer for such instruction, at no additional cost, in the event qualified instructors are not available on staff for certain sophisticated equipment.

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- C. Schedule the first training after the systems are operational. Provide a minimum of (3) 2-hour training sessions (6 hours of training total) on the systems included in this specification.
- D. Provide a video recording of the training sessions to the Owner for their future use in describing the operation of the system.

3.5 SYSTEM ACCEPTANCE TESTS

- A. System acceptance tests shall not be performed until the contractor's system checkout and testing and tuning report have been completed by the Contractor. The system acceptance tests consist of the following:
 - 1. Take a physical inventory of equipment on site and compare to equipment lists in the contract documents.
 - 2. Demonstrate the operation of system equipment.
 - 3. Both subjective and objective tests will be required to determine compliance with the specifications. Provide test equipment specified for these tests.
- B. Provide final, "as-built" drawings and run sheets in both electronic and paper format. Provide manuals, and other required documents in electronic format, as detailed in Submittal 2, in Part 1 of this specification.
- C. In the event further adjustment is required, or defective equipment must be repaired or replaced, tests may be suspended or continued at the option of the Owner.
- D. If the need for further adjustments becomes evident during the demonstration and testing, continue work until the installation operates properly. Included in the continued work shall include, but not be limited to, changes to or installation of resistive pads, readjustment of loudspeaker aiming, adjustment of system equalizers, programming changes to the control system, if these adjustments are required.

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- E. If acceptance of the system is delayed because of defective equipment or because the equipment does not fulfill this specification, reimburse the Owner for time and expenses for these tests during extensions of the acceptance-testing period.

3.6 CLEANUP AND REPAIR

Upon completion of the work, remove refuse and rubbish from and about the premises, and shall leave the relevant areas and equipment clean and in an operational state. Repair damage caused to the premises by the installation activities, at no cost to the Owner.

3.7 PROTECTION OF WORK

During the installation, and up to the date of final acceptance, protect finished and unfinished work against damage and loss. In the event of such damage or loss, replace or repair such work at no cost to the Owner.

END OF *SCOPE OF WORK* DOCUMENT