CHAPTER XX

SOUND DISTRIBUTION SYSTEM

20.1 SYSTEM

20.1.1 Sound distribution system on the railways include transmission of:

(a) Announcement to passengers and other railway users at Railway station areas, information regarding arrival, departure and late running of trains and also important information pertaining to railway traffic.

(b) Speeches and musical programmes for railwaymen and guests in closed auditoriums or open grounds.

(c) Announcements and musical programmes for workshop staff in shop, halls and hospitals.

(d) Announcements to railway men working in marshalling and sorting yards. (This is dealt separately in Chapter XIX under yard communication systems).

20.2 SPECIFICATION & PERFORMANCE PARAMETERS

21.2.1 Types of services - There are two types of services:

(a) "A" Category - desirable where high quality sound reproduction (both intelligibility and fidelity) is aimed at.

(b) "B" Category - employed where prime consideration is intelligibility.

21.2.2 USES : The uses of two types of services are as follows:

(a) `A' category service may be used where the acoustic conditions are fairly good for the listeners and it is possible to provide adequate acoustic treatment.

(b) `B' Category service may be used where the acoustic conditions are not favourable. High reverberation or high noise level conditions will require this type of service.

20.2.3 TECHNICAL REQUIREMENT FOR QUALITY OF REPRODUCTION FOR 'A' CATEGORY

i) Frequency response - The frequency response of the entire system excluding the voice coils of the loudspeakers shall be within ± 3 dB from 100 to 10000 Hz.

ii) Harmonic distortion - The total harmonic distortion of the entire system excluding the voice coils of the loudspeakers shall not exceed 5% at the rated output of the amplifier.

iii) Signal-to-noise ratio - The signal-to-noise ratio under normal operating conditions of the amplifying system as a whole with flat operation of the tone control shall not be worse than 50 dB.

NOTE : The normal operating conditions are those where sound pressure level of 70 to 80 dB is maintained.

iv) SENSITIVITY - System should be capable of direct operation from input voltage ranging 0.5mV to 1.5 V.

v) Reverberation time (for indoor installation only) - The reverberation time should be as per Annexure B and clause 20.2.8.

20.2.4 TECHNICAL REQUIREMENTS FOR QUALITY OF REPRODUCTION FOR `B' CATEGORY:

i) Frequency response - The frequency response of the entire system excluding the voice coils of the loudspeakers shall be within ± 3 dB from 100 to 7500 Hz. The frequency range can be further limited up to 4000 Hz to improve speech intelligibility in noisy and reverberant locations.

ii) Harmonic distortion - The total harmonic distortion of the entire system excluding the voice coils of the loudspeakers shall not exceed 5% at the rated output of the amplifier.

iii) Signal to noise ratio - The signal-to-noise ratio under normal operating conditions of the amplifying system as a whole with flat operation of the tone control shall not be worse than 40 dB.

NOTE - The normal operating conditions are those where sound pressure level of 70 to 80 dB is maintained.

iv) Sensitivity - System should be capable of direct operation from input voltage ranging 0.5 mV to 1.5 V.

v) The test procedure for measurement of above parameters are given in Annexure-A.

20.2.5 ACOUSTIC SURVEY

a) Objective - The objective of an acoustic survey is to determine the acoustic defects in relation to the location of the sound sources so that the necessary acoustic correction can be done to ensure an optimum, acceptable sound distribution.

b) Acoustic defects - The acoustic defects are:

(i) Echo
(ii) Flutter
(iii)Reverberation
(iv) Multiple decay rates.

20.2.6 ECHO

(a) The sound reflection reaching a listeners ear at least 1/15th of a second after the original sound is termed as echo.

(b) The effect of echo is aggravated by any focussing provided by any part of the same building or nearby building. This is mainly confined to the frequency range above 1000 Hz and this is because of the highly directional nature of higher frequencies.

21.2.7 Flutter

(a) Where parallel surfaces like side walls exist, there is a tendency for the sound energy to decay in a series of steps, rather like a series of echoes of diminishing intensity, where the interval between successive steps is the time for sounds to be reflected from one surface to the opposite surface. The effect is flutter.

(b) Flutter is predominant for frequencies above 1000 Hz and the aural effect is a hardness or harshness, particularly noticeable in speech.

20.2.8 Reverberation

(a) Reverberation is an accumulation of echoes, one interfering with and masking the other, so that the individual echoes cannot be distinguished. It is the persistence of sound by reflection from surrounding surfaces after the source sound has ceased.

(b) The effect of reverberation is the garbling of speech and distortion of music.

(c) A certain optimum reverberation is required for enhancing the effect of music or speech; too short a reverberation time produces a `dead' effect and in smaller rooms, this will affect the speech delivery of a speaker.

(d) The reverberation time, a measure of reverberation, is defined as the time taken for a sound to decay in its intensity through a range of 60 decibels.

(e) The reverberation time is calculated as follows:

$$T = \frac{0.01524\ V}{2.3\ S \log_{10} (1-a)}$$

where,

T - is the reverberation time in seconds.
V - is the volume in cubic metres.
S - is the total surface area in sq. metres.
a - is the average absorption coefficient of the surface.

20.2.9 Multiple decay

(a) Even when the reverberation time approaches the optimum, there may be something lacking in the quality of the sound, if more than one rate of decay is present.

(b) Large areas of flat unbroken surfaces or acoustically coupled unequal volumes, as in the case of an auditorium wherein the portion under balcony and the rest of the portion are having different reverberation times cause such an effect.

20.3 GENERAL REQUIREMENTS

20.3.1 Composition of sound distribution system - Sound distribution system consists essentially of a microphone, an amplifier, a number of loudspeakers, connecting cables and sectionalising transformers, preamplifiers, power supply units, voltage regulating devices. Standby equipments are also provided as necessary.

20.3.2 Sound power and ambient noise level - Taking into account such factors as audience absorption and maximum ambient noise level, the mean level of sound power shall be 5 to 15 dB above the ambient noise level. In quiet places like waiting rooms and refreshment rooms,

sound level should be higher by 5 dB; in closed auditoriums 5-10 dB; in railway platforms 10 dB; in station concourses, loco sheds, outdoor stadiums and similar noisy places 12 to 15 dB.

20.3.3 Electrical Power Requirement : A nomogram connecting the various design quantities; such as volume to be covered, required sound pressure level, reverberation time of the hall and the loudspeaker efficiency to determine the required electrical power output of the amplifying system, and the method of use of the nomogram are given in Appendix B. However, care should be exercised in using the nomogram as this is applicable only to hall having good acoustics and negligible feed back effect from the loudspeaker-microphone installation.

20.3.4 Circuit Plans and Operating Instructions –

a) Complete block diagrams and schematic diagrams for the equipment installed should be prepared and made available alongwith the circuit diagrams for each of the equipment, at the place where the central equipment is located. The layout and sizes of the wiring and cabling should also be indicated. The loudspeaker load connected to each output line and the particulars of the line transformer should be indicated. The operating instructions should also be made available alongwith rating of fuses to the operating staff.

b) Approval of plans for the proposed installation should be obtained from the competent authority.

c) The location of the central equipment, loudspeakers, microphones etc. should be fixed by the engineer and the accommodation reserved at an early stage.

20.3.5 Requirements for a playback - When music or announcements are recorded on tapes and later fed through sound distribution systems, care should be taken to see that the reverberation characteristics of the place in which the original recordings are made do not downgrade the quality of playback through the sound distribution system. Because the reverberation characteristics of the place of original recording and of the place in which the recording is played back are additive.

20.3.6 Conformity of Specifications - All materials equipment and other components of the installation should conform to RDSO specification of Public Address System and the relevant Indian Standard Specifications wherever they are applicable. Some relevant IS specs. are given in Annexure `D'.

20.3.7 Acoustic corrections:

(a) Requisites for acoustic correction - The type and extent of acoustic defects are to be known, so that the acoustic corrections can be applied.

(b) Effect of parallel walls - Parallel wall surfaces must be avoided as far as possible.

(c) Effect in smaller rooms - The smaller rooms require greater attention since they develop spatial sound patterns due to resonances at different frequencies as decided by the dimensions of the room.

(d) Effects of side walls - Random reflections from the side walls will reduce the flutter and high efficiency absorbing material may be used on the side walls to reduce the flutter.

(e) Areas opposite to sound source - Curvilinear surfaces and large area of reflection opposite to the sound normally give rise to echo and they must be avoided.

(f) Method of acoustic correction:

(i) After calculating the reverberation time, the surface area requiring acoustic treatment may be calculated depending on the optimum reverberation time chosen.

(ii) While calculating the reverberation time, adequate allowance for the absorption by audience is to be given. Normally 50% to 65% occupation of the seats can be considered. One occupied seat will amount to 33 absorption units which can be defined as the product of area in square metres and absorption coefficient.

(iii)The calculations in para above must be repeated for six different frequencies, e.g., 128 Hz,256 Hz 512 Hz, 1024 Hz, 2048 Hz 4096 Hz and the type of acoustic material must then be properly chosen. Absorption coefficients for common materials are given in Annexure - A.

20.3.8 MICROPHONES

20.3.8.1 Use of microphones:

(a) Moving Coil Microphone - These are commonly used and have robust construction. Normally low impedance microphones are used as these permit the use of long microphone lines. These should have uni-directional characteristics which help in reducing acoustic feedback/howling specially in indoor sound system.

(b) Condenser Microphone - Due to smaller size condenser microphones are commonly used for lavallier application either as Tie Pin Type or as Neck Type. These microphones require 1.5 V battery to power electret condenser cartridge. These microphones have higher sensitivity compared to moving coil microphones.

20.3.8.2 Sensitivity - Sensitivity of the microphone shall be of the order of -55dB relative to 0.0002 dyne/cm for an impedance of 50 ohms.

20.3.8.3 Frequency response - the microphone chosen should have uniform frequency response within ± 3.0 dB from 100 to 10000 Hz.

20.3.8.4 Connecting microphones -

(a) Use of more than one microphone may be essential in large stages. In such cases, output from several microphones should be mixed in a mixing system and the common output fed to the amplifier, where the amplifier itself is capable of mixing individual microphone inputs, separate mixing system is not required.

(b) The microphone plugs and sockets should be of multi-contact (three or more) type and freely interchangeable.

20.3.8.5 Siting of microphone and loudspeaker

(a) Sound distribution system, especially in a closed hall, has the risk of acoustic feed-back from the loudspeaker to the microphone causing singing. Siting of microphones and loudspeakers should be such that there is good pick-up of speaker's voice without abnormal rise in bass and good distribution with uniform coverage without acoustic feed back. The microphone should be sited normally in an acoustic shadow.

(b) It is also desirable to create the illusion that sound is being heard directly. There should not be cases of sound from the loudspeaker, or reflected sound from the walls, reaching the audience after the sound from the speaker has reached directly.

(c) Microphone should be, as far as possible, behind the loudspeaker in order to minimize the acoustic feed back. The correct distance between microphone and source should be pre-determined and arranged to be constant as far as possible. It is important to see that if the

level of reverberant sound or the surrounding noise near the microphone is high, the distance between microphone and source shall be reduced. The sound source should be directly towards the microphone, as otherwise the high notes, which are highly directional, would not be satisfactorily picked up by the microphone and thereby the clarity of the speech sound reproduced by the system will be poor.

(d) In 25 KV AC electrified area, the microphone siting should aim at avoiding the electrostatic or electromagnetic induction either in the equipment or in the lead from the microphone to the amplifier.

20.3.8.6 WIND SHIELDS: Microphones, when used outdoors, may have to be fitted with some means of protection against wind. However, it is desirable that performance of microphones should not be adversely affected by such wind shield.

20.3.9 LOUDSPEAKERS

20.3.9.1 Criteria for determining the loudspeakers required - The number of loudspeakers, their location, height, direction and the power input to the loudspeakers installed will have to be decided with the object of maintaining the intensity of reproduced sound above the local noise level as prescribed in Para 20.3.2 so that the masking effect of noise over the signal could be reduced considerably.

20.3.9.2 The loudspeakers used should have adequate power handling capacity and should normally be of high efficiency type.

20.3.9.3 Loudspeakers used for "A" Category reproduction should have effective frequency range of 100 to 10,000 Hz. (The response of the speaker system within the environment after installation should be considered as the effective frequency response). For this reproduction, directional type of loudspeakers (column) should be used.

The vertical directivity pattern of the system should be such as to feed the audience at uniform level, avoid harmful level, reverberant sound or echo, and feedback of energy to the microphones. In the horizontal plane, the directivity should be uniform across the width of the hall.

20.3.9.4 Column type loudspeakers:

(a) Column loudspeakers are ideal for obtaining the vertical directivity pattern. The height of column and number of speakers in it determine the directivity. A wide range of high quality reproduction may be obtained by employing multiunit type, wherein the whole frequency range will be covered by two or three groups of speakers arranged in separate columns, but mounted close to each other and connected through a properly designed dividing network.

(b) The directivity pattern of such speakers should be such as to provide sufficient intelligibility at all points of the seated area and avoid feed back to microphone, dead spot and echo.

(c) For best results, the column loudspeakers shall be installed vertically at a height of 1.5 m above the platform level and inclined at an angle of 8 degree to 10 degree towards the ground.

20.3.9.5 For "B" Category reproduction, the loudspeaker should have useful response from 100 to 7,500 Hz. Cabinet/horn type loudspeaker should be adequate for such purposes.

20.3.9.6 Cone type loudspeakers with wooden/metal cabinets - Cone type loudspeakers of appropriate power output may be used in comparatively quiet covered areas like waiting rooms, retiring rooms, etc.

20.3.9.7 Horn type loudspeakers - Horn type loudspeakers are suited to open platform and large halls with high roofs. They shall be so placed and their size so chosen that their radiation may not be in opposition and also the reflections from the roof and walls are avoided. An electrical filter to cut off low frequencies may be used with the line matching transformer to avoid damage to the voice coil at low frequencies.

20.3.9.8 Connecting loudspeakers -

(a) All the loudspeakers in each group should be connected in parallel and in phase across the output line.

(b) The pair of wires from each group should be terminated on the announcers panel at the amplifiers end, so that the line could be isolated from the output of the amplifier in case of any line fault or changed over to a standby amplifier, if provided.

(c) When a number of loudspeakers are connected to the same output circuit, matching transformers shall be used with each loudspeaker so that it consumes the rated power.

(d) These transformers should have at least the minimum frequency characteristic required of the public address system. The power handling capacity of the transformer used with a loudspeaker should not be less than the power to be absorbed by the speaker. These should have several taps on primary and or secondary to give multiple turns ratio.

(e) These transformers enable the loudspeakers, through the selection of proper turns ratio, to take an input of predetermined value of audio load from the amplifier, at the same time, care being taken not to overload the loudspeaker. Where the constant voltage output line from the amplifier is used, the total wattage of loudspeaker load should not exceed the rated power of the amplifier.

(f) When a single loudspeaker unit is connected to the amplifying system, it's impedance should be matched to the source impedance so as to consume the rated power.

20.3.10 AMPLIFYING SYSTEMS

20.3.10.1 CAPACITY OF AMPLIFIERS -

The output power of the amplifying system should be so chosen as to be capable of establishing at any point amongst the audience, a sound level of 80 dB during operation, the gain controls of the amplifying system should be so set that the signal reach each member of audience at comfortable listening level, that is during weak passage the signals are distinctly audible at each point, while during loud passage these do not cause annoyance. The amplifying system should have a gain sufficient to deliver the required output power.

The amplifiers should preferably be in multiples of 60 W. rates capacity, one for each group instead of using high power sets for the entire installation.

20.3.10.2 Input - In addition to the required number of microphone input channels, the amplifier must have a tape recorder/ CD player input channel. It shall be possible to control the proportion of the levels of the signals mixed.

20.3.10.3 Sensitivity - As the input voltages required to be amplified may range from 0.5 mili volt to 1.5 V, the amplifying system should have a sensitivity sufficient to operate directly from the lowest and highest input voltages to be met with.

20.3.10.4 Frequency response - The frequency response of the amplifiers should be within + 3.0 dB from 100 to 10000 Hz for "A" Category reproduction and from 100 to 7500 Hz for "B" Category reproduction.

20.3.10.5 Matched impedance working - For matched impedance working, the output impedance of the amplifier should be such as to operate into the range of impedances presented by the load.

20.3.10.6 The output transformer of the amplifier should have impedance tapping of 4,8 & 16 ohms to enable operation with loudspeakers of these standard impedances. For constant voltage working, the transformer should be provided with 70 to 100 volts constant voltage tappings.

20.3.10.7 High power amplifiers should incorporate safeguard against excessive voltage or current rise in case of open circuit condition or short circuit conditions respectively, in output circuit.

20.3.10..8 Standby amplifiers -

(a) Standby amplifiers shall be provided so that announcement is not held up due to defects in the working of amplifiers.

(b) Easy changeover arrangement for switching from the defective amplifiers to the standby amplifiers by the announcer without the aid of any technical staff is preferable.

(c) Provision should be available for easy localisation and rectification of faults in any part of the installation.

20.3.10.9 Installation :

(a) All equipment should be robustly made and designed for continuous operation. Equipment should be securely installed in such a manner as to have convenient access to all sides of it. Access by unauthorised persons should be guarded against. Precautions should be taken to keep away dust from the equipment, especially if earth moving machines, concrete mixers etc. are working in the immediate vicinity of the accommodation provided.

(b) When the number of equipment is not large, they may be placed on a table and wired. The positioning of the equipment should be such that the lengths of the inter-connecting cables are kept minimum for convenience.

(c) In case the number of equipment is large, it is desirable to mount them in racks of suitable dimensions. The racks may be of metal or wood and either in one piece having compartments or different sections of uniform width assembled together. Each compartment of section shall contain one item of equipment. The height of the rack will depend on the number of equipment to be mounted and accommodation available, ensuring that all manual controls are within easy reach.

(d) Switches should be provided for isolating any faulty section of the equipment thereby facilitating operation and avoiding danger to the operating personnel. The arrangement made should enable the remaining part of the equipment to be available for use.

(e) The patch cords if used should be tested and neatly arranged to avoid obstruction and should be easily identifiable. Necessary safety measure should be adopted to avoid accidental contacts with high voltage points in the rack.

f) Insulation required in 25 kV ac electrified area - The amplifier along with the cable and loudspeakers shall be such as to withstand a dielectric strength test voltage of 1000 AC rms for two seconds, when applied between the terminals of the speaker and the body.

20.3.11 POWER SUPPLY

20.3.11.1 Power supply

(a) It shall be ensured that reliable mains power supply is available near the proposed location of the announcing equipment.

(b) The installation should be normally operated from 230 V single phase 50 Hz AC mains supply.

(c) A voltage regulating device will have to be provided, if the regulation of the power supply is poorer than ±5%.

(d) When only DC supply is available, if necessary, an inverter of required capacity should be provided to convert DC supply into AC supply.

(e) If no mains supply is available, petrol or oil engine driven generating set of required capacity giving 230 volts single phase 50 Hz, AC should be used. Such a generating set should be located away from central equipment and microphones and preferably in another building at some distance from the hall having sound distribution installation to avoid noise (Electrical & Mechanical) produced by the generating system.

(f) All amplifiers should preferably be capable to operate on 12 V/24 VDC Car Battery besides on 230 V, 50 Hz AC supply.

20.3.12.WIRING AND CABLING

20.3.12.1 Microphone Cables -

(a) These cables carry low level signal currents and are, therefore, susceptible for electrical interference. Twisted pairs of conductors with sufficient insulation, screened continuously with close mesh of tinned copper braid shall be used. The copper braiding should be sheathed with an insulated covering. The microphone cables shall be isolated from power, loudspeaker and telephone cables.

(b) Joints in the cables should be avoided as far as possible.

(c) The plugs and sockets used for microphones cables should have strong self-cleaning contacts so as to eliminate noise and they shall be non-reversible and have sufficient number of pins to connect not only the main conductors but also the cable shields.

(d) Microphone cables should be laid without sharp bends as far as possible. Inside buildings, they may be laid on the floor along the walls or under the carpet to avoid damage due to any heavy object falling on them and cutting them.

(e) In 25 kV ac electrified areas, cables with their shields earthed must be used, if electromagnetic induction is anticipated.

(f) The plugs and sockets for loudspeaker connections should be of a type that cannot be easily or accidentally inserted in electric or power circuits.

(g) The speaker cable should be twin core rubber or PVC insulated lead-covered cables. These should be rated for 250 volts insulation and should be isolated from microphone cable and power cable.

20.3.12.2 Distribution and connecting cables - The cables chosen for distribution and connections should be such that the line losses do not exceed the values specified in Annexure C.

20.3.12.3 Additional requirements in 25 kV ac electrified area – The additional requirements are:

a) In the electrified areas, the length of parallelism between the loudspeaker circuit and catenary system should be limited to 1.2 Km. Where this length is exceeded, suitable sectionalising transformers shall be provided.

b) A minimum separation of 5 metres between the nearest wiring of the loudspeaker and the catenary system shall be kept.

c) Screened cables & wires or cables & wires in metallic conduit should be used in electrified areas, so as to eliminate the effects of induction both electromagnetic and electrostatic. The cable screening conduit shall be effectively earthed at both the ends. If sectionalising transformers are provided, earthing of the cable screen should be done on the two sides of the transformers. The value of this earthing resistance should be as low as possible and shall not exceed 5 ohms.

d) The screened cables used for working the loudspeakers shall have a screening factor of 0.5 within the field intensity of 50V/Km to 450 V/Km at 50 Hz.

e) It is desirable to run a main cable for the loudspeaker circuits as far away as possible from the catenary system and connect the loudspeaker at different points by distribution cables run at right angles to the catenary system.

(f) Wiring for equipment should also be screened (sheathed).

20.3.13 EARTHING AND OTHER SAFETY PRECAUTIONS

20.3.13.1 General - The layout and wiring of cables for loudspeakers shall, as far as possible, be so done as to ensure safety and avoidance of the obstructions in the normal functioning of the installation. The Indian Electricity Rules 1956 and the Indian Standard Code of Practice for Electrical Wiring and Fittings in Buildings (IS:732-1958) shall be followed, as far as they are applicable for wiring loudspeaker installations.

20.3.13.2 Earthing -

(a) Proper earthing of the entire installation (with appropriate earthing of the individual equipment also) is absolutely essential to avoid danger from any possible shocks to the users of the equipments, the operating personnel or the audience.

(b) Earthing connections to the nearby water mains are of usually lower resistance than any form of buried earth electrode system. An equipment of installation may be satisfactorily earthed by means of connection to the nearest water supply mains by a good soldered joints. In the absence of a suitable water main, the earthing may be done by connection to other efficiently earthed object.

(c) The use of two or more separate earthing connections at different points on the system is inadvisable due to risk of trouble from circulating currents. The earth connection from water supply mains or other earthed electrode should be brought to an earth-busbar in the equipment

room. The earthing connection to the installation equipments should be drawn from this earth-bus bar.

The screening leads of a microphone should have a separate insulated lead run direct to the earth connection. It shall not be connected to the electrical earthing of the installation which gives rise to hum.

21.3.13.3 Earthing leads - A fairly heavy cable (such as 7/0.75 mm VIR in conduit) or bare copper wire (4.0 mm dia) is normally satisfactory as the earthing connection lead. If bare copper wire is used, care should be taken to run it insulated from other metallic objects all along its length.

20.3.13.4 Earthing in 25 kV AC electrified area -

(a) All the sheaths/screens of wires/cables and metallic conduits must be earthed at both ends.

(b) In electrified areas, the metal mounting of the cone type loudspeakers and the body of the horn type loudspeakers shall be earthed. The resistance of this earthing shall not exceed 10 ohms.

20.3.13.5 Safety requirements for amplifiers operated from electric mains - The amplifier or amplifiers operating from mains supply shall conform to the requirement specified in IS:9302 - Mains operated audio amplifiers.

20.3.13.6 Fire and Explosion risk – The installation of the system in a situation, where there may be a possibility of an explosion, or in an inflammable atmosphere, should as far as possible, be avoided. However, if it becomes necessary to have the installation in such a situation, it should not be vulnerable to fire explosion risks.

20.4 MAINTENANCE

20.4.1 General conditions of wiring and components of the entire system to be checked once every year.

20.4.2 The frequency response and the noise level of the amplifier shall be checked annually and relevant parameters are to be recorded in Table I, II, III, IV& V. Wiring arrangements has been shown in figures 1, 2 & 3.

20.4.3 The earthing arrangement shall be maintained properly and inspected once in a quarter. Alternating current induction hum at 50 Hz and its harmonics also should be checked.

20.4.4 INSPECTION AND TESTING

20.4.4.1 The completed permanent installation should be inspected and tested by the ADSTE/DSTE to ensure that the work is being carried out in a satisfactory manner and that the materials and components used conform with the standard practice. Temporary installation may be similarly tested and inspected by a senior inspector.

20.4.4.2 Routine inspection of the installation shall be carried out at intervals in accordance with the manufacturer’s instructions or as specified from time to time.

20.3.15.3 A log book shall be kept in which details of all routine attention, faults and tests should be carefully recorded for scrutiny.

20.4.5 SELECTION OF ANNOUNCERS

20.4.5.1 Choice of announcers - When DSTE/ADSTE assists in the choice of announcers, the following essential characteristics should be sought for in the prospective announcers.

(a) They should be possess a pleasing voice so as to reflect their helpful, polite and friendly attitude.

(b) They should be free of any defect or impediment in speech, including marked accents.

(c) They should be able to speak habitually with smoothness of diction and clarity of pronunciation.

20.4.5.2 Quality of announcements - The following precautions will enhance the quality of announcements :

(a) Keeping a distance of 4" to 6" from the microphone and maintaining it.

(b) Checking up the correct volume range required.

(c) Speaking slowly and deliberately and preferably with a slight pause between words.

(d) Being particularly careful in the pronunciation of names. Names which can not be readily understood or which are inherently difficult to pronounce, may be spelt.
(e) Avoiding undue raising of voice. A relatively quiet, natural conversational tone is best.

(f) Modulate the voice according to the meaning - avoid monotones.

(g) Avoiding a sing-song style of delivery (usually characterised by a nasal tone of voice).

(h) Being careful about the use of words containing sibilants, especially if the announcer's voice is of such a type as to emphasise unduly hissing or lisping tendencies.

(i) Avoid coughing, sneezing or clearing of throat while the sound distribution system is kept energised.

(j) Avoid the habit of blowing into the microphone.

(k) Avoid chewing of "pan" or tobacco while making announcements.

(l) Lay emphasis on key/important words and operating part of sentences.

20.4.6 **ROOM FOR ANNOUNCER**

20.4.6.1 Requirements for the announcer's room -

(a) The announcer should be seated in an enclosure having good acoustic characteristics, i.e. acceptable reverberation time without any specific acoustic defects.

(b) The ambient noise level in the enclosure should not be more than 40 dB referred to 0,0002 dyne per cm2.

(c) Air-conditioning may be extended to this enclosure, if any nearby room is air-conditioned, otherwise a noiseless exhaust fan shall be provided.

(d) The window panes should preferably be of double glass.

(e) Minimum size of the room shall be 2.5 m X 3.5 m.

(f) As far as possible, the room should be made dustproof, else, the dust should be absorbed and not sweeped.

(g) The announcer shall be suitably connected by telephone with the section controllers at big junction stations. Such telephones shall have only visual indicators for calling the announcer's attention.

(g) Where train describing system exists, it may be extended to the announcer also, if necessary.

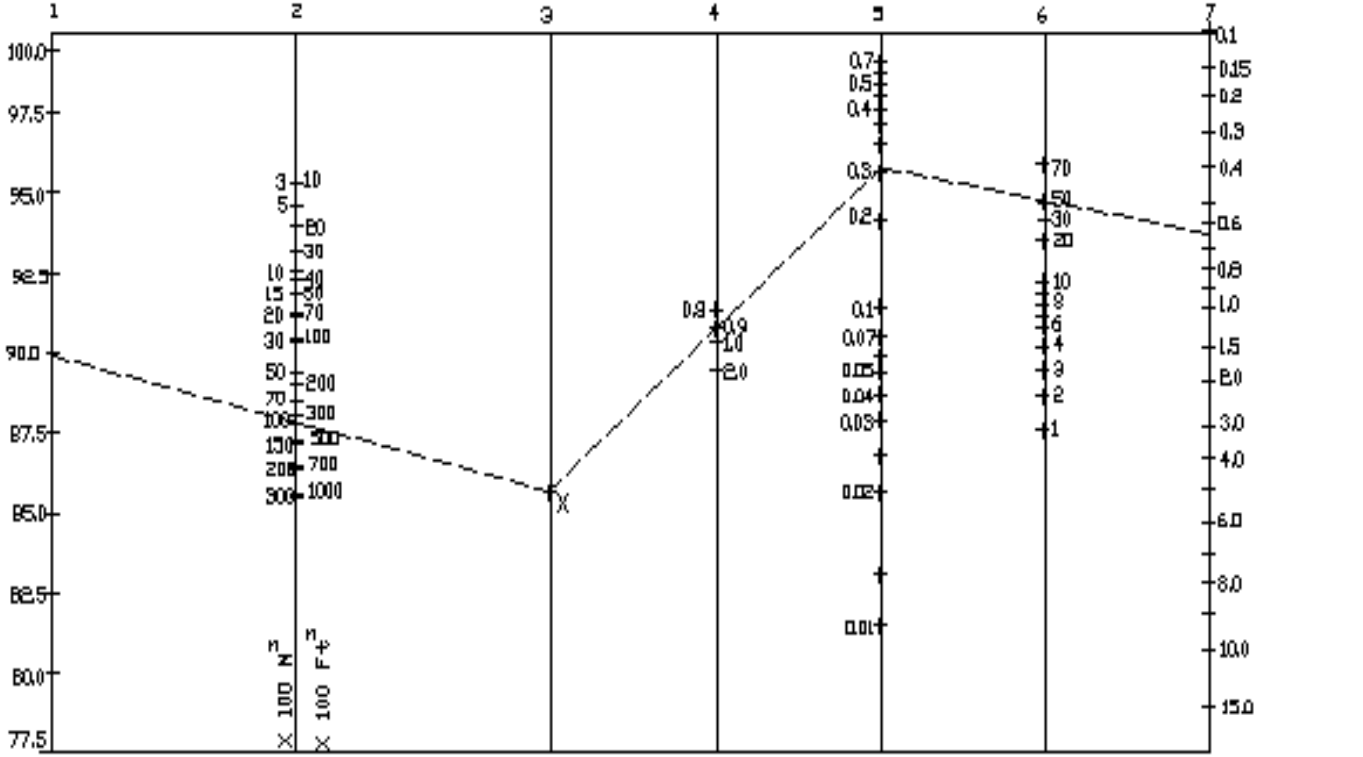
ANNEXURE - A

Para 20.3.7 f(iii)

Absorption co-efficient at 512 Hz

Brick Wall-lime plaster	...	0.03
Brick wall opening	...	0.02
Wood work	...	0.05
Concrete glasses tile	...	0.015
Carpet	...	0.15 to 0.21
Heavy curtain	...	0.35 to 0.5
Cellotex 1" thick	...	0.8
Acoustic plaster	...	0.3
Hair felt	...	0.4
Glazed windows	...	0.027
Gypsum plaster	...	0.028
Plywood chair	...	0.03

ANNEXURE -B



NOMOGRAM FOR DETRMINATION OF AUDIO POWER

SUPPOSE A SOUND PRESSURE OF 90 db IS REQUIRED FOR A ROOM OF VOLUME 100 M^3 WITH REVERBERATION TINE 0.9 SECONDS. DRAW A STRAIGHT LINE CONNECTING 90 db POINT IN LINE 1 WITH 100 M^3 POINT IN LINE 2 AND EXTEND THIS TO CUT THE DATUM LINE 3 AT X. CONNECT X TO 0.9 SEC. POINT IN LINE 4 AND EXTEND TO CUT LINE 5 AT 0.3 VATTS. IF LOUDSPEAKER EFFICIENCY BE 50%, DRAW A STRAIGHT LINE CONNECTING 0.3 WATT POINT IN LINE 5 TO 50% POINT IN LINE 6 AND EXTEND TO CUT LINE 7 AT 0.65 WATT. THE ELECTRICAL POWER INPUT TO L.S. SHOULD BE 0.65 WATT TO GIVE THE DESIRED RESULT.

ANNEXURE - C

Para 20.3.12.2

LOUDSPEAKER CABLE SIZES AND LENGTHS FOR SPECIFIED LINE LOSSES

(i) Low Impedance Lines = 15% Power loss.

Wire Size	Maximum length of loudspeaker cables in Meters for load impedance in ohms				
mm	2	4	8	16	32
2.06	30	60	120	240	480
1.60	20	40	80	160	320
1.32	12.5	25	50	100	200
1.00	7.5	15	30	60	120
0.80	4.5	9	18	36	72

(ii) High Impedance Lines = 5% power loss.

Wire Size	Maximum length of loudspeaker cables in Meters for load impedance in ohms		
mm	100	250	500
1.60	300	750	1500
1.32	200	500	1000
1.00	120	300	600
0.80	75	187.5	375
0.63	50	125	250

(iii) Maximum length to transmit upper frequency.

Wire size	Max.length of loudspeaker cables in mtrs for load impedance in ohms.			
mm	300	5000	7000	10000
2.65	1150	1150	900	820
2.06	1200	950	750	600
1.60	900	730	600	520
1.32	750	580	460	410
1.00	600	460	380	320
0.80	...	380	300	260
0.63	...	...	...	200

ANNEXURE - D

(Para 20.3.6)

IS	1881	Code of practice for indoor installation of PA system.
IS	1882	Code of practice for outdoor installation of PA system.
IS	1302	Methods of measurement on audio amplifier.
IS	7741	Specification for loudspeakers.
IS	9302	Mains operated audio amplifier.
IS	9551	Specification for high fidelity audio equipment and system.
IS	2748	Methods of measurements on microphones.
IS	12420	Circular audio connectors.
IS	5608	LF wires and cables with PVC insulation and PVC sheath.
IS	1596	Polythylene insulated cables for working voltages upto and including 1100 V
IS	732	Code of practice for electrical wiring and fitting in buildings.

ANNEXURE - E

Para 20.2.4 (v)

TEST PROCEDURE FOR SOUND DISTRIBUTION SYSTEM

TEST-1 FREQUENCY RESPONSE Para 20.2.3 (i)/20.2.4 (i)

1.1 The test set up shall be as per figure-1.

1.2 A tone of 0.5 mV at different frequencies shall be fed from signal generator to the amplifying equipment.

1.3 For each frequency, input level and corresponding output power at loudspeaker point shall be noted.

1.4 Repeat 1.2 & 1.3 with tone of 1.5 V.

TEST-II SENSITIVITY TEST (Para 20.2.3 (iv)/20.2.4 (iv)

2.1 The test set up as per Figure - 2.

2.2 Tone of 1 KHz shall be fed from the oscillator at different input voltages starting from 0.5 mV and in steps of 100 mV, 500 mV, 1 V and 1.5 V and record corresponding sound pressure level. It should be 70 to 80 dB.

TEST-III RELATIVE SOUND PRESSURE LEVEL

3.1 The test set up shall be as per Figure-2.

3.2 A tone of 1 Khz at 0.5 mV shall be fed through power amplifier to the loudspeaker system.

3.3 The level of received tone shall be measured at different spot with the sound level meter (measures directly in dB).

TEST-IV SIGNAL TO NOISE RATIO (Para 20.2.3 (iii)/20.2.4 (iii)

4.1 The test set up shall be same as Figure-2.

4.2 In the vacant situation of the auditorium, the environmental noise shall be measured by sound level meter with signal Generator disconnected and power amplifier ON.

4.3 The above measurement should be done at the same spots where relative sound pressure levels were measured.

4.4 The noise level should be then compared with signal levels recorded in Test-III.

TEST-V REVERBERATION TIME (Para 20.2.3(v)

5.1 The test set up shall be as per Figure-3.

5.2 Amplifier is adjusted to give highest practical sound level.

5.3 Gain of recorder is adjusted to give maximum deflection of the tracer styles.

5.4 Level recorder is started and audio tone to the speaker is then cut off allowing the recorder to produce continuous record during the whole of the decay period.

5.5 Time taken for the sound level to decay by 60 dB after the source is abruptly switched off is to be noted from the level recorder. This is reverberation time.

5.6 The above mentioned reverberation time to be found out for different locations.

TABLE OF TEST - I

Sr.No.	In put Signal Level	Frequency(Hz)	Output Voltage	Load Resistance	Power of Sound Pressure Level
	0.5 mV & 1.5 mV	100 Hz. 500 Hz 1000 Hz 1500 Hz 2000 Hz 3000 Hz 4000 Hz 5000 Hz 6000 Hz 7000 Hz 8000 Hz 9000 Hz 10,000 Hz			

TABLE OF TEST -- II

Sr.No.	Frequency (Hz)	In put Signal Level	Sound Pressure Level in dB.
	1 KHz	0.5 mV 100 mV 500 mV 1 V 1.5 V	

TABLE OF TEST -- III

SR.NO.	LOCATION NO.	SOUND PRESSURE LEVEL IN dB.

TABLE OF TEST -- IV

Sr. No.	LOCATION No. (Same As Test III)	Sound Pressure Level in dB.	NOISE LEVEL IN dB	S/ N RATIO

TABLE OF TEST -- V

Sr. No.	POSITION OF MEASUREMENT	Sound Pressure Level With Tone ON	Time Taken to decay the level by 60 dB

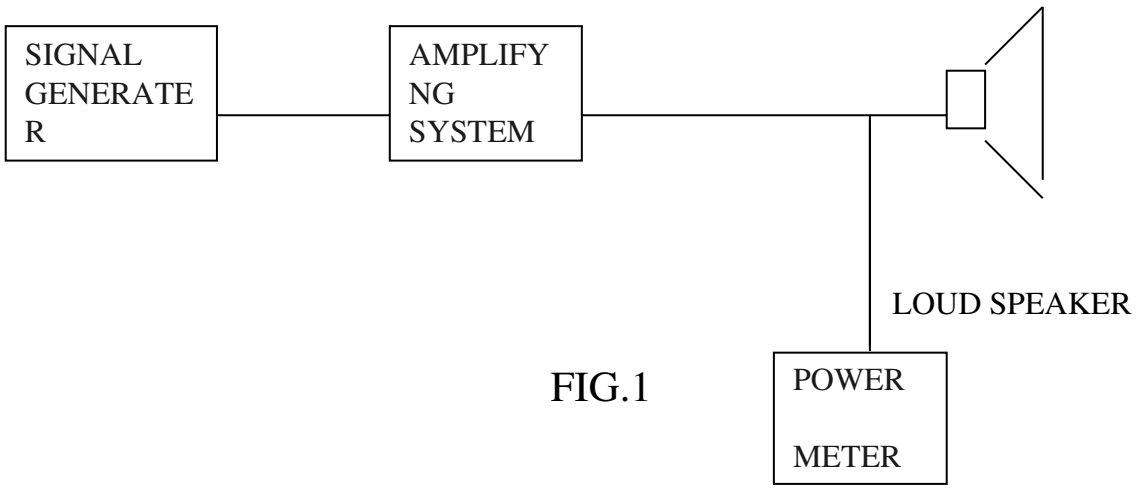


FIG.1

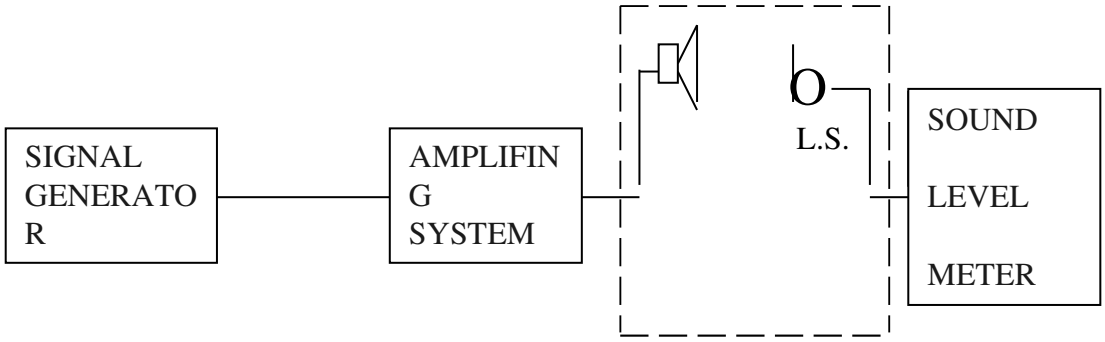

SIGNAL GENERATOR
AMPLIFING SYSTEM
L.S.
SOUND LEVEL METER

FIG.2

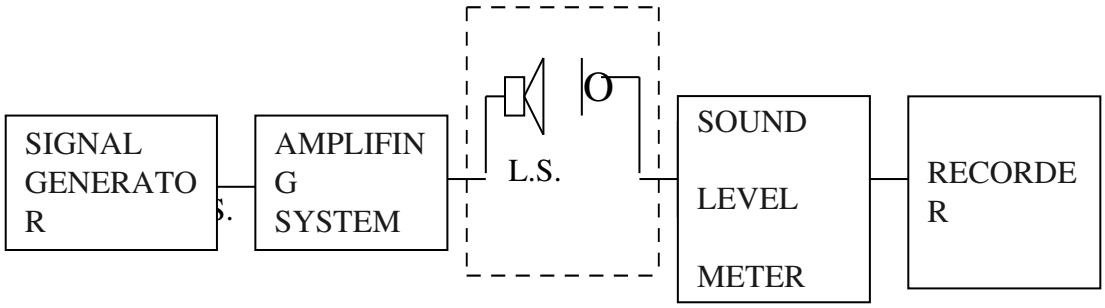

SIGNAL GENERATOR
AMPLIFING SYSTEM
L.S.
SOUND LEVEL METER
RECORDER

FIG.3