

10 PUBLIC ADDRESS AND VOICE ALARM SYSTEM

10.1.1 Overview

10.1.1.1 A combined Public Address and Voice Alarm (PAVA) system is required to be provided throughout the public realm area of Castlefield Viaduct, in accordance with the fire strategy – refer to the Arup fire strategy documentation for further information.

10.1.1.2 The PAVA system is a contractor design portion – refer to the Technical Introduction for details. The Contractor shall undertake detailed design of the PAVA system and shall hold full design responsibility for the complete system, including final electroacoustic performance and the interface with the Fire Detection and Alarm system. The responsibility of the Contractor shall include the final electroacoustic design including the type, number, location, orientation and power of loudspeakers.

10.1.1.3 The Contractor shall include for the design, procurement, supply to site, off-loading, storage, coordination, erection, installation, connection, setting-to-work, testing, commissioning, demonstration and hand over to the Client of all necessary equipment, materials, accessories, controls, cabling and other items comprising complete, safe and functionally efficient installations.

10.1.1.4 The Contractor shall demonstrate the system and provide instruction to the client's operating staff and to Building Control after the PAVA system has been installed, fully tested and commissioned.

10.1.1.5 The work in this Contract shall include the whole of the labour and all materials necessary to form a complete, fully operational installation and all tests, adjustments and commissioning as prescribed in this performance specification, other related documents as may otherwise be required to give an effective working installation to the satisfaction of the Employer's Representative.

10.1.2 System outline

10.1.2.1 The PAVA system shall be interfaced with the viaduct fire detection and alarm system – refer to the schematic drawings for details.

- 10.1.2.2** Operation of the PAVA system shall be consistent with the fire safety strategy and evacuation plan – refer to the fire strategy documentation for further information.
- 10.1.2.3** The primary function of the system shall be to provide secure, fail-safe and high intelligibility emergency speech broadcast to all areas.
- 10.1.2.4** The foregoing summary is intended for general guidance only, to assist in the preparation of a detailed design, and no omission from this description shall relieve the Contractor from his obligations to carry out the whole of the works hereinafter described.

10.1.3 Performance requirements

- 10.1.3.1** The system shall provide a Speech Transmission Index (STI), as described in BS EN 60268-16:2011, of ≥ 0.50 STI average across all measurement points with a corresponding average minus one standard deviation of ≥ 0.45 .
- 10.1.3.2** The system shall achieve the above STI values with an overall signal to noise ratio ≥ 10 dBLA (and ≥ 10 dB in each of the 500Hz, 1kHz and 2kHz frequency octave bands).
- 10.1.3.3** The Contractor shall conduct an ambient typical operating level survey and design a PAVA system that shall deliver intelligible voice messages from the emergency microphones and emergency pre-recorded message units 5 dBLAeq above the measured ambient operating level.
- 10.1.3.4** The Contractor shall select appropriate EN 54 compliant PAVA speakers to meet the requirements of the system.
- 10.1.3.5** Loudspeaker cables shall be selected and sized to ensure ≤ 1 dB power loss, assuming an additional future power load of at least +10% on each circuit.
- 10.1.3.6** The average (rms) sound levels of attention drawing signals preceding emergency message speech shall be 0 dBLA to +3 dBLA of the average sound level of the speech.
- 10.1.3.7** Voice reproduction shall be of a good quality and natural sounding except for areas covered by re-entrant horn loudspeakers. Switching shall be inaudible and the system shall be free from audible distortion, hum and noise.
- 10.1.3.8** All primary user and automatic actions, i.e., use of microphone panels and fire panel commands, shall result in full and complete system response within 0.5s of the action.
- 10.1.3.9** The Contractor shall rectify any defect or shortcoming of the installed system which results in or contributes to a failure to meet

any of the above performance requirements, and which is attributable to the Contractor.

10.1.4 Functional requirements

10.1.4.1 The system shall provide the following functional facilities:

- Interface(s) to the Fire Detection and Alarm System based on final number of evacuation zones and staged alarm requirements.
- Automated initiation of pre-recorded emergency speech broadcast to selectable areas triggered by the Fire Detection System.
- Manual initiation of pre-recorded emergency speech broadcast to selectable areas.
- Live emergency speech broadcast to selectable areas.
- Fault monitoring, indication / reporting / logging including reporting back to the Fire Detection and Alarm System.
- Back-up power and resilient systems (avoiding single points of failure), with adequate redundancy.
- Public address message broadcast to selectable zones.

10.1.4.2 The system security and resilience features shall include:

- Fire rated cabling and equipment rooms.
- Diverse cable routing, equipment and appropriate containment.
- Interleaved loudspeaker circuits as required by BS 5839-8.
- Prioritisation of emergency broadcasts over non-emergency inputs.
- Loudspeaker and loudspeaker line monitoring.
- Critical signal path monitoring (fault monitoring of all critical components including microphones, emergency digital message stores, amplifiers and routing and control equipment) with local alarms and reporting to the Fire Detection and Alarm System.
- Redundant / spare amplifier capacity.
- Component identification and labelling, including red colour coding where appropriate.
- Clear operator instructions for emergency use.
- Standby/back-up power supply systems.

10.1.4.3 The system shall consist of the following elements:

- Emergency microphones and control panels for live emergency speech broadcast and selection of evacuate, alert and coded messages.
- Digital message units containing pre-recorded speech.
- Public address messaging microphone and control panel/touch screen for non-emergency speech broadcast, and audio relay

selection – refer to drawings included in the appendices for proposed locations.

- Distributed equipment racks located within comms rooms or PAVA equipment rooms.
- Industry standard digital signal processing (DSP) system and dedicated system distribution network.
- Loudspeakers.
- Amplification.

10.1.4.4 PAVA amplifier racks are proposed to be provided within a dedicated cabinet within the Welcome Kiosk.

10.1.4.5 The PAVA system is provided with a dedicated 20A single phase supply routed directly from the National Trust Feeder Pillar in fire-rated cabling in to a lockable isolator. The Contractor shall be responsible for the final connections to the PAVA cabinets and associated battery backup / UPS to comply with the requirements of BS 5839-8.

10.1.4.6 The Contractor shall verify that the rooms allocated and the building services provided are adequate to suit the PAVA installation selected.

10.1.4.7 PAVA amplifier racks shall include electrical containment, lockable doors (keyed alive) and fan trays as required.

10.1.5 **Quality assurance**

10.1.5.1 Installations shall comply with all relevant statutory instruments and regulations current at the date of tender (unless specifically stated otherwise in this Performance Specification or on any drawing) and in particular with the following:

- BS 5839-8
- BS EN 60268-16.

10.1.5.2 Wherever possible, all products, systems and equipment shall be certified as compliant with the following standards unless this would lead to deficient electroacoustic performance such as sound pressure level, speech intelligibility etc.:

- BS EN 54-16
- BS EN 54-24.

10.1.5.3 Any deviations/variations from BS EN 5839-8 and the relevant BS EN 54 standards shall be brought to the attention of the Employer's Representative.

10.1.6 Coordination

- 10.1.6.1** The Contractor shall ensure that the installation is fully coordinated with all other services and building elements.
- 10.1.6.2** The Contractor shall coordinate layout and installation of system components with other mechanical and electrical systems.
- 10.1.6.3** The locations of loudspeakers, microphones, microphone control panels and other equipment are to be subject to such revision by the Employer's Representative as may be found necessary or desirable at the time the work is installed in order to meet field conditions or to coordinate with modular requirements of ceilings, or to simplify the work, or for other legitimate causes.
- 10.1.6.4** All equipment and systems shall be designed and installed such that there will be no effect of electromagnetic interference on the operation of the PAVA system.
- 10.1.6.5** The Contractor shall: establish grades and elevations and shall verify all dimensions and locations in the field prior to the start of any work and/or installation of equipment, containment and fixtures; adjust the location of containment, panels, equipment, pull boxes, fixtures, etc. to accommodate the work to prevent interferences, both anticipated and encountered and determine the exact route and location of each cable containment prior to fabrication.

10.1.7 Submittals

- 10.1.7.1** The Contractor shall submit the calculations and drawings and any other installation proposals to the Employer's Representative for comment and for any revisions arising out of such comments.
- 10.1.7.2** The Contractor shall submit the following technical information to the Employer's Representative for comment prior to the installation of any part of the PAVA system and for any revisions arising out of such comments.
- At the time of tender, a list of all proposed equipment items, with technical data sheets or other documentary evidence to show that each item will meet the requirements of this Performance Specification.
 - Loudspeaker layout drawings, demonstrating coordination with fixtures and fittings as necessary.
 - Schematic diagram showing interconnection of components.
 - Public address console layouts.
 - Statement of compliance with BS 5839-8 detailing any variations.

- Details of any minor deviations from this Performance Specification.

10.1.7.3 The Contractor shall supply the following technical information prior to the manufacture or delivery of any equipment:

- Drawings of the racks and panels as appropriate, e.g. auxiliary input panels, emergency microphone panels etc.
- Performance Specifications for all cables to be installed, together with full wiring drawings showing the route, protection, separation and termination requirements for each cable. Power supply requirements shall also be shown.
- A power amplifier schedule.

10.1.7.4 Operations and Maintenance manuals shall contain the following:

- A description of system operation (e.g. system priority and the use of input panels), routine care, maintenance and testing and simple fault-finding procedures.
- Settings record for all controls, including pre-amplifier, signal processing and amplifier settings.
- A schedule of loudspeaker tapings and a copy of plan layout drawings of the building showing the final sound level measurements.
- A full set of drawings, manufacturers' handbooks for all proprietary items, and a list of the spares provided.

10.1.7.5 A system layout drawing, framed or otherwise permanently mounted, shall be provided for installation adjacent system control equipment in the PAVA rack locations. The drawing shall show the coverage zones, main distribution routes and the locations of all system inputs and loudspeakers.

10.1.8 Testing

10.1.8.1 The Contractor shall carry out performance tests on the Contract works to demonstrate that the works meet the requirements of the Contract documents, in accordance with this Performance Specification. A method statement shall be provided to the Employer's Representative for approval at least 10 days before the performance tests are scheduled to commence. Upon successful completion of these tests, the Contractor shall carry out a full system demonstration for acceptance purposes.

10.1.8.2 The Contractor shall arrange for works inspection of the central equipment rack and remote panels. The Contractor shall advise the Employer's Representative when the equipment has been fully works tested and is ready for pre-delivery inspection. Temporary circuits shall be connected, as necessary, to enable complete

testing of all audio paths, zoning, priority switching and fault warning circuits.

10.1.8.3 The Contractor shall allow a minimum of 1 day for the acceptance demonstration, plus 1 day for instruction of operational staff.

10.1.8.4 The Contractor shall have available during the testing period the following electro-acoustic test equipment:

- Sound level meter and calibrator, complying with IEC 61672-1:2013 Type 1 or 2;
- 1/3 octave band spectrum analyser (minimum range 40Hz - 16kHz at ISO centre frequencies, display resolution increment 2 dB);
- Pink noise source (minimum bandwidth 20Hz - 20kHz, ± 0.5 dB);

10.1.8.5 The works inspection and performance testing shall include, but not necessarily be limited to:

- Objective speech intelligibility tests: STI or STIPA measurements;
- Sound level measurements, to ensure that the system sound levels for each input, meet the Performance Specification requirements;
- Subjective assessment of the electro-acoustic performance of the system, including judgements and comments on the intelligibility of speech in all other areas as agreed with the Employer's Representative;
- Full operational tests on the rack equipment and system inputs, including a complete check on input routing and priority;
- Test of interfaces to the fire detection system;
- Impedance of each loudspeaker line;
- Equalisation of the system in each acoustically distinguishable space;
- Electrical safety and earth checks (by a competent person, to be approved).

10.1.8.6 The results of the tests shall be presented to the Employer's Representative not more than 10 working days after the tests have been completed. Three copies of each test report shall be provided. A copy of the report, including any amendments, shall be included within the system manual. The report shall include:

- Test details - dates, times, test personnel (with qualifications as appropriate);
- Measured values of system performance in appropriate format for the parameter measured, e.g. marked-up drawings and tables showing electroacoustic performance and completed matrices proving correct priority and routing operation.

10.1.8.7 The objective speech intelligibility measurement procedure shall be as follows:

- Measurements of speech intelligibility shall be measured in accordance with the methodology for the STI method detailed in IEC 60268-16: 2011; using MLS, swept sine signal or STIPA signal.
- The number and location of measurement position shall be agreed in advance with the Employer's Representative.
- "Noiseless" and "With noise" results to be provided on site if a STIPA signal is used.
- Calculations in the final report shall be based upon the post processing inclusion of ambient noise, absolute threshold masking and spectrum, using measured ambient noise levels and measured sound operating levels on site.

10.1.8.8 The sound level measurement procedure shall be as follows:

- The sound level meter shall be calibrated immediately before commencing the measurements. The sound level meter shall be set to dBLA, slow ('S') response.
- Measurements shall be taken at 1.5m above floor level (1.2m above floor level in seating areas).
- The required sound level shall be set within one area (average of at least 3 measurement locations within each space) using a pre-recorded test message. A pink noise signal shall then be fed into the system via the test input, and the test input gain (not the amplifier gain or loudspeaker tapings) shall be adjusted to obtain the same level.
- The pink noise input gain setting shall be noted and used to set up the sound levels at all other locations. One zone shall be selected at a time to minimise disturbance.
- Measurement locations within each space shall be chosen to indicate the maximum range of sound levels.
- The sound levels measured using a dBLA sound level meter without an Leq facility shall be visual averages. When an Leq facility is available the sound level shall be measured over a 15 second period when measuring a pink noise signal.
- Measurement locations and corresponding sound levels shall be marked up on the loudspeaker layout drawings. The drawings shall also indicate the final tapping value of each loudspeaker or each set of similar loudspeakers.
- If the measured sound levels do not meet the required levels then adjustments shall be made to the pre-amplifiers, amplifiers and/or loudspeaker tapings. The documented levels shall be the measured levels after adjustment. Any areas where the required levels cannot be achieved shall be highlighted on the drawings.
- The pink noise test shall ensure that the relative sound levels between different areas are correctly set. Once this is completed

each system input needs to be set correctly. This shall only involve measurements at 2 locations and adjustment of the pre-amplifier setting of each system input.

- Each of the recorded messages stored within the system shall be broadcast and measured in turn. The sound levels of any pre-announcement tone and of the spoken message shall be measured and noted separately. The sound level shall be the dBLA visual average or Leq over the length of the pre-announcement tone or the spoken message. Adjustments shall be made to the pre-amplifier setting until the measured sound level of the spoken message meets the required sound level.

10.1.8.9 Upon successful completion of the tests the Contractor shall carry out a full system demonstration for acceptance purposes.

10.1.8.10 If required by the Employer's Representative (in the event of apparent non-compliance of the installed system with the Performance Specification), the Contractor shall provide precision test equipment for verification of voltage, impedance, power, frequency response, phase response, signal-to-noise ratio, total harmonic distortion and STI.

10.1.8.11 The PAVA system shall be considered defective if the outcome of the above tests and inspections do not comply with the requirements of this Performance Specification.