

SECTION 27 31 17

PUBLIC ADDRESS SYSTEM

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Functional requirements of PA system
- B. Performance requirements of PA system

1.02 MEASUREMENT AND PAYMENT

- A. Measurement: Public address system will be measured for payment as a lump sum unit acceptably installed and tested for compliance.
- B. Payment: Public address system will be paid for at the Contract lump sum price for public address system or as part of the lump sum price for Communications Work, as determined by the lump sum measurement specified above, as indicated in the Bid Schedule of the Bid Form.

1.03 REFERENCES

- A. Acoustical Society of America
 - 1. S1 Standards on Acoustics
 - 2. S2 Standards on Mechanical Vibration and Shock
 - 3. S12 Standards on Noise
- B. American National Standards Institute (ANSI)
 - 1. ANSI S1.1 Acoustical Terminology
 - 2. ANSI S1.4 Specifications for Acoustical Level Meters
 - 3. ANSI S1.8 Preferred Reference Quantities of Acoustical Levels
 - 4. ANSI S1.13 Methods for the Measurement of Sound Pressure Level in Air
 - 5. ANSI S3.2 Standard for Measuring the Intelligibility of Speech over Communication Systems
- C. Bellcore:
 - 1. Pub 43720 Private Line Interconnection; Operational Features of Bell System Switch Terminations.
 - 2. Pub RFC 890007 Electrical Characteristics of Bell System Network Facilities at the Interface with Voiceband Ancillary and Data Equipment.

D. Electronic Industries Association (EIA):

1. RS-160 Sound Systems
2. RS-174 Audio Transformers for Electronic Equipment
3. RS-276 Acceptance Testing of Dynamic Loudspeakers
4. RS-278 Mounting Dimensions for Loudspeakers
5. RS-299 Loudspeakers, Dynamic, Magnetic Structures and Impedance
6. RS-426 Loudspeakers Power Rating, Full Range
7. RS-438 Test for Measuring Stiffness of Loudspeaker Spiders
8. RS-446 Detail Specification - Illuminated and Non-Illuminated Pushbutton Switches
9. RS-490 Standard Test Methods of Measurement for Audio Amplifiers
10. SE-101 Amplifiers for Sound Equipment
11. SE-103 Speakers for Sound Equipment
12. SE-104 Engineering Specifications for Amplifiers for Sound Equipment
13. SE-105 Microphones for Sound Equipment

E. Rural Electrification Administration (REA):

1. REA Form 528 General Specification For Private Automatic Branch Exchanges, Sections "a" through "e"
2. REA Telephone Engineering and Construction Manual (TE & CM)

F. National Fire Protection Agency (NFPA):

1. NFPA 72 Standard for the Installation, Maintenance and use of Protective Signaling Systems

G. California Occupational Safety and Health Standards (Cal OSHA)

1.04 SYSTEM DESCRIPTION

- A. Furnish a PA system in the passenger station for public information announcements.
- B. Provide all interfaces with other systems in the station and in the BART operating system, as specified and indicated, to provide a completely integrated operating system.

1.05 DESIGN WORK

- A. An acoustical modeling and test measurements shall be performed to verify conformance of the PA system design as indicated in ANSI S3.2 for intelligibility of speech and voice announcement requirements for a minimum Articulation Index of 0.80.
- B. The modeling shall include recommended locations and number of additional speakers necessary for the PA system to achieve an average of 80 dBA plus or minus 3 dB at 5 feet above floor levels in accordance with ANSI S1.8 and S1.13. The background ambient noise level of 60 dBA shall be used to calculate the nominal sound pressure level in accordance with ANSI S1.13

1.06 SUBMITTALS

- A. General: Refer to Section 01 33 00 - Submittal Procedures, and Section 01 33 23 - Shop Drawings, Product Data, and Samples, for submittal requirements and procedures.
- B. Submit the following:
 - 1. Complete functional diagram of the PA system.
 - 2. Speaker circuit impedance calculations and expected individual speaker output variation as a function of impedance. Include verification of wiring for supervision in trouble and alarm conditions.
 - 3. Equipment power consumption calculations for overall PA system. Calculations shall be performed for 3 Sound Pressure Levels (SPL): 0 dBA SPL at 4 feet from speaker center line; 80 dBA SPL at 4 feet from speaker centerline; and 94 dBA SPL at 4 feet from speaker center line.
 - 4. SPL coverage calculation, acoustical modeling and performance test results for the station platform, concourse, and mezzanine levels. Coverage calculations shall be performed at 5 feet above platform, mezzanine, or concourse floor levels. Speaker outputs shall be at 80 dBA SPL at 4 feet from speaker center line.
 - 5. Cabling, grounding, and shielding scheme in equipment cabinets.
 - 6. Description of the purpose and function of proposed test and diagnostic equipment, and procedures for programming the voice and tone synthesizer for pre-recorded messages.

PART 2 - PRODUCTS

2.01 FUNCTIONAL REQUIREMENTS

- A. General: The PA System shall be designed in accordance with ASA Standard Document Series S1, S2, and S12, and the following requirements:
 - 1. Overall system harmonic distortion when measured at the speaker output shall be a maximum of 3 percent over the frequency range of 250 Hz to 5000 Hz.

2. Speaker circuits shall be supervised.
- B. Announcement Zones: The PA system shall be divided into zones as indicated in the Contract Drawings, and announcements shall be directed to these zones as follows:
1. The PABX telephone in the Station Agent's Booth shall have the capability to announce to any single zone or all zones.
 2. Manual announcements made from any location other than those from the Station Agent's Booth shall be broadcast on all zones.
 3. Automatic messages shall be announced on all zones.
- C. Manual and Automatic Voice Announcements: The PA system shall be able to broadcast manual and automatic voice or tone announcements, as follows:
1. Manual voice announcements shall be allowed through the PABX System using the PABX telephone sets in the following locations:
 - a. Station Agent's Booth.
 - b. Platform areas with the exception of those at the end-of-platforms.
 - c. Emergency Management Panel Room.
 - d. Central Control. Equipment required in Central Control to carry out the announcements are not part of Contract.
 2. Automatic voice and tone announcements shall be allowed from the following locations or subsystem:
 - a. Activation of the Fire Alarm manual pull box located as indicated shall initiate a one-time automatic announcement. The announcement shall state "All station escalators will stop within 90 seconds." The announcement shall be repeated in Spanish.
 - b. Unanswered phone calls or unsuppressed alarms at the Station Agent's Booth shall initiate a series of code calls in the form of chiming sounds. Chimes shall be initiated after 15 seconds of ringing for an unanswered call, instantly for call waiting, and 15 seconds of any alarm. Chimes shall repeat every 15 seconds. Chimes for unanswered phone calls shall be suppressed by answering the call from the Station Agent's Booth. Chimes for call waiting shall be suppressed by terminating call in progress and answering the call waiting. Chimes for both unanswered and call waiting shall also be suppressed from any station phone with call pick-up capability. Alarms shall be suppressed by an acknowledge button that shall be provided in the PA Control Panel. The frequency spectra, duration and attack, and reset times of chimes shall be subject to approval by the District. The type of chimes shall be as follows:
 - 1) Courtesy phone call, two chimes
 - 2) PABX phone call, three chimes

- 3) Station Agents Booth annunciator panel alarm, four chimes
 - c. The Station Network Terminal (SNT) system will generate an analog voice message for announcing train destinations and other messages. The PA system shall send a signal to the FTC system when the PA system is in use to synchronize announcement of train destinations with other announcements.
- D. A Station Agent's select panel shall be furnished to allow selection of pre-recorded voice and tone messages for broadcast over the PA system. Messages can be one-time or continuous, with combined voice and tones.
- E. The PA system shall transmit a signal to Central Control when any individual station PA location is making an announcement.
- F. Announcement shall be prioritized in using the PA system in the order listed below. Any announcement shall be pre-empted by an announcement of higher priority. Pre-empted automatic announcements shall resume after a higher priority announcement is completed.
 1. Emergency Management Panel Room PABX telephone
 2. Fire Alarm
 3. Code Calls
 - a. Annunciator Panel Alarm
 - b. Courtesy Phone Call
 - c. PABX Phone Call
 4. Central Control
 5. Station Agent PABX telephone
 6. Platform PABX telephones
 7. Train Destination and other messages

2.02 PERFORMANCE REQUIREMENTS

- A. The PA equipment shall be of solid-state design, bearing the latest manufacturers model. The equipment shall be rack-mountable with balanced outputs and powered from 120 VAC.
- B. The PA system shall be designed in accordance with EIA SE-104 and the following requirements:
 1. Frequency Response: Plus or minus 3 dB over the frequency range of 30 Hz to 20 kHz, and plus or minus 1 dB or better over the frequency range of 250 Hz to 5000 Hz as measured from the Station Agent handset to the output of any speaker.

2. Total Harmonic Distortion (THD): Less than 1 percent over the frequency range of 30 Hz to 20 kHz measured at the output of any speaker.
 3. Operating Performance: Ambient temperature between 0 degrees C and 40 degrees C, and relative humidity of 5 percent to 95 percent.
 4. Headroom: \pm 20 dB above nominal SPL, without increase in hum, noise, total harmonic distortion, or frequency response.
 5. Hum and Noise: 80 dB below Nominal SPL.
 6. Power Capacity: 50 percent greater than power output at nominal SPL.
- C. The power amplifier shall be provided with a nameplate indicating power rating to satisfy design coverage, SPL requirements, and reserve capacity requirements. Power amplifiers shall conform to EIA SE-101 and to the following criteria:
1. Frequency response: 80 Hz to 20 kHz flat \pm 1 dB;
 2. Output: Constant 70.7 volts nominal, transformer isolated;
 3. Overload Protection: Current limited, thermal overload;
 4. Front Panel Controls: ON/OFF switch, volume control, fuse or circuit breaker (maintainable from front of unit);
 5. Front Panel Indications: LED ON/OFF indicator lamp;
 6. Listed for Protective Signaling Service; and
 7. Supervised in accordance with NFPA 72.
- D. Compressors shall be provided to compensate for the varying audio levels of sources utilizing the system.
- E. Mixer/preamplifiers shall be provided as needed that conform to the following requirements:
1. Inputs: Minimum of two spare inputs;
 2. Front Panel Controls: ON/OFF switch, level controls, line or mic; and
 3. Front Panel Indications: LED ON/OFF indicator lamp.
- F. An Automatic Level Control Unit (ALCU) shall be provided for automatic adjustment of announcement levels to speakers throughout the station. Sensing of the ambient noise on the platform and mezzanine levels shall be via separate microphones.

G. A voice and tone synthesizer shall be provided to conform to the following requirements:

1. Messages: Minimum of 30 voice messages with a 30 second maximum time limit per message;
2. Tones: Multi-frequency, constant or periodic;
3. Supervision: Provision for supervision or fault detection in accordance with NFPA 72;
4. Quality: Messages generated shall be from recording and storage of human voices; and
5. Message Storage: Messages shall be stored in solid-state memory devices.

H. Loudspeakers, Audio Transformers, Enclosures, and Baffles:

1. Loudspeakers shall conform to EIA SE-103, RS-299, and RS-426, and shall meet the following requirements:
 - a. Power: min. 10 watts continuous;
 - b. Weatherproof, corrosion and fire resistant;
 - c. Listed for Protective Signaling Service; and
 - d. Loudspeakers in the end-of-line supervisor's booth, station agent's booth, and the Emergency Management Panel Room shall be provided with volume control.
 - e. Frequency response shall be plus or minus 3 dB at the following frequencies:
 - 1) Cone-type loudspeakers: 50 Hz to 19 kHz
 - 2) Horn-type loudspeakers: 300 Hz to 12 kHz
2. Audio transformers shall be provided to conform with EIA RS-174 and to the following requirements:
 - a. Insertion loss: 0.5 dB max;
 - b. Distribution: Primary for nominal, tapped to meet SPL;
 - c. Power rating: 15 watts continuous; and
 - d. Listed for Protective Signaling Service.
3. Loudspeaker enclosures shall be corrosion resistant and lined with backing. Speaker enclosures shall be designed and constructed to suppress any resonances in the audio band of 80 Hz to 20 kHz. Loudspeaker enclosures shall be waterproof and fire resistant. Recessed or exposed enclosures can be either cylindrical or square. Square enclosures shall be used for mounting on roof or canopy structures. Cylindrical enclosures shall be used for speakers suspended under canopy roofs.

4. Baffles shall be vandal-proof, weatherproof, and corrosion and fire resistant.
- I. DC power supplies shall conform to the following requirements:
1. Regulation: ± 0.5 percent;
 2. Ripple: Less than 1 percent;
 3. Front Panel Controls: ON/OFF switch, circuit breaker;
 4. Front Panel Indicators: ON/OFF lamp; and
 5. 120 V ac Input: Operate at 105 V ac to 130 V ac, 60 Hz ± 5 Hz.
- J. Station Agent's Booth: The Station Agent's Booth shall be equipped with the following.
1. A PA control panel providing the functions listed below. In stations with more than one booth, each booth shall be provided with a control panel.
 - a. Pushbuttons including electronic circuits for zone announcements; one per zone, one for all-calls, and two for future zones. The pushbuttons shall latch and illuminate upon activation.
 - b. Pushbuttons including electronic circuits for control functions; one pushbutton to unlatch, one push button to silence code calls, and two spares.
 - c. Pushbuttons and lamps conforming to 16 mm IEC Style Pushbuttons per NEMA Type 13 and EIA RS-446.
 - d. Push pad for the select panel to activate pre-recorded messages from the Voice and Tone Synthesizer;
 - e. LED Lamps and Lamp Test for pushbuttons; and
 - f. PA busy lamp indicating zone activation.
 2. Loudspeaker: Mounted in the ceiling;
 3. Loudspeaker Volume Control: Adjustable from 60 dBA SPL;
- K. The supervisory equipment shall include the following requirements:
1. Output: Relay contact, one contact for any power amplifier, synthesizer or DC power supply fault.
 2. Front panel: Latched LED for each power amplifier, synthesizer or DC power supply fault. Reset pushbutton to clear latched LEDs.

- L. Loudspeaker cables shall be twisted single pair, foil-shielded. Cable size shall be such that system performance is not impaired. Minimum cable sizes shall be AWG No. 16 for runs less than 1000 feet; and AWG No. 14 for cable runs over 1000 feet.

PART 3 - EXECUTION

3.01 TESTING

- A. Factory and acceptance testing in accordance with EIA RS-276 and RS-490 shall be performed on the PA equipment.
- B. In addition, the following tests shall be performed on the PA systems:
 - 1. Test on coverage and intelligibility of voice announcements within the passenger station premises. Tests shall be conducted with announcements made from Central Control. The methods used for the measurement of sound pressure levels and intelligibility of speech and sound shall conform to the requirements of ANSI S1.13 and S3.2.
 - 2. System frequency response from handset to loudspeaker output and pre-amp to loudspeaker output at nominal SPL.
 - 3. Dispersion of loudspeakers between 80 Hz to 20 kHz.
 - 4. Cable isolation from shields and ground.

END OF SECTION 27 31 17