

SECTION 17800

PUBLIC ADDRESS SYSTEM

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Section includes requirements for a Public Address (PA) system for passenger stations as a subsystem of Caltrain station communications, and that will function as an extension of the existing public address system network. These requirements are for standard Caltrain stations (center island platform or outboard platforms). For other applications (i.e. areas beyond station platforms, maintenance facilities, tunnels, multiple platforms, etc.) refer to the corresponding project additional specific requirements.
- B. Coordinate and provide interfaces between the station Communications Equipment Room (CER) and the station PA subsystem. In absence of CER, some Caltrain stations may still utilize outdoor Station Communications Cabinets (SCC) also sometimes referred to as Communications Interface Cabinets (CIC). It is the intent to phase out the SCC's/CIC's and upgraded to CER's. For simplicity, the terms "SCC" and "CIC" are omitted. The term "CER" is used instead and it covers all types of station central Communications equipment implementation.

1.02 REFERENCE STANDARDS

- A. Electronics Industries Alliance (EIA):
 - 1. EIA 160 Sound Systems
 - 2. EIA-101 Amplifiers for Sound Equipment
- B. Sound Equipment (SE):
 - 1. SE-103 Speakers for Sound Equipment
 - 2. SE-104 Engineering Specifications for Amplifiers for Sound Equipment
- C. National Fire Protection Association (NFPA):
 - 1. NFPA 70 National Electrical Code (NEC)
- D. Local noise ordinances
- E. Building Industry Consultant Service International (BICSI):
 - 1. Telecommunications Distribution Methods Manual

1.03 SYSTEM DESCRIPTION

- A. The PA system shall be used to provide train destination information and emergency messages to passengers, employees, and emergency response personnel. Primary communication of announcements shall be from the assigned Central Operations to the station via existing leased T1 lines or privately owned carrier network. The new

PA system shall also provide the capability to broadcast locally generated announcements and remote dial-in telephone announcements by the Caltrain users. The new PA system shall be either a new PA system installation at the new Caltrain station or a replacement of the existing PA system at the existing station.

1. The primary objective of the PA System is delivery to the passengers adequate levels of intelligibility of PA announcements.
2. PA equipment shall include phone input processing circuits, power amplifiers, premixers / ambient noise compensators, speakers, local paging and ambient noise sensing microphones, cabling, conduit, and all other station oriented equipment defined in this Section and as shown on the Contract Drawings.
2. Unless otherwise indicated in the Contract Documents, the PA system equipment shall be located in the new Station Communication Equipment Room (CER) and on the Station Platform(s). This shall also include station conduit and cabling network associated with the PA wiring.
3. The PA system shall provide for remote monitoring of local PA dry-contact alarms via UPS digital I/O sensing and reporting these PA alarms to the CCF UPS Monitoring software (at later time, Caltrain may use such digital I/O alarms for reporting via future SCADA). The Station PA shall also support future remote monitoring of local PA alarms via TCP/IP protocol to the Caltrain SNMP Network Management System utilizing Network Management cards at the pre-mixer and amplifier equipment.
4. Support Engineer in testing the operation of PA system at the stations from Central Control Facility (CCF).
5. Use of any component or device, not expressly specified herein, that is required to implement the work, shall be subject to the Engineer's approval of required submittals.

1.04 DESIGN REQUIREMENTS

- A. General: Remote PA messages to the station shall originate from the CCF and from a dial-up line for the announcements over the phone by the Caltrain end users. At the station, the PA system shall announce these messages and, shall be capable of broadcasting locally generated announcements and messages.
- B. Public Address (PA): There shall be one PA zone per each station platform. Depending on the quantity of the station platforms, the station shall be divided into one (one-platform station) or two (two-platform station) PA announcement zones. Each PA zone shall be served by the associated 2-channel amplifier and ambient noise sensing microphone. Each zone PA volume shall be increased/decreased according to the noise level measured by the corresponding ambient noise level microphone. All station PA measurements shall be performed at 5 feet above the floor level. The new PA system shall provide for the following measurements (measured at 95% of the station platforms):
 1. The PA system shall provide intelligible output coverage at a levels 6 dB to 12 dB over measured ambient noise.

2. On station platforms the coverage shall be a uniform level of plus or minus 3 dB @ 1000 Hz Octave band.
 3. The speech intelligibility of the PA system announcements (measured in STI-PA female index) shall be minimum 0.6.
- C. Sound Level Adjustment: The PA system shall monitor the ambient sound level at the associated station area and automatically adjust the output level of the power amplifiers. The system shall also have the ability to automatically adjust the output of the system to meet day time and night time noise abatement requirements of local municipalities. It shall be programmed to filter out "clicking," "pitching" and any other unsettling sounds, which may occur during use of switches, push-to-talk buttons, rotation of volume controls and other potential similar origins. The PA system shall be programmed to eliminate positive feedback for all microphones used by the PA system. The system shall be programmed to implement timed hang-up function for any sources of PA announcements.
- D. CCF PA messages: Messages from CCF will be communicated via DS0 leased (fractional T1) or privately owned telephone lines utilizing E&M messaging. The PA System shall be ready for the future VOIP implementation of the Caltrain communications system and shall be capable of accepting remote PA messages from CCF in following formats: a phone line input from the future IP-to-Analog Phone Gateway and/or audio line output from the future Station Control Unit computer.
- E. Local PA messages: A push-to-talk microphone/handset shall be provided to enable the broadcast of local ad-hoc PA messages.
- F. Cell/Public/Private Phone Messages: The PA system shall have the ability to broadcast ad-hoc PA messages via a cell, public, or private phone. To mitigate concern of "prank calls" to this line, a phone access device shall be implemented programmed with access codes given by Caltrain. The PA System shall be ready for the future VOIP implementation of the Caltrain communications system and shall be capable of accepting remote PA messages from cell, public, or private phone passed through the future IP-to-Analog Phone Gateway as a phone line input.
- G. PA system shall implement message broadcast priority as follows: In-progress PA announcements shall be pre-empted according to the priority scheme defined below.
1. CCF PA: Top Priority
 2. Local PA via push-to-talk microphone/handset: Second Priority
 3. Cell/Public/Private Phone Messages: Third Priority
- H. PA system shall have the ability to monitor the speaker loading of each output channel to determine if any speaker wire disconnects, breaks, wire grounding, speaker faults, or other speaker circuit changes have occurred and transmit an alarm via output dry contacts when a change is detected. Wire these dry contact outputs to the local UPS sensing inputs for transmission of this alarm information to CCF UPS Monitoring Software. In the future, these alarms will be wired to the Caltrain future SCADA system. The PA System shall also support secondary means of communications and transmission of such alarm/event information via its Ethernet network interface cards for the future SNMP based monitoring and control over the Caltrain LAN.

- I. The CER UPS shall be programmed to monitor status of the PA System dry contact outputs wired to UPS inputs for reporting via the UPS networking cards such abnormal conditions to the existing Caltrain UPS APC Smart Monitoring system located at CCF. If necessary, the Contractor shall provide for data cabling interface between UPS networking cards and the station LAN.
- J. All digital processor/digital mixer parameters shall be backed up via FLASH ROM, and not requiring battery backup. System configurations shall be capable of being stored for recall from any system presets from the front panel control, switch closure, via manufactures application software running under Windows O/S or scheduled from the internal real-time clock/calendar. If communication between the host computer and the digital processor/ digital mixer is lost, the unit shall continue to function with the last commands received.
- K. The manufacturer's software for remote configuration, performance monitoring, and alarm monitoring shall be acquired and tested. All functions shall be tested at the station sites as current station LAN installations permit. The software shall be able to remotely interface with the PA hardware via Ethernet and be able to:
 - 1. Configure the mixer inputs, outputs, crossovers, and preset functions
 - 2. Control the power output amplifiers gain
 - 3. Be TCP/IP compliant to monitor equipment status via SNMP tools
 - 4. Be TCP/IP compliant to receive equipment alarms via SNMP tools
- L. Redundant Ethernet switch ports at the CER shall provision at least 100 Mbps for a separate PA Virtual Local Area Network (VLAN) to segregate the PA traffic from all others on the network.
- M. The station PA VLAN shall share the station LAN 1000 Mbps Ethernet backbone bandwidth with other station subsystems. The station LAN 1000 Mbps backbone will operate in a physical ring topology via the station single-mode fiber optic cable.
- N. For all locations where environmental control is not implemented, all equipment installed shall be treated as equipment exposed to the elements. The equipments' design, materials, installation, mounting, termination and coatings shall be implemented with appropriate protection against exposure to elements. This protection shall still accommodate requirements of good maintenance.

1.05 SUBMITTALS

- A. Refer to Sections 16000, Basic Electrical Requirements, and 17000, Basic Technical Requirements, for related requirements and additional submittals.
- B. Design submittals: For each design level, include the following as a minimum:
 - 1. Product Data: For each type of equipment. Submit performance data and descriptions or samples of all products furnished under this Section.
 - 2. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, required clearances, method of field assembly, components, and location of each field connection. This shall include but not be limited to rack layouts and wiring diagrams, termination details, installation and

- demolition drawings with final equipment placement based on the findings in the field, installation details, design drawings depicting deviations from the bid documents.
3. Product Certificates: Signed by manufacturers of equipment certifying that products furnished comply with specified requirements.
 4. Installer Certificates: Signed by manufacturer certifying that installers or technicians are capable of complying with requirements.
 5. Manufacturer Certificates: Signed by manufacturers certifying that they comply with requirements.
 6. Design documentation depicting termination details and conduit/cablings/terminals labeling.
 7. If applicable, design documentation regarding the cutover process and phases for switching from the existing PAS to the new PAS. This should also include methods to reduce Caltrain downtime.
 8. Design documentation describing software and hardware configuration settings for all equipment affected by the project (including network, PA and UPS devices configs and alarm setup, etc.).
- C. Submit installation drawings no later than 14 days prior to installation of PA system.
- D. Testing: Submit, 30 days prior to system testing, Test Procedures and the description of the intended Test Equipment. The Test Procedures shall demonstrate how the new PA system meets each design requirement from the subpart 1.04 above.
- E. Test Results: Submit, within 15 days after conclusion of system testing, a report of final Test Procedures and the Results obtained from these tests.
- F. Qualifications: Submit resume showing installer qualifications.
- G. Maintenance Data: For equipment to include in training and maintenance manuals specified in General Provisions. Training shall include operation, maintenance and trouble shooting of the new PA System for the Caltrain.
- H. As-Built Documentation: Submit as-built documentation as specified in Section 17000, Basic Communications Technical Requirements, including all changes to approved Contract Drawings incorporated in the final installation, within 6 weeks after installation completion. The asbuilt documentation shall describe final equipment layout, installation details and the software configuration settings.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Demonstrate that the team members had previously worked on at least two successful projects of similar nature and similar hardware. Additionally, minimum three years experience installing and maintaining equipment required for this Section; and shall be an authorized representative of equipment manufacturer for both installation and maintenance of equipment required for this Section.

PART 2 – PRODUCTS

2.01 GENERAL

- A. For other materials and products, refer to Section 17000, Basic Communications Equipment, Materials, and Methods, and Section 17120, Communications Wires and Cables.

2.02 EQUIPMENT

- A. Unless superseded by the individual requirements stated herein, PA system electronic components shall conform to the following general requirements:
 - 1. Solid state design
 - 2. UL listed
 - 3. Latest manufacturer design
 - 4. Balanced outputs
 - 5. EIA 19-inch rack mountable
- B. Trumpet Type Loudspeakers shall conform to the following:
 - 1. Rated for outdoor use
 - 2. Throw: 60 feet
 - 3. Include mounting hardware for mounting to wood/metal poles and surface/ceiling mounting.
 - 4. Frequency Response Voice: 250-3,000 Hz
 - 5. Frequency Response Music: 140-20,000 Hz
 - 6. Dispersion Coverage: 120° H x 90° V
 - 7. Speakers shall be the Atlas Sound, model APX40TN or Engineer approved equal
 - 8. Color: Match the color of the attachment surface for wall mounted speakers, as approved by the Engineer
- C. Audio Output Power Amplifiers: Power amplifiers shall conform to the following:
 - 1. Configuration: The power amplifier shall be selected as one 2-channel amplifier per a platform. The power amplifier(s) shall be installed utilizing separate 'A' and 'B' channels. A platform shall configure 'A' and 'B' channels to alternating speakers on the same speaker poles. Amplifier input shall match the outputs of the Pre-Mixer/Pre-amplifier and accommodate its PA zone specific ambient noise compensator.
 - 2. Frequency Response: 50 Hz to 15 kHz ± 0.3 dB

3. Output Level: Constant 70.7 volts (nominal), transformer isolated
 4. Overload Protection: Output Current Limited, Thermal Overload
 5. Output Power: At least 25 percent greater than the required output power (10 dB above nominal) at station nominal sound pressure levels with a minimum of 600 Watts per channel.
 6. Harmonic Distortion: Maximum 0.5 percent from 30 Hz to 10 kHz
 7. All indicators and controls shall be accessible from the amplifier front panel
 8. Local serial access port following RS232 Data Communication specifications:
 - a. Baud Rate: Selectable to 19.2K, 38.4 K, 57.6 K, or 115.2 K BAUD
 - b. Data Format: Serial, binary, asynchronous; 1 start bit; 1 stop bit; 8 data bits; no parity to allow initial configuration input, configuration changes, and monitoring of system status.
 9. Have an Ethernet interface module, which allows for remote control, monitoring, and generation of alarms via 100Mbps Ethernet to monitor equipment status via SNMP tools or provide equal SNMP functionality.
 10. The Ethernet interface module shall be the Crown IQ-PIP-Lite or Engineer approved equal.
 11. EIA 19-inch rack mountable
 12. The amplifier shall be the Crown CTs1200 or Engineer approved equal.
- D. Pre-Amplifier/Pre-Mixer equipment:
1. The Pre-Amplifier/Pre-Mixer shall conform to the following:
 - a. Continuous adjustments from 1 second to 5 minutes for sampling of ambient noise conditions to provide a zero time delay for announcements.
 - b. Automatic adjustment range: 10 to 30 dB
 - c. Sense Channel: 250 Hz to 4 kHz +/- 1 dB
 - d. Expand or attack and release times: 3 to 25 seconds adjustable attack time and 15 to 120 seconds release time.
 - e. Support "BLU-LINK" capability to enable intercommunications with additional standalone rack-mount Pre-mixer expansion modules (BSS Audio, model BLU-BIB and/or BSS Audio, model BLU-BOB1 or approved equal) providing for expansion of Line/Mic inputs and outputs for the power amplifiers.
 - f. Support reporting of abnormal/alarm conditions via the dry output contacts.

- g. Provide for slots to accept:
 - i. Analog Input Modules, each providing for 4 line/mic inputs
 - ii. Hybrid Input Modules, each providing for 1 phone and 2 line/mic inputs
 - h. Provide for flexible software allowing for the following:
 - i. monitoring the ambient sound level at the associated station area and automatically adjust the output level of the power amplifiers
 - ii. ability to automatically adjust the output of the system to meet day time and night time noise abatement requirements of local municipalities
 - iii. filter "clicking," "pitching" and any other unsettling or undesirable sounds as specified in these specifications
 - iv. elimination of positive feedback for all stationary and mobile microphones used by the new PA system (if applicable)
 - v. capable of accepting flexible controls, switch and volume adjustment tools for various PA zones
 - vi. capable of implementation the contract specified priority scheme for various remote and local PA announcements
 - i. Contain an Ethernet interface module which allows for remote control and monitoring via 100 Mbs Ethernet and TCP/IP compliant to monitor equipment status via SNMP tools over the Caltrain LAN/WAN.
 - j. EIA 19-inch rack mountable
 - k. The pre-mixer/pre-amplifier shall be the BSS Audio, model BLU-160 or Engineer approved equal.
- E. Local Paging Microphone/Handsets shall conform to the following:
- 1. Possess the following features:
 - a. Designed for Outdoor applications
 - b. Physical design promotes noise canceling
 - c. Rugged
 - d. Push-to-talk switch
 - e. Low-Impedance, Dynamic microphone
 - 2. Frequency Response: 100 Hz to 5 kHz

3. If required, housed in outdoor, stainless steel, NEMA 4X Latching, Hinged Cover, Microphone Enclosure by Hoffman A606CHNFSS or Engineer approved equal. The assembly shall incorporate female/male XLR connector terminations allowing disconnect and removal of the microphone and its cord out of enclosure.
 3. The microphone shall be a Shure 577B or Engineer approved equal
- F. Ambient Noise Sensing Microphones shall be dynamic, omni-directional, and conform to the following:
1. Frequency Response: 80 – 10,000 Hz
 2. Low impedance, 150 ohms
 3. Output Level: -61 dB
 4. Weather resistant
 5. Capable of being "phantom" powered (depending on the application)
 6. The microphone shall be a Crown PZM11LLWRS1, a Bogen ANS500M (appropriately weather proofed), or Engineer approved equal.
- G. PA cables shall:
1. Conform to the requirements Caltrain Standard Specifications 17120, Communications Wires and Cables, or Division 16, Electrical Sections.
 2. The following models (or Engineer approved equals) are recommended:
 - a. Speaker 4-Conductor Cable 14AWG: Belden model 6102UE for indoor installations and Belden model 5102UP for outdoor installations.
 - b. Speaker 4-Conductor Cable 16AWG: Belden model 6202UE for indoor installations and Belden model 5202UP for outdoor installations.
 - c. Microphone 2-pair Shielded Cable 18AWG: Belden model 6341PC for indoor installations and 5341PT for outdoor installations.
- H. Protector Blocks:
1. Terminal Block Design: Protected terminal blocks shall be used for all copper cabling going to the outdoor equipment. All protector terminal blocks shall be assembled in manner, which allows for a 19 inch rack mount installation.
 2. Protection Terminal Blocks: Protection shall be provided by Bourns 125-EW with Mounting Studs or Engineer approved equal.

- I. AC Power Termination: Provide and install a disconnect switch assembly to terminate the incoming UPS AC power, and shall distribute power to the PA system components from this assembly.
- J. Terminal Blocks:
 - 1. Terminal block shall be provided and installed on the side panel for miscellaneous internal interconnections.
 - 2. Brass binding posts shall be embedded in high impact polyurethane base.
 - 3. Binding posts shall be equipped with two brass nuts and flat washers, sized to accept a minimum of two #12 AWG conductors.
- K. Phone Access Device:
 - 1. Furnish and install Telephone Line Powered Remote Access Device between the cell phone dial in line and the pre-mixer phone input. The device shall be installed in the existing telecom room and support the following features:
 - a. Programmable 6 digit security code
 - b. Two levels of access and programmable toll restriction
 - c. Answers on the first ring. Disconnects on CPC, time out or by dialing #7
 - d. Programmable 5 second to 50 minute call timer
 - e. Wall mountable
 - f. The Phone Access Device shall be a Viking, model RAD-1A or Engineer approved equal
- L. Miscellaneous Equipment: Furnish and install the miscellaneous equipment necessary to complete the PA system. This shall include junction boxes, surface conduit between station junction boxes and PA devices, as well as miscellaneous mounting hardware and devices.

2.03 FACTORY ACCEPTANCE TESTS

- A. Perform the tests based on the approved Test Procedures and Test Equipment. Demonstrate how the new PA system meets each design requirement of these specifications from the subpart 1.04 above. These tests shall include measurements of STI, coverage areas, sound pressure levels, input priorities implementation, noise filtering, feedback elimination, ambient noise sensing and automatic level control function, operation of the timed hang-up function, UPS/PA Alarm reporting, etc.
- B. All equipment circuitry shall be checked for accuracy against the Contract Drawings. Tests shall verify point to point wiring and tags for proper nomenclature and terminal location.
- C. All testing shall be witnessed, and, if successful, signed-off by the Contractor and the Engineer. If a test fails because of the Contractor improper execution, the Contractor shall fix and retest the failed or underperforming elements.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install equipment to comply with manufacturer’s written instructions, including taking measures to reduce noise, crosstalk, hum, and other audio quality issues.
- B. If required, dismantle and remove the existing PA equipment as per design submittals (including the cutover phasing sequence) approved by the Engineer.
- C. Install PA system as follows:
 - 1. All PA equipment at the station
 - 2. Ac power cable from station UPS power circuit breaker
 - 3. Signal and station ground cable connection from stub-up at base of cabinet to disconnect switch assembly and ground busses
 - 4. PA speakers and the Ambient Noise Sense microphone on the light standards and other structural members. Light standards used for speaker mounting must have an installed full-length divider to separate communication wiring from power wiring, or internal flex raceway for communication/PA wiring.
 - 5. Conduit required to cable speakers to local PA equipment as required
 - 6. PA cable from cabinet/rack to PA speakers, including necessary wiring and devices for noise sensing circuit(s)
 - 7. Connections to, and termination of, all incoming telephone communications circuits from the Main Point of Entry (MPOE) cabinet
 - 8. PA Equipment Network interfaces at Ethernet switches and PA digital I/O alarm wiring as required
 - 9. Two Speakers in single mounting locations shall have ‘A’ and ‘B’ audio channels connected to the alternating speakers
- D. Verify that all equipment is the appropriate model, properly installed and connected. The quality of the installation shall be demonstrated by tests for continuity, visual inspection and any other tests required by this Section.
- E. Have all communications conduits inspected and cleaned prior to cable installation. Conduits shall have a clean, smooth concentric interior surface
- F. Install PA cables in a separate conduit than those containing UTP data cable associated with other subsystems wherever possible.
- G. Crossover of cables shall be avoided when cables are pulled into conduits. Care shall be taken not to have the conductors pulled tight or twisted in conduit fittings or boxes. All cables to be installed in a single conduit shall be pulled simultaneously.
- H. Verify that all cables are properly routed, supported, terminated and labeled.

- I. Verify that all equipment is installed in its proper location in accordance with the Engineer approved design. Verify that all mechanical connections are made and secure.
- J. Wires and cables shall be continuous without splices between junction boxes, terminals, pull boxes, manholes and hand holes.
- K. Provide protective covering for installed speakers and amplifiers until construction is complete. Prevent operation of amplifiers when covered.
- L. Apply all IP addresses to the PA modules and Gateways as required by the Caltrain's network standards and assigned by Caltrain Network Manager and recorded in the network Domain Name Server.
- M. Configurations of the PA Mixer, Ambient Noise Compensator, and Output Amplifier shall be submitted electronically after final testing is completed.
- N. Refer to Section 17060, Grounding of Communications Equipment, for grounding requirements.

3.02 FIELD QUALITY CONTROL

- A. Perform the following field tests:
 - 1. Functional tests of equipment for inputs at nominal Sound Pressure Level and STI measurements using STI-PA Female tone generators.
 - 2. Correct phasing of all speakers
 - 3. Noise level sensing and automatic broadcast level compensation
 - 4. The functional tests shall fully exercise the system and determine functional compliance as follows:
 - a. Perform end-to-end tests for every control and indication point
 - b. Test all components and lines
 - 5. Operational Test: Perform tests that include originating program and page material at microphone outlets, amplifier program inputs, and other inputs. Verify proper routing and volume levels and freedom from noise and distortion.
 - a. Verify full functional communication between the assigned CCF and each of the existing stations
 - b. Verify all features are available at each of the Control Consoles and they work as specified with the station
 - c. Test and record the gain using a sound level meter at each speaker location and each mid-point between speakers along the platform under normal operation. Acceptable gain levels are between 3-15 dB

6. Signal-to-Noise Ratio Test: Measure the ratio of signal-to-noise of complete system at normal gain settings, using the following procedure:
 - a. Disconnect a microphone at the connector or jack closest to it and replace it in the circuit with a signal generator using a 1,000-Hz signal. Replace all other microphones at corresponding connectors with dummy loads, each equal in impedance to microphone it replaces. Measure the ratio of signal to noise.
 - b. Repeat test for each separately controlled zone of loudspeakers
 - c. Minimum acceptance ratio is 50 dB
7. Acoustic Coverage Test: Feed STI-PA Female tone generator into the system to measure STI levels at five locations in each zone and establish the SPL level for each zone. In addition, the SPL levels between locations in the same zone and between locations in adjacent zones must not vary more than plus or minus 3 dB.
8. Alarm testing of the speaker circuit loads: Disconnect the speakers at several points along each separate channel to insure that alarms levels are appropriately set and that alarms are sent by the equipment via the Ethernet interface and UPS Alarm Reporting.
9. Demonstrate the operation of programmed Day/Night time output level adjustment and input signal priorities.
10. Demonstrate the continued operation of the PA system during outside power outage.
11. STI Testing shall demonstrate the installed PA system outputs' intelligibility as per the design.
12. Support Caltrain's staff in testing announcements initiated by the CCF.
13. Retesting: Correct deficiencies, where necessary to optimize volume and uniformity of sound levels, and retest.
14. Schedule all tests with at least seven days advance notice to Engineer.

END OF SECTION