

TITLE : General Specification for Public Address Systems  
ISSUE NO. : 3  
DATE : July 2005  
APPROVED BY : SPE/4  
ENDORSED BY : PM

Amendment	Date	Authority

Issued by  
Project Division  
Electrical & Mechanical Services Department

COPYRIGHT

All rights including subsequent amendments are reserved. This general specification is intended for use on Government installations managed by the EMSD. Prior written consent by the Director of Electrical & Mechanical Services must be obtained for adoption of or extraction from this specification for other use.

## I N D E X

1. Scope
2. Description of System
3. Related Documents and Specification
  - 3.1 Reference to User/Design/Installation Specification
  - 3.2 Other National or International Standards
4. Detailed Design and Performance Specification
  - 4.1 Definition of Terms and Abbreviations
    - 4.1.1 Terminology
    - 4.1.2 Symbols and Abbreviations
    - 4.1.3 Measuring System
    - 4.1.4 Measuring Criteria
  - 4.2 Equipment Functional Requirements and Performance Characteristics
    - 4.2.1 Microphone
    - 4.2.2 Microphone Floor Stand and Boom Arm
    - 4.2.3 Microphone Desk Stand and Flexible Gooseneck Shaft
    - 4.2.4 Mixer-Power Amplifier
    - 4.2.5 Mixer-Preamplifier
    - 4.2.6 Power Amplifier
    - 4.2.7 Loudspeaker
    - 4.2.8 Speaker Selector
    - 4.2.9 Monitor Panel
    - 4.2.10 Relay Control Box
    - 4.2.11 Cassette Deck
    - 4.2.12 Compact Disc Player
    - 4.2.13 MiniDisc Player/Recorder
    - 4.2.14 Digital Audio Tape (DAT) Player/Recorder
    - 4.2.15 Equipment Cabinet
    - 4.2.16 Microphone Cable
    - 4.2.17 Loudspeaker Cable
    - 4.2.18 Power Cable
    - 4.2.19 Underground Loudspeaker Cable
    - 4.2.20 Conduit
    - 4.2.21 Connector and Accessories
  - 4.3 Installation Requirements
    - 4.3.1 General
    - 4.3.2 Equipment Fixing and Interconnection

- 4.3.3 Materials and Workmanship
- 4.3.4 Surface Wiring
- 4.3.5 Surface Conduit

## 1. Scope

- 1.1 This specification lays down the technical specification, functional features and performance characteristics of basic equipment items, quality of installation, materials used and standard of workmanship, which are required for the provision of a general public address system.
- 1.2 This specification should be read in conjunction with the “General Requirements for Electronic Contracts, ESG01” and the Particular Specification. Unless otherwise stated in the Particular Specification, the requirements laid down in this document shall apply to contracts/orders for the supply and installation of all public address or sound systems issued by the Electrical & Mechanical Services Department.

## 2. Description of System

- 2.1 A public address system shall basically comprise one or more microphones, mixer and/or power amplifiers, loudspeakers of various types to suit the local environment and other ancillary equipment such as control and monitoring panels etc.
- 2.2 Microphone inputs of different priority and groupings of loudspeakers to serve a number of zones may be required. Typical systems to be provided are those for speech reinforcement/background music in school halls; public waiting areas for clinics, hospitals and Government Offices; sports grounds, swimming pools etc. Detailed tailoring of individual system is given in the Particular Specification.

## 3. Related Documents and Specification

### 3.1 Reference to User/Design/Installation Specification

- (a) The latest edition of “General Requirements for Electronic Contracts, ESG01” issued by the Project Division, EMSD.
- (b) The latest edition of “General Specification for Electrical Installation in Government Buildings” issued by the Architectural Services Department of the Government of the Hong Kong Special Administrative Region.
- (c) The latest edition of IEC 60386:1972 or BS 4847:1989 “Method of Measurement of Speed Fluctuations in Sound Recording and Reproducing Equipment”.
- (d) The latest edition of IEC 60268-1:1985 or BS 6840-1:1987 “Sound System Equipment. Methods for Specifying and Measuring General Characteristics Used for Equipment Performance”.
- (e) The latest edition of IEC 60268-2:1987 or BS 6840-2:1993 “Sound System Equipment. Glossary of General Terms and Calculation Methods”.

- (f) The latest edition of EIA-160 Sound Systems.
- (g) The latest edition of EIA/CEA-490 Standard Test Methods of Measurement for Audio Amplifiers.
- (h) The latest edition of EIA-27A Acceptance Testing of Dynamic Loudspeakers.

### 3.2 Other National or International Standards

Equipment complying with other national and international standards may be offered. Tenderers shall demonstrate clearly the factors of technical superiority or other aspects as reviewed by these standards.

## 4. Detailed Design & Performance Specification

### 4.1 Definition of Terms and Abbreviations

#### 4.1.1 Terminology

Not applicable.

#### 4.1.2 Symbols and Abbreviations

- (a) “BS” means British Standards
- (b) “EIA” means Electronic Industries Alliance of USA
- (c) “IEC” means International Electrotechnical Commission
- (d) “r.m.s.” means root mean square
- (e) “LED” means light emitting diode
- (f) “EMSD” means Electrical and Mechanical Services Department of the Government of the Hong Kong Special Administrative Region

#### 4.1.3 Measuring Systems

All units are SI units.

#### 4.1.4 Measuring Criteria

- (a) Unless otherwise stated, all voltage, power levels, power or voltage ratios for amplifiers are r.m.s. measured at 1 kHz or relative to measurement made at 1 kHz.
- (b) Frequency response of cassette decks, Compact Disc players, MiniDisc players/recorders and Digital Audio Tape (DAT)

players/recorders is measured on a record/playback basis at nominal record and playback signal levels. If a -20 dB recording level is required for this parameter, it should be clearly stated.

- (c) Sensitivity of loudspeakers is measured at a distance of 1 metre with a random noise signal of 1 watt.

## 4.2 Equipment Functional Requirements and Performance Characteristics

### 4.2.1 Microphone

#### 4.2.1.1 Unidirectional Microphone

- (i) It shall be of dynamic type provided with built-in blast and pop protection and microphone holder.
- (ii) The microphone shall be provided with a built-in on-off switch and a suitable length of cable. The required length of cable is specified in the Particular Specification.
- (iii) All cables for microphones shall be terminated with Cannon XLR-type connectors.
- (iv) Where required, the microphone shall be provided with a tiltable mount and hardware adaptable to the floor stand or desk stand (Items 4.2.2 and 4.2.3 refer.)

#### 4.2.1.2 Miniature Omnidirectional Lavalier Microphone

It shall be lightweight and unobtrusive with smooth exterior and recessed grill screen minimizing clothing noise. It shall be of rugged aluminium case construction and fitted with a flexible long-life cable. The lavalier cord shall be easily snapped onto or disengaged from a clasp of the lavalier holder. A proper cable anchoring shall be provided and shall be terminated with the connector.

#### 4.2.1.3 Performance Characteristics Required

- (i) on-axis frequency response not to vary by more than +6 dB, -10 dB over the frequency range 100 to 10 000 Hz, relative to 1 kHz,
- (ii) sensitivity not to be less than 1.0 mV/Pa (-77 dB ref. 1 V/ubar) at 1 kHz,
- (iii) distortion to be less than 0.5% at 1 kHz at 30 Pa sound pressure level input,

- (iv) front-to-back discrimination ratio to be greater than 15 dB for 300 to 5 000 Hz for unidirectional microphones,
- (v) balanced, low impedance in the range 200 to 600 ohm at 1 kHz.

#### 4.2.2 Microphone Floor Stand & Boom Arm

- (a) The floor stand shall comprise a substantially constructed heavy cast black painted base supporting a satin chrome finished column with a self locking device permitting the inner column to be raised or lowered with one hand within a range of adjustment from 900 to 1600 mm nominal.
- (b) Adaptor for microphone or adaptor for the boom arm shall be provided.
- (c) The boom arm shall comprise a satin chrome finished tubing with a suitable size of counter weight. The length shall not be less than 700 mm.
- (d) The boom arm shall be fitted with a locking device for snapping onto the adaptor of the microphone floor stand.
- (e) The boom adjustment range shall be 360° in any direction.

#### 4.2.3 Microphone Desk Stand & Flexible Gooseneck Shaft

- (a) The desk stand shall be similarly constructed as the floor stand but with a short satin chrome pillar, with adjustment by means of a clamping ring designed to support the microphone 100 to 200 mm above desk top.
- (b) The flexible gooseneck shaft shall be a stainless steel flexible tubing of not less than 300 mm and permit easy bending in any direction of 45°.
- (c) The gooseneck shall be fitted with a thread insert and a XLR-type connector for easy mounting onto a desk stand on one end and a microphone on the other.

#### 4.2.4 Mixer-Power Amplifier

- (a) The mix-power amplifier shall be fully solid-state, and provided with balanced floating outputs of 70 V and 100 V for loudspeaker connections.
- (b) As a minimum requirement, the mixer-power amplifier shall be

provided with the following facilities: -

- (i) power on/off switch,
- (ii) mains 'on' indicator lamp,
- (iii) independent mixing volume control for each input,
- (iv) master volume, bass and treble tone controls,
- (v) three-core flexible cord and correctly fused plug for mains supply and earth connection,
- (vi) AC and DC fuse protection,
- (vii) standard sockets complete with plugs and locking rings for each input and terminals for loudspeaker output.

(c) Performance Characteristics Required

- (i) microphone input sensitivity not to be greater than 0.5 mV for rated output for source impedance of 200 to 600 ohm balanced,
- (ii) high level input sensitivity not be greater than 400 mV for rated output for source impedance up to 50 kohm,
- (iii) preamplifier provided at least 60 dB signal range from noise to clipping,
- (iv) frequency response not to vary by more than  $\pm 3$  dB over the frequency range 50 to 15 000 Hz, at rated output power,
- (v) total harmonic distortion at rated output not to exceed 2% between 50 and 15 000 Hz, distortion shall not increase at lower power output,
- (vi) noise level to be better than 65 dB below rated output with input shorted, over the frequency range 50 to 15 000 Hz, unweighted.

4.2.5 Mixer-Preamplifier

- (a) The mixer-preamplifier shall be fully solid-state and provided with the following facilities: -
  - (i) power on/off switch,
  - (ii) independent mixing volume for each input,

- (iii) master volume, bass and treble tone controls,
- (iv) flexible cord and correctly fused plug for mains supply connection,
- (v) AC and DC fuse protection.

(b) Performance Characteristics Required

- (i) microphone input sensitivity not to be greater than 0.5 mV for rated output for source impedance of 200 to 600 ohm,
- (ii) high level input sensitivity not to be greater than 400 mV for rated output for source impedance up to 500 kohm,
- (iii) r.m.s. output level not to be less than 0 dBm,
- (iv) output impedance : 600 ohm balanced,
- (v) preamplifier provides at least 60 dB signal range from noise to clipping,
- (vi) frequency response not to vary by more than  $\pm 2$  dB over the frequency range 50 to 15 000 Hz at rated output,
- (vii) total harmonic distortion at rated output not to exceed 1% between 50 and 15 000 Hz, distortion shall not increase at lower power output,
- (viii) base control  $\pm 10$  dB at 100 Hz,
- (ix) treble control  $\pm 10$  dB at 10 000 Hz,
- (x) noise level to be better than 80 dB below rated output with input shorted, over the frequency range 50 to 15 000 Hz, unweighted.

4.2.6 Power Amplifier

- (a) The power amplifier shall be fully solid-state and provided with the following facilities: -
  - (i) power on/off switch,
  - (ii) mains 'on' indicator lamp,
  - (iii) input protection against overload,

- (iv) volume, bass and treble controls,
- (v) balanced floating output of 70 V and 100 V for loudspeaker connections,
- (vi) flexible cord and correctly fused plug for mains supply connection,
- (vii) AC and DC fuse protection,
- (viii) standard sockets complete with plugs and locking rings for each input and terminals for loudspeaker output.

(b) Performance Characteristics Required

- (i) input sensitivity not to be greater than 0.77 V for rated output for source impedance of 600 ohm,
- (ii) frequency response not to vary by more than  $\pm 3$  dB over the frequency range 50 to 15 000 Hz,
- (iii) total harmonic distortion at rated output power not to exceed 1% between 50 and 15 000 Hz, distortion shall not increase at lower power output and/or less than full load,
- (iv) noise level to be better than 70 dB below rated output with input shorted, over the frequency range 50 to 15 000 Hz unweighted,
- (v) output regulation to be less than 2 dB from no load to full load, the amplifier shall be stable under no load conditions.

4.2.7 Loudspeaker

4.2.7.1 Horn Speaker

- (a) The horn speaker shall be perfectly weatherproof and complete with built-in multiple tapping matching transformer and mounting bracket suitable for mounting onto any hard surfaces or masts.
- (b) It shall satisfy the following performance characteristics: -

(I) General Purpose Horn Speaker

- (i) on-axis frequency response not to vary by more than  $\pm 10$  dB over the frequency range 250 to 6 000 Hz,

(ii) sensitivity not to be less than 103 dB/W.

(II) Wide Range Horn Speaker

(i) on-axis frequency response not to vary by more than  $\pm 10$  dB over the frequency range 200 to 15 000 Hz,

(ii) sensitivity not to be less than 95 dB/W.

4.2.7.2 Speaker Column

(a) The speaker column shall comprise at least four dynamic cone speaker units arranged in column on a baffle board. Multiple tapping matching transformers shall be provided.

(b) The enclosure shall be acoustically designed to provide a unidirectional wide lateral beam spread of sound with limited cover in the longitudinal direction.

(c) The wooden enclosure shall be rigid and complete with high quality front grille cloth, and fibre glass or BAF insulation lining of not less than 20 mm thick covering the interior column; speech coils and magnet air gaps shall be protected against ingress of dust and moisture.

(d) The column shall be suitable for mounting on any hard surface and the mounting mechanism shall permit free rotation about the vertical axis and adjustable tilting angle. Mounting brackets shall be supplied.

(e) The column shall be finished to harmonize with the wall or immediate background.

(f) It shall satisfy the following performance characteristics: -

(i) on-axis frequency response not to vary by more than  $\pm 10$  dB over the frequency range 200 to 10 000 Hz,

(ii) sensitivity not to be less than 95 dB/W.

4.2.7.3 Ceiling Mount Speaker

(a) The speaker shall be either suitable for flush mounting to a false ceiling of any configuration, or for surface

mounting if there is not false ceiling. It shall be equipped with a multiple tapping matching transformer to provided easy control of speaker sound volume. A dust proof bag or metal box shall be provided to protect the speaker. Supporting brackets to mount the speaker onto false ceilings of different configurations shall be provided.

- (b) It shall satisfy the following performance characteristics: -
  - (i) on-axis frequency response not to vary by more than  $\pm 10$  dB over the frequency range 200 to 8 000 Hz,
  - (ii) sensitivity not to be less than 90 dB/W.

#### 4.2.7.4 Box Speaker

- (a) The speaker shall be contained in a rigid wooden enclosure designed for surface mounting. The volume of the enclosure shall be not less than 4 litres and its inner rear section shall be fitted with sound absorption lining.
- (b) It shall satisfy the following performance characteristics: -
  - (i) on-axis frequency response not to vary by more than  $\pm 10$  dB over the frequency range 200 to 10 000 Hz,
  - (ii) sensitivity not to be less than 90 dB/W.

#### 4.2.8 Speaker Selector

- (a) The speaker selector shall allow speaker groups and all-call circuit to be selected individually, collectively or in any combinational manner.
- (b) Each speaker group and the all-call circuit shall be provided with lamp indicators to show the conditions of use.
- (c) Each switch shall be capable of handling the power of its controlling circuit.

#### 4.2.9 Monitor Panel

- (a) The monitor panel shall be made of 1.6mm stainless steel or 3.2mm

anodised aluminium. All labels shall be engraved if the panel is custom made.

- (b) As a minimum requirement, the panel shall be provided with the following facilities: -
  - (i) monitor speaker with volume control,
  - (ii) system power on/off switch,
  - (iii) VU meter,
  - (iv) channel selector switch,
  - (v) line voltage selector switch for monitoring 70 V or 100 V outputs.

#### 4.2.10 Relay Control Box

- (a) The relay control box shall be made of 1.6 mm stainless steel or 3.2 mm anodised aluminium.
- (b) The relay control box shall be equipped with adequate relays sets to provide inhibit circuits to microphone inputs. The tenderer/contractor shall be required to submit a schematic diagram to show the operation of the circuit.

#### 4.2.11 Cassette Deck

- (a) The cassette deck shall be of speed 47.5 mm/sec.
- (b) The cassette deck shall be provided with the following facilities:-
  - (i) power on/off switch,
  - (ii) microphone and headphone jacks,
  - (iii) input/output level control and meters,
  - (iv) three-digit resettable tape counter,
  - (v) automatic shut-off at tape end in every tape mode or auto-reverse mode as required,
  - (vi) noise reduction system.
- (c) It shall satisfy the following performance characteristics: -
  - (i) frequency response not to vary be more than  $\pm 3$  dB over the

frequency range 50 to 13 000 Hz using ferric oxide tape,

- (ii) signal-to-noise ratio to be better than 55 dB using ferric oxide tape,
- (iii) wow and flutter to be less than 0.05% r.m.s., weighted in accordance with BS 4847,
- (iv) total harmonic distortion to be less than 1.0% using ferric oxide tapes,
- (v) fast forward and rewind time not to be more than 90 seconds for C-60 tapes,
- (vi) microphone input sensitivity not to be greater than 0.5 mV for rated output for source impedance of 200 to 600 ohm,
- (vii) line input sensitivity not to be greater than 78 mV for source impedance up to 50 kohm,
- (viii) line output level not to be less than 400 mV.

#### 4.2.12 Compact Disc Player

- (a) The Compact Disc player shall be provided with the following facilities: -
  - (i) power on/off switch with indicator,
  - (ii) headphone jack preferably with volume control,
  - (iii) output level control,
  - (iv) fluorescent information display,
  - (v) direct track selection buttons,
  - (vi) random and disc/track repeat playback,
  - (vii) remote control unit,
  - (viii) CD, CD-R, CD-RW & MP3 playback capability,
  - (ix) 24-bit DAC converter,
  - (x) optical digital outputs and RCA analog outputs.
- (b) It shall satisfy the following performance characteristics: -

- (i) frequency response not to vary be more than  $\pm 1$  dB over the frequency range 20 to 20 000 Hz,
- (ii) signal-to-noise ratio to be better than 100 dB,
- (iii) wow and flutter to be less than measurable limit,
- (iv) total harmonic distortion to be less than 0.0025%,
- (v) dynamic range to be better than 95 dB,
- (vi) channel separation to be better than 90 dB,
- (vii) analog output level to be at 2 V r.m.s.,
- (viii) sampling frequency to be at 44.1 kHz or above.

#### 4.2.13 MiniDisc Player/Recorder

- (a) The MiniDisc player/recorder shall be provided with the following facilities: -
  - (i) power on/off switch with indicator,
  - (ii) headphone jack preferably with volume control,
  - (iii) input selector,
  - (iv) fluorescent information display,
  - (v) digital recording level control,
  - (vi) random and disc/track repeat playback,
  - (vii) remote control unit,
  - (viii) MiniDisc & MP3 playback capability,
  - (ix) 24-bit DAC converter,
  - (x) optical and RCA inputs and RCA line outputs,
  - (xi) MD Long Play (MDLP) modes for higher recording time,
  - (xii) high speed recording and timer standby recording,
  - (xiii) text entry capability,
  - (xiv) adaptive transform acoustic coding (ATRAC) compression

and expansion method for high signal to noise response,

(xv) 2 channel recording and playback.

(b) It shall satisfy the following performance characteristics: -

- (i) frequency response not to vary be more than  $\pm 1$  dB over the frequency range 20 to 20 000 Hz,
- (ii) signal-to-noise ratio to be better than 90 dB,
- (iii) wow and flutter to be less than measurable limit,
- (iv) total harmonic distortion to be less than 0.0025%,
- (v) dynamic range to be better than 90 dB,
- (vi) typical digital input level from  $-23$  dBm to  $-15$  dBm,
- (vii) analog input level to be at 100 mV r.m.s. minimum,
- (viii) analog output level to be at 1.1 V for load impedance of 10 kohm,
- (ix) sampling frequency to be at 44.1 kHz or above.

#### 4.2.14 Digital Audio Tape (DAT) Recorder

- (a) The DAT recorder shall be of speed 8.15 mm/sec in SP mode and 4.075 mm/sec in LP mode.
- (b) The DAT recorder shall be provided with the following facilities:-
  - (i) power on/off switch with indicator,
  - (ii) headphone jack preferably with volume control,
  - (iii) fluorescent information display,
  - (iv) mechanism for reduction of radiated noise,
  - (v) remote control unit,
  - (vi) super bit mapping technology,
  - (vii) repeat playback mode,
  - (viii) menu-driven control,

- (ix) 24-bit DAC converter,
  - (x) optical digital outputs,
  - (xi) optical and coaxial digital inputs,
  - (xii) long recording/playback modes,
  - (xiii) quick loading and high speed searching,
  - (xiv) menu-driven track title/ID entry,
  - (xv) variable record mute time.
- (c) It shall satisfy the following performance characteristics: -
- (i) frequency response not to vary be more than  $\pm 1$  dB over the frequency range 20 to 20 000 Hz,
  - (ii) signal-to-noise ratio to be better than 90 dB,
  - (iii) wow and flutter to be less than measurable limit,
  - (iv) total harmonic distortion to be less than 0.005% in SP mode or 0.075% in LP mode,
  - (v) dynamic range to be better than 90 dB,
  - (vi) fast forward and rewind time not to be more than 60 seconds for 120-minute tapes,
  - (vii) channel separation to be better than 90 dB,
  - (viii) digital line input/output compliant to IEC 60958,
  - (ix) nominal analog balanced (XLR) and unbalanced (RCA) input level to be at +4 dBu and -10 dBV,
  - (x) nominal analog balanced (XLR) and unbalanced (RCA) output level to be at +4 dBu and -10 dBV,
  - (xi) sampling frequency for recoding and playback to be selectable at 48 kHz, 44.1 kHz and 32 kHz.

#### 4.2.15 Equipment Cabinet

- (a) The cabinet shall be standard 483 mm and of compatible height and sufficient strength and rigidity to house the equipment. It shall be complete with locking door and three-pin power sockets.

- (b) The cabinet shall be constructed from either teakwood of at least 15 mm thick or stainless steel of at least 1.29 mm thick, depending on individual system requirements.
- (c) Facilities shall be provided for good free ventilation and easy access of connecting cables from outside for maintenance.

#### 4.2.16 Microphone Cable

- (a) The microphone cable shall be flexible twisted pair of tinned annealed copper conductors, PVC insulation, tinned copper braided shield, and PVC outer sheath. The colour of the sheath shall be either light grey or white.
- (b) The cable shall satisfy the following minimum characteristics: -
  - (i) at least 16 strands per conductor,
  - (ii) strand diameter not to be less than 0.15 mm,
  - (iii) nominal outer diameter not to be greater than 50 mm,
  - (iv) capacitance between conductors not to be more than 110 pF/m,
  - (v) inner conductor d.c. resistance not to be more than 36 ohm/km at 20°C,
  - (vi) insulation thickness not to be less than 0.25 mm.
- (c) For lavalier microphone, the cable shall satisfy (iv) to (vi) above and
  - (i) at least 10 strands per conductor,
  - (ii) strand diameter not to be less than 0.1 mm,
  - (iii) nominal outer diameter not to be greater than 3.4 mm.

#### 4.2.17 Loudspeaker Cable

- (a) The loudspeaker cable shall be flexible pair of tinned, annealed copper conductors, PVC insulated, and white or grey PVC sheath. For surface wiring, the cable shall be a parallel pair. For conduit run, the cable shall be a twisted pair.
- (b) The cable shall satisfy the following minimum characteristics: -

- (i) at least 19 strands per conductor,
- (ii) strand diameter not to be less than 0.21 mm,
- (iii) nominal outer diameter not to be greater than 8 mm,
- (iv) insulation thickness not to be less than 0.5 mm.

#### 4.2.18 Power Cable

Power cables shall be three-core PVC insulated, non-armoured with copper conductors of not less than 2.5 mm<sup>2</sup> to the latest edition of BS 6004:2000 and BS 6346:1997 or their international equivalent standards and complete with an overall protection sheath of PVC.

#### 4.2.19 Underground Loudspeaker Cable

- (a) Underground cables shall be PVC insulated, armoured, with one or two twisted pairs of tinned, annealed copper conductors, tinned copper braided shield and complete with an overall protective jacket of PVC.
- (b) The cable shall be of at least 19 strands per conductor of diameter not less than 0.21 mm.

#### 4.2.20 Conduit

- (a) Conduit, except flexible conduit, shall be made of galvanized iron of heavy gauge, screwed, longitudinally welded. All conduits and conduit fittings shall comply with the latest edition of BS 4568-1:1970 and BS EN 50086-1:1994 and subsequent amendments or their international equivalent standards.
- (b) Flexible steel conduit and solid type adaptors shall comply with the latest edition of BS 731-1:1952 or its international equivalent standard, and in addition, the flexible conduit shall be of the metallic water tight pattern, PVC oversheathed and with a separate earth wire enclosed for earth continuity.

#### 4.2.21 Connector & Accessories

- (a) All audio connectors for wall panels, mixer inputs, microphones etc. shall be Cannon XLR type.
- (b) Each indoor loudspeaker shall be terminated through a 2 A three-pin plug and socket complying with the latest edition of BS 546:1950 and supplements or its international equivalent standard to facilitate easy removal of the loudspeaker. Locally made plug and socket of equivalent standard is also acceptable. The Contractor shall be

responsible for properly mounting the socket base plate onto any existing adaptable box provided by others as instructed by the Engineer. Outdoor speakers shall be terminated through weatherproof type plugs and sockets provided with a push-on cap and cap retaining ring.

- (c) A sheet metal box with stainless steel cover shall be required to house one Cannon XLR male or female socket and a pilot LED indicator. The LED shall be 'screw-in' type for easy replacement. Both the socket and LED shall be provided.

### 4.3 Installation Requirements

#### 4.3.1 General

- (a) All equipment, cabling etc. shall be installed in locations as indicated on the floor plans and drawings accompanied with the Particular Specification or as instructed by the Engineer on site.
- (b) All cables shall, as far as practicable, be run inside conduits or trunkings already provided for the purpose by others.
- (c) The Contractor shall provide and install all conduits, trunkings, raceways and adaptable boxes to supplement the conduits or trunkings already provided, or to the requirement laid down in the Particular Specification.
- (d) The Contractor shall make good any work disturbed during installation at his own expense.
- (e) Where appropriate, the installation of surface wiring, conduit and trunking systems shall comply with the relevant standards and regulations stipulated in Clause 2.1.2 of the "General Requirements for Electronics Contracts ESG01" and the requirements as specified hereinunder.

#### 4.3.2 Equipment Fixing and Interconnection

- (a) All equipment except portable equipment shall be firmly held in place. Fastenings and supports shall be adequate to support their loads with a safety factor of at least three. If attachment to roof truss members is required to lift equipment into place attachment shall be made only a permanent lifting eyelets provided in the roof truss. Welding or drilling of the steel roof truss is not permitted; permanent attachment to trusses shall be made by approved clamping arrangements employing neoprene or similar bearing pads to protect the truss finish.
- (b) Interconnection of various items of equipment shall be mechanically

and electrically connected by multi-pins connectors or terminals.

- (c) Lines shall be run in separate conduits for microphone level circuits (level below -20 dBm), line level circuits (up to +30 dBm), loudspeaker circuits (above +30 dBm), and power circuits. All other conduits shall be spaced not less than 50 mm from power conduits. Power conduits shall be grounded to the power system ground.

Microphone and 600 ohm lines shall be insulated from the conduit and from each other for the entire conduit length. Microphone and 600 ohm line conduits shall be mechanically and electrically connected to receptacle boxes and electrically grounded to the audio system ground point. Lines in conduit shall not be spliced.

- (d) Microphone line shields shall be grounded only at the microphone frame. Other shields shall be grounded only at the power amplifier inputs or at the control equipment outputs. Continuity of shields shall be preserved at connecting points. All audio grounds in the sound equipment rack(s) shall be connected to a common point on the rack(s). This point shall be connected to the building ground.

- (e) All audio lines, including microphone lines, line-level lines and loudspeaker lines, shall be floating with respect to the ground, either side of audio lines shall be grounded. If the equipment has a single ended input or output, it must be provided with isolation transformers to provide the floating conditions. Muting of microphones shall be done by shorting the microphone output, not by opening the circuit. Cut-off or transfer switches in line-level lines or loudspeaker lines shall be two-pole, switching both sides of the line simultaneously.

Outputs of power amplifiers shall not be inter-connected. Loudspeaker lines leaving the equipment rack(s) shall be connected via barrier strip terminals.

#### 4.3.3 Materials and Workmanship

- (a) All cables shall be run in a vertical or horizontal direction. Only cables required to feed a point on a ceiling may be fixed to the ceiling.
- (b) When cables pass through walls or columns, a piece of PVC sleeve of adequate size shall be inserted into the wall or column, and the cables shall be drawn therein. Holes so created around the sleeves shall be fitted up with cement and touched up with paint. The colour of the paint shall match with that of the walls or columns.
- (c) Rubber grommets or insulated bushes shall be used to protect the

cables passing through metal covers of distribution board, box or any other metal work.

- (d) Cables shall be run at least 150 mm clear of non-electrical services.
- (e) Unless otherwise authorized by the Engineer, cables shall be secured flat to the surface of walls and ceiling by means of buckle clips or cable saddles.
- (f) Buckle clips shall be of heavy gauge, heavily tinned brass with counter-sunk fixing holes, and shall be fixed by means of non-corrosive pins or screws of 15 mm minimum length secured to one plug inserted to a depth of 20 mm minimum. Where the buckle clips are secured to plaster, concrete etc. the plug shall be made from teak dwelling or parallel length. Every fixing hole in the buckle clip will be deemed to require a pin or screw. The heads of the screws or pins shall be level with the surface of the clips so that no damage to the sheath of the cables can occur.
- (g) Spacing of the clips shall not exceed 150 mm in horizontal direction and 225 mm in vertical direction.
- (h) A clip shall be provided not less than 75 mm and not more than 100 mm from any bend or termination and cables shall be set so that they lie flat against the surface.

#### 4.3.5 Surface Conduit

- (a) Surface conduits shall be fixed by galvanized heavy spacing saddles, and shall run only in a perpendicular or horizontal direction. On straight run 20 mm and 25 mm conduits shall be supported by not less than one saddle every one metre in addition to the support provided by any structure, box or fitting.
- (b) For 32 mm and larger conduits, saddles may be placed not more than 1.2 m apart. Angle bends shall, in all cases, be supported by two saddles, as near thereto as possible. Heavy spacing galvanized saddles shall be fixed with brass screws in rawl plugs, or other approved methods.
- (c) Conduit bends shall have a radius of four times the outer diameter of the conduit.
- (d) A saddle shall be provided not less than 150 mm and not more than 200 mm from any bend or termination.
- (e) Steel conduit systems shall be mechanically and electrically continuous throughout, and efficiently earthed.

- (f) Chases for conduit in walls shall be either perpendicular or horizontal.
- (g) Joints in runs of steel conduit shall be made by means of a coupler into which the ends of both conduits are to be inserted and tightened up.
- (h) An adequate number of suitably sized hot-dipped galvanized cast iron draw-in boxes shall be provided in conduit runs to enable cables to be drawn in easily and without damage. Draw-in boxes shall be fitted after every two bends, or after a maximum straight run of 15 m.

\*\*\* End \*\*\*