

SECTION 27 51 16

~~~ PROJECT NOTE ~~~~~

ARCHITECT OF RECORD/ENGINEER OF RECORD IS RESPONSIBLE FOR REVIEWING THIS SPECIFICATION SECTION IN DETAIL FOR COORDINATION WITH THE PROJECT SCOPE OF WORK.

ALL "PROJECT NOTE" TEXT IS TO BE REMOVED FOLLOWING REVIEW OF THE CONTENT OF EACH NOTE BY THE ARCHITECT OF RECORD/ENGINEER OF RECORD.

EDIT THE DOCUMENT FOOTER TO INCLUDE THE PROJECT NAME AND NUMBER.

EDIT THE DOCUMENT HEADER TO INDICATE THE ARCHITECT OF RECORD PROJECT ISSUE" DATE. THE "CPS CONTROL" DATE SHOULD NOT BE EDITED.

ANY MODIFICATIONS TO THE TECHNICAL STANDARDS IN THIS SECTION - INCLUDING THE REMOVAL OR ADDITION OF MANUFACTURERS - MUST BE APPROVED BY CPS.

REQUESTS FOR MODIFICATION ARE TO BE SUBMITTED TO THE DESIGN MANAGER DURING THE DESIGN PHASE FOR REVIEW AND APPROVAL.

~~~ END OF PROJECT NOTE ~~~~~

PUBLIC ADDRESS SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Amplifier and control equipment.
- B. Input equipment.
- C. Reproducer equipment.
- D. Sound system cable.
- E. Accessories.

1.02 DEFINITIONS

- A. Refer to Section 27 05 03 - Communications General Requirements for definitions.

1.03 REFERENCE STANDARDS

- A. City of Chicago Building Code - Municipal Code of Chicago for the Building Industry; 2017.
- B. City of Chicago Electrical Code - National Electrical Code with Chicago Amendments; 2017.
- C. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination
 - 1. Coordinate layout and installation of system components and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.05 SUBMITTALS

- A. Shop Drawings: Indicate electrical characteristics and connection requirements. Indicate layout of equipment mounted in racks and cabinets, component interconnecting wiring, and wiring diagrams of field wiring to speakers and remote input devices.
 - 1. Equipment Details: Detail equipment assemblies and indicate dimensions, weights, required clearances, method of field assembly, components, and location of each field connection.

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- 2. Console layouts.

3. Control panels.
 4. Rack arrangements.
 5. Wiring Diagrams: Power, signal, and control wiring. Include the following:
 - a. Identify terminals to facilitate installation, operation, and maintenance.
 - b. Single-line diagram showing interconnection of components.
 - c. Cabling diagram showing cable routing.
- B. Calculations: For sizing backup battery.

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RETAIN PARAGRAPH AND SUBPARAGRAPH BELOW IF DRAWINGS DO NOT INCLUDE DETAILED PLANS OR IF PROJECT INVOLVES UNUSUAL COORDINATION REQUIREMENTS.
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- C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

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1. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

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- D. Product Data: Provide data showing electrical characteristics and connection requirements for each component.
1. Preamplifiers.
 2. Power amplifiers.
 3. Transfer to standby amplifier.
 4. Microphone.
 5. Volume limiter/compressor.
 6. Control console.
 7. Telephone paging adapter.
 8. Tone generator.
 9. Equipment cabinet and rack.
 10. Monitor panel.
 11. Loudspeakers.
 12. Noise-operated gain controller.
 13. Microphone and headphone outlets.
 14. Battery backup power unit.
- E. Qualification Data: For Installer.
- F. Field quality-control test reports.
- G. Operation Data: Include instructions for adjusting, operating, and extending the system.
- H. Maintenance Data: Include repair procedures and spare parts documentation.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Authorized installer of specified manufacturer with service facilities within fifty (50) miles of Project.
 - 1. Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
 - 2. Installer must have been in business a minimum of five (5) years and have a minimum of five (5) similar installations.
- B. Source Limitations: Obtain public address and music equipment through a single source authorized by manufacturer to distribute each product.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in City of Chicago Electrical Code, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with City of Chicago Building Code.
- E. Comply with UL 50.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Do not install electronic components until major construction work in the area is complete. Do not install in areas where dust or moisture can contaminate the working parts or where finish can be marred by construction work.
- B. Stage materials in a secure area of the project site until installation. Materials and items shall be placed so that they are protected from damage and deterioration.

PART 2 PRODUCTS

2.01 SYSTEM DESIGN

- A. Public address system for voice and music.
- B. The system will provide for the amplified distribution of program material to the outlined speaker systems. Program origination will be from system sources and/or other sources outlined in this Section.
- C. The systems to be installed shall include the following:
 - 1. Main/Auxiliary Gymnasium Sound System - Capable of one common or three independent channels.
 - 2. Multipurpose Room Gymnasium Sound System - Capable of one common or three independent channels.
 - 3. Natatorium Sound System - Capable of one common or three independent channels.
 - 4. Cafeteria Sound System.

2.02 FUNCTIONAL DESCRIPTION OF SYSTEM

- A. System Functions: Include the following:
 - 1. Selectively connecting separate zones to different signal channels.
 - 2. Selectively amplifying sound among various microphone outlets and other inputs.
 - 3. Communicating simultaneously to all zones regardless of zone or channel switch settings.
 - 4. Reproducing high-quality sound that is free of noise and distortion at all loudspeakers at all times during equipment operation including standby mode with inputs off; and output free of non-uniform coverage of amplified sound.

2.03 EQUIPMENT AND MATERIALS

- A. Coordinate features to form an integrated system. Match components and interconnections for optimum performance of specified functions.
- B. Equipment: Modular type using solid-state components, fully rated for continuous duty, unless otherwise indicated. Select equipment for normal operation on input power usually supplied at 110 to 130 V, 60 Hz.
- C. Waterproof Equipment: Listed and labeled for duty outdoors or in damp locations.

2.04 AMPLIFICATION AND CONTROL EQUIPMENT

- A. Gymnasium, Multipurpose and Natatorium 3-Channel Local Sound System:
 - 1. Equipment Cabinets: Lowell L260 Series with key locking front doors and casters or Atlas equivalents.
 - 2. Master On-Off Panels: Rauland RDP Series Units or Lowell Equivalent.
 - 3. Mixers: Biamp Advantage One Units or TOA Equivalent (Provide 3).
 - 4. Amplifiers: QSC CS320V Power Amplifier (provide system with 3 channels and 1 spare backup channel of amplification).
 - 5. Distribution Amp/Router: Biamp DA28R - no substitutions.
 - 6. Equalization Panels: Sabine GRQ3100 Series Equalizers with feedback exterminator provide system with 3 channels of equalization - no substitutions.
 - 7. Control Modules: Provide the appropriate quantity and type module for each system input and include override electronics for central school intercom system priority.
 - 8. Surge Protection: Provide a Tripp Lite or Exide surge protector for each system.
 - 9. Cabinet Hardware: Provide matching filler panels for all unused spaces as well as engraved labels for each control and any hardware connectors, etc., for a complete and operating system.
- B. Cafeteria Local Sound System:
 - 1. Equipment Cabinets: Lowell L50 Series wall cabinet with key locking front door or Atlas equivalents.
 - 2. Master On-Off Panels: Rauland RDP Series Units or Lowell Equivalent.
 - 3. Mixers: TOA M900MK2 or Equivalent.
 - 4. Amplifiers: QSC CS320V Power Amplifier.
 - 5. Feedback Exterminator: Sabine FBX1020 Feedback Exterminator - no substitutions.
 - 6. Equalization Panel: Biamp mEQ301 System Equalizer.
 - 7. Control Modules: Provide the appropriate quantity and type module for each system input and include override electronics for central school intercom system priority.
 - 8. Surge Protection: Provide a Tripp Lite or Exide surge protector for each system.
 - 9. Cabinet Hardware: Provide matching filler panels for all unused spaces as well as engraved labels for each control and any hardware connectors, etc., for a complete and operating system.

2.05 PROGRAM SOURCES FOR EACH SYSTEM

- A. CD Unit: Marantz PMD 370 or Tascam Equivalent - rack mounted.
- B. Digital Tuner: Precision Electronics T-115 or TOA DT Series equivalent - rack mounted.

2.06 SPEAKER SYSTEMS

- A. Gymnasiums Speaker Systems: Community or Altec with custom face plates. Full range systems with recommended hanging hardware and institutional face plates. Provide TRC6D transformers on each speaker.
- B. Cafeteria Speaker Systems: Rauland USO216 with Rauland ACC1001 Grills and recessed Backboxes and Supports.
- C. Natatorium Speaker System: Underwater type speakers for in pool use. Marine/harsh environment type speakers for pool area. Full range system with recommended hanging hardware and institutional face plates. Provide transformers on speakers as required.

2.07 SYSTEMS WIRE AND CABLE

- A. Speaker Cable: West Penn 226 or a Belden equivalent.
- B. Microphone Cable: West Penn 291 or a Belden equivalent.

2.08 ACCESSORIES

- A. Provide the following system accessories to be used with the Gymnasiums, Natatorium, Multipurpose Room and Cafeteria Sound Systems:

1. Wired Microphones: Provide 3 - Rauland 1285 Dynamic Cardioid units with Phantom Power or Altec equivalents.
2. Microphone Cords: Provide 2 - 25 foot and 2 - 50 foot Horizon or Conquest microphone cords.
3. Microphone Stands: Provide 3 - Rauland-Borg 1122E Floor and 3 - Shure S37A Desk Stands.
4. Wireless Microphones: Provide 6 - Shure UT124/58 Clip-On and Handheld wireless microphone systems - no substitutes.
5. Remote Mixer: Provide 2 - Shure System 200 portable mixer and power supply or an Audio Technical equivalent.

2.09 PATHWAYS

- A. Conduit and Boxes: Comply with requirements in Sections 26 05 33.13 - Conduit for Electrical Systems, 26 05 33.16 - Boxes for Electrical Systems, and 26 05 33.23 - Surface Raceways for Electrical Systems. Flexible metal conduit shall not be used.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Wiring Method: Install wiring in raceways except within consoles, desks, and counters. Conceal raceways except in unfinished spaces.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess. Use lacing bars in cabinets.
- D. Control-Circuit Wiring: Install number and size of conductors as recommended by system manufacturer for control functions indicated.
- E. Separation of Wires: Separate speaker-microphone, line-level, speaker-level, and power wiring runs. Install in separate raceways or, where exposed or in same enclosure, separate conductors at least 12 inches - for speaker microphones and adjacent parallel power and telephone wiring. Separate other intercommunication equipment conductors as recommended by equipment manufacturer.
- F. Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
- G. Match input and output impedances and signal levels at signal interfaces. Provide matching networks where required.
- H. Identification of Conductors and Cables: Color-code conductors and apply wire and cable marking tape to designate wires and cables so they identify media in coordination with system wiring diagrams.
- I. Wall-Mounting Outlets: Flush mounted.
- J. Floor-Mounting Outlets: Conceal in floor and install cable nozzles through outlet covers. Secure outlet covers in place. Trim with carpet in carpeted areas.
- K. Conductor Sizing: Unless otherwise indicated, size speaker circuit conductors from racks to loudspeaker outlets not smaller than No. 18 AWG and conductors from microphone receptacles to amplifiers not smaller than No. 22 AWG.
- L. Weatherproof Equipment: For units that are mounted outdoors, in damp locations, or where exposed to weather, install consistent with requirements of weatherproof rating.
- M. Speaker-Line Matching Transformer Connections: Make initial connections using tap settings indicated on Drawings.
- N. Connect wiring according to Section 26 27 26 - Wiring Devices.
- O. Make cable shields continuous at splices and connect speaker circuit shield to equipment ground only at amplifier.

- P. Support cables above accessible ceilings to keep them from resting on ceiling tiles. Use spring metal clips or plastic cable ties to support cables from structure for ceiling suspension system. Include bridle rings or drive rings.
- Q. Use suitable cable fittings and connectors.
- R. Connect reproducers to amplifier with matching transformers.
- S. Ground and bond equipment and circuits in accordance with Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 1. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
 - a. Do not ground microphone line shields, except at microphone frame and at console input connectors.
 - b. Ground other shields of two-conductor cables only at one (1) end, as appropriate. Terminate "floating" ends with wedge-on collars, plastic tape, or heat-shrinkable tubing.
 - c. Maintain continuity of shields at all connecting points.
 - 2. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding. Connect all audio grounds in an equipment rack to a common point.

3.02 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Schedule tests with at least seven days' advance notice of test performance.
 - 2. After installing public address and music equipment and after electrical circuitry has been energized, test for compliance with requirements.
 - 3. Operational Test: Perform tests that include originating program and page messages at microphone outlets, preamplifier program inputs, and other inputs. Verify proper routing and volume levels and that system is free of noise and distortion.
 - 4. Signal-to-Noise Ratio Test: Measure signal-to-noise ratio of complete system at normal gain settings as follows:
 - a. Disconnect microphone at connector or jack closest to it and replace it in the circuit with a signal generator using a 1000-Hz signal. Replace all other microphones at corresponding connectors with dummy loads, each equal in impedance to microphone it replaces. Measure signal-to-noise ratio.
 - b. Repeat test for each separately controlled zone of loudspeakers.
 - c. Minimum acceptance ratio is 50 dB.
 - 5. Distortion Test: Measure distortion at normal gain settings and rated power. Feed signals at frequencies of 50, 200, 400, 1000, 3000, 8000, and 12,000 Hz into each preamplifier channel. For each frequency, measure distortion in the paging and all-call amplifier outputs. Maximum acceptable distortion at any frequency is 3 percent total harmonics.
 - 6. Acoustic Coverage Test: Feed pink noise into system using octaves centered at 500 and 4000 Hz. Use sound-level meter with octave-band filters to measure level at five locations in each zone. For spaces with seated audiences, maximum permissible variation in level is plus or minus 2 dB. In addition, the levels between locations in the same zone and between locations in adjacent zones must not vary more than plus or minus 3 dB.
 - 7. Power Output Test: Measure electrical power output of each power amplifier at normal gain settings of 50, 1000, and 12,000 Hz. Maximum variation in power output at these frequencies must not exceed plus or minus 1 dB.
 - 8. Signal Ground Test: Measure and report ground resistance at public address equipment signal ground. Comply with testing requirements specified in Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Retesting: Correct deficiencies, revising tap settings of speaker-line matching transformers where necessary to optimize volume and uniformity of sound levels, and retest. Prepare a written record of tests.

- C. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified. Prepare a list of final tap settings of paging speaker-line matching transformers.

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DELETE THIS ARTICLE IF BOARD CONTRACTS SEPARATELY FOR THIS SERVICE. CONSIDER INCLUDING A PROVISION FOR SUBMITTING A CONTINUING MAINTENANCE AGREEMENT PROPOSAL.
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3.03 ADJUSTING

- A. On-Site Assistance: Engage a factory-authorized service representative to provide on-site assistance in adjusting sound levels, resetting transformer taps, and adjusting controls to meet occupancy conditions.
- B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose, without additional cost.

3.04 CLEANING

- A. On completion of installation inspect exposed finishes. Remove burrs, dirt, paint spots, and construction debris. Repair damaged finish(es), including chips, scratches, and abrasions.
- B. All equipment, hardware and finishes shall be cleaned prior to final acceptance. Unless otherwise indicated, clean shall mean free of dust, dirt, mud, debris, oil, grease, residues, and contamination.
- C. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion. Protect conduit and wireway openings against the entrance of foreign matter by means of plugs or caps. Cover fixtures, materials, equipment and devices furnished or installed under this Section or otherwise protect against damage, both before and after installation. Hardware, materials, equipment, or devices damaged prior to final acceptance of the work shall be restored to their original condition or replaced.
- D. During the course of installation work, provide for on-going proper disposal of all debris, including but not limited to: equipment packaging and shipping materials, shipping pallets, empty cable reels/boxes, cable cuttings, etc. The Contractor shall, at all times, keep the site free from accumulations of waste material or rubbish caused by its employees or work. Remove all crates, cartons, and other waste materials or trash from the working areas at the end of each working day. Flammable waste material must be removed from the working areas at the time of generation. All rubbish and debris, combustible or not, shall be discarded in covered metal containers daily and removed from the premises at least weekly and legally disposed of.

3.05 CONTRACTOR STARTUP

- A. Startup Service: Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements. Complete installation and startup checks according to manufacturer's written instructions.

3.06 CLOSEOUT ACTIVITIES

- A. See Section 01 79 00 - Demonstration and Training, for additional requirements.
 - 1. Schedule training with at least seven days advanced notice.
- B. Demonstration: Demonstrate operation of system to Board's personnel.
 - 1. Use operation and maintenance data as reference during demonstration.
 - 2. Briefly describe function, operation, and maintenance of each component.
- C. Training: Train Board's personnel on operation and maintenance of system.

1. Train Board's maintenance personnel to adjust, operate, and maintain public address and music equipment.
2. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
3. Provide minimum of four hours of training.

END OF SECTION 27 51 16