BR 13402

THE RAILWAY EXECUTIVE

CODE OF PRACTICE

FOR

RAILWAY STATION PUBLIC ADDRESS EQUIPMENT

CODE OF PRACTICE FOR RAILWAY STATION PUBLIC ADDRESS EQUIPMENT

Foreword

The use of public address equipment on stations has now become a commonly accepted service to passengers, who expect to find this helpful medium at least on all important terminal and junction stations. In fact, the same applies to railways as to any other industry in the country : we must move with the times or else we lose patronage. The public expect to obtain assistance from public address equipment just as they expect comfortable seats and good atmosphere and a high standard of sound amplification in a modern cinema.

The responsibility for providing such a standard of speech reproduction is very largely yours, not only by exercising care in installation having regard to the varying acoustic properties of railway station, but also by seeing that the equipment is maintained to a high standard thereafter.

It is true that a man takes pride in his job if he is the right man for it, and this booklet is therefore issued with a view to assisting you to make such pride in your job effective. The matter has been dealt with in a general way in two booklets issued in 1951, as follows :–

"Notes for Instruction and Guidance of Staff in the Use of Public Address installations at Railway Stations" (B.R.25000/1) ; and

"Public Address Installations at Railway Stations – Notes Regarding : (a) Selection of Announcers, (b) Layout and Equipment" (B.R.25000/2)

and the present booklet is intended to supplement the above-named insofar as the engineering aspects are concerned.

This page is blank on the original

THE RAILWAY EXECUTIVE.

SIGNAL AND TELECOMMUNICATIONS ENGINEERS' DEPARTMENT

CODE OF PRACTICE FOR RAILWAY STATION PUBLIC ADDRESS EQUIPMENT

1. GENERAL

This Code of Practice covers the provision of Public Address Equipment for use on Railway Stations. The essential requirement is that all areas over which it is intended that announcements shall be heard should be adequately and evenly covered by clear, intelligible speech.

It will generally be necessary to make announcements on more than one specified area and possibly on all areas at the same time.

In this Code of Practice the term Contractor is intended to cover the Manufacturer or Supplier of the equipment and Contractor for installation work, as applicable.

2. INSTALLATION AND WIRING

It is preferable that the planning, installation and wiring should be done by railway staff, but conditions may make it necessary for some of this work to be carried out by Contractors. Division of work between the Contractor and the Railway Executive will be made in three ways, namely :–

(a) Equipment purchased from the Contractor for a specific station, or obtained from stock, and installed and tested out by railway staff.

(b) Equipment purchased from the Contractor for a specific station, amplifiers and internal equipment being installed and wired by the Contractor; loud speaker wiring and installation being carried out by railway staff and tested by the Contractor in conjunction with railway staff.

(c) Equipment purchased from the Contractor for a 'specific station, all installation work and wiring being done by the Contractor and tested by the Contractor in conjunction with railway staff.

The Contractor will be expected to supply for inspection samples of the items of equipment it is proposed to employ, and to give a demonstration free of charge and without obligation to the Railway Executive. Heavy equipment would be inspected at the works of the Contractor.

3. LAYOUT AND GROUPING OF LOUDSPEAKERS

When the complete equipment for a station is to be obtained on a contract basis a plan giving details of the areas over which speech coverage is required will be supplied to the Contractor by the Railway Executive. A separate loudspeaker circuit should be provided for each of the areas shown on the plan. All information regarding circuit grouping will be supplied by the Railway Executive and arrangements will be made at the request of the Contractor for his engineers to visit and survey the station before tendering; the plan, with all loudspeaker positions marked thereon, being returned by the Contractor with his tender.

In such cases it will be the responsibility of the Contractor to ensure that the loudspeakers are so positioned as to give an even distribution of clear, intelligible speech over the desired areas, at the same time limiting the speech to the prescribed areas as far as is practicable. Intelligible speech should be clearly audible in trains standing at platforms on which the announcement is intended to be heard. The Railway Executive will assist the Contractor in finding suitable locations for loudspeaker mounting and it may be necessary, in some cases, particularly on the open ends of platforms, for the Railway Executive to specify the mounting positions.

In planning the location of loudspeakers, it is essential that the Regional Architect be consulted and his wishes respected as far as is practicable, always bearing in mind that the purpose of the installation is to serve the public by providing clear, intelligible announcements.

In order to avoid, as far as possible, annoyance to the public residing in the neighbourhood of the station, some circuits may need to be divided to enable certain loudspeakers to be switched off during times of “off peak” traffic, the switching being carried out in accordance with local requirements either in the Announcer's room or at other suitable locations.

4. CONSTRUCTION OF THE EQUIPMENT

It should be noted that station public address equipment is required for continuous use for most of the day and that the situations where the apparatus is housed are often subjected to humid and dust-laden atmosphere. The design, therefore, should take these conditions into account both as regards finish and factor of safety of the components.

All valves, switches, keys, resistors and capacitors should be of standard types in normal commercial use in the British Isles.

The use of electrolytic capacitators should be restricted as far as possible.

5. AMPLIFYING EQUIPMENT

The audio power output of the amplifying equipment should be sufficient to provide adequate speech coverage with the maximum number of loudspeakers which are required to be in circuit at the same time, a suitable allowance being made for possible development. In estimating the power required, it should be remembered that announcements intended for areas covered by more than one loudspeaker circuit will be made simultaneously on all circuits concerned and that the announcements will not be repeated on each circuit independently.

Larger installations should be provided with more than one amplifier and be so designed that in the event of an amplifier failure it is possible to uncouple the faulty unit and serve the installation from the remainder without undue reduction in volume or quality. In the case of smaller installations served by a single amplifier, the amplifier should be so arranged as to enable its replacement by a spare to be effected speedily in a simple manner.

In general, the amplifier equipment should be rack-mounted, but in the case of small installations cabinet amplifiers may be specified.

6. AMPLIFIER RACKS

Amplifiers other than the cabinet type should be mounted on standard racks and be completely self-contained, possessing their own power units and so arranged that the complete amplifier can be easily removed from the rack without disturbing the other equipment or wiring in any way. The lower edge of the lowest panel should, if practicable, be not less than 2 feet above floor level.

All amplifiers of the same output rating should be interchangeable and the designation of each amplifier should be clearly inscribed on its front panel.

P.O. type 3,000 relays operated by remote control should be provided for loudspeaker circuit selection, switching being carried out on a two-pole basis. One relay should be provided for each loudspeaker circuit. All relays should be accessible and so mounted as to facilitate adjustment, and be suitably enclosed in removable dust covers. The operation of a relay should bring into use the appropriate loudspeaker circuit, and some method should be employed to ensure that the output level is reasonably independent of loudspeaker load, and that speech quality is not adversely affected by load variation.

The main power supply should be terminated on a double pole switch fitted on a panel at the base of one rack or at any convenient point, as required. A mains supply distribution panel should be provided at the foot of each rack carrying independent switches and fuses serving each amplifier or auxiliary unit.

The output lines to all loudspeaker circuits should be terminated on fuses mounted on a panel at the top of the rack on the basis of one pair of fuses per circuit, each pair being suitably labelled or signwritten.

Inter-panel wiring should be terminated on shrouded terminal strips and each wire and terminal clearly designated. Mains power supply leads, however, should be terminated on shrouded plugs. The wiring should be formed into a cable and so secured as to allow easy removal of any panel.

The Contractor will normally be requested to state in the tender the size, weight and number of racks.

Consideration should be given to the provision of switching arrangements to enable the effecting of the temporary connection changes, stipulated in Section 5 above, in the event of an amplifier failure.

A meter should be associated with each amplifier to indicate the cathode voltage or current of each valve. Selection of the valve to be tested should be effected by means of a rotary switch or telephone type keys so located or labelled

as to indicate clearly which valve is being tested. The meters should give the reading directly in volts or milliamps and the resistance of the meter should be such as to ensure that valve voltages and currents are not affected by the connection of the meters. Maximum and minimum readings should be suitably displayed on the panel-e.g., on a paper insert in a metal frame with transparent front. Where applicable, contacts on the valve test switch should be provided to restore to normal the D.C. voltages of the valve under test without necessitating the operation of any control cabinet key.

A test panel should be provided embodying a monitor loudspeaker or test meter capable of testing all power amplifier outputs, selection of circuit being effected by means of a rotary switch or telephone type keys so designated as to indicate the amplifier output under test. Where applicable, contacts on the switch or keys should restore to normal the D.C. voltages of the amplifier under test without operation of any control cabinet key.

In larger installations, consideration should be given to the incorporation on the test panel of a 400 c.p.s. oscillator with suitable switching to assist in testing of amplifiers and/or loudspeakers.

7. AMPLIFIERS

The distortion of each amplifier should not exceed a total harmonic content of 5 % of the output voltage when delivering its rated power and the noise generated by each amplifier should not exceed a level of 50 decibels below its full rated output. The overall range of frequency should be such as to ensure maximum intelligibility of speech under the particular acoustic conditions.

The standards laid down in B.S.1106, “The Use of Radio Valves in Equipment” should be observed in the design of the amplifiers.

High tension switching should be provided for each amplifier operated by relays under the control of a contact on the loudspeaker group selection keys or microphone key, if fitted.

The output of the power amplifiers should be suitable for working into high impedance lines, so that all loudspeakers on any one circuit may be connected in parallel. The output switching should be effected by relays under the control of loudspeaker selection keys on the control cabinet.

All components should be readily accessible for inspection and easily removed without removing other equipment, Resistor and capacitor banks should be so positioned as to avoid overheating due to heat generated by valves or other components, and the type of wiring and its position be such as to ensure that it is not adversely affected by heat generated in the amplifier.

All components should be clearly marked in an approved manner with their value, valve holders being marked to show the type of valve employed. Diagrams clearly showing the position of all components should be provided.

Tone controls should be such as to allow for the independent attenuation of the lower and higher frequencies as required. Tone and gain controls should be so arranged as to prohibit interference by unauthorised persons.

Each amplifier should be protected by means of a removable cover with adequate ventilation.

Fuse holders must be of robust construction and each fuse clearly designated. Where tubular glass fuses are employed, the holder shall be of the type in which each fuse contact is firmly gripped by clips, or other type approved by the Railway Executive.

Facilities for valve testing shown under Section 6, " Amplifier Racks," are also desirable in cabinet amplifiers.

The following information concerning each type of amplifier will be required from the Contractor before purchase :–

Class of output stage (power amplifiers).
Power consumption.
Input impedance.
Output voltages and impedances.
Input voltage to produce full rated output. Rated output.
Percentage variation in output power and voltage when the output loading is changed from rated output to half rated output and from rated output to twice rated output.
Schematic, layout and wiring diagrams.

8. LOUDSPEAKERS (GENERAL)

In general, a low power diffusion type of loudspeaker should be employed, although suitably placed multi-unit loudspeakers may be used on areas such as a concourse or large circulating area. Cabinet loudspeakers may be employed in small rooms such as waiting rooms, and it may, in some cases, be necessary to make use of projection loudspeakers. The practice of serving the open ends of platforms by means of projection loudspeakers mounted at the ends of the awning roof should not be adopted when it is possible to serve these areas adequately with loudspeakers operating at relatively low volume.

Loud speakers in refreshment rooms should be connected to independent circuits and switches on the announcer's control cabinet so that announcements can be limited to selected items. Details of the equipment and fixing must be approved by the local representative of the Hotels Executive, and that Executive must be informed of all new proposals involving its premises so that arrangements can be made for the necessary liaison.

In order to meet standard clearance requirements, no part of any loudspeaker should be lower than 8 feet above platform level or less than 4 feet from the platform edge when viewed in plan, but there may be instances where these figures require modification in order to give sufficient clearance from overhead traction conductors.

All loudspeaker driving units should be of the moving coil type with permanent magnet, with terminations suitable marked to assist in phasing. They should be so designed that they can be readily inspected or withdrawn for attention. Diffusion and projection loudspeakers must be weatherproof and adequately protected and finished in order to give satisfactory service without undue deterioration under weather and general conditions obtaining on railway station platforms in the British Isles. The metal work of horns and casing of loudspeakers should be protected from corrosion in accordance with the current recommendations of the Railway Executive Director of Research.

All loudspeakers should be suitable for connection to high impedance amplifier outputs.

Impedance matching transformers, tapped to enable the output from individual speakers to be varied to suit local circumstances, should be mounted inside the loudspeaker unit casing and not attached externally, and the leads should be terminated inside the casing, entering at the rear or bottom according to type.

The following information regarding each type of loudspeaker complete with transformer will be required from the Contractor before purchase :–

Type.
Details of construction.
Details of material and finish of all casings and of projection loudspeaker horns.
Details of directional properties including polar curves, if available.
Impedance of speech coil at average speech frequencies.
Full details of impedance ratios and connections of matching transformers.
Maximum power handling capacity.
Weight.
Drawings showing fixing arrangements and all main dimensions.
Diameter of cones.
Details of any volume control device incorporated.

9. LOW POWER DIFFUSION TYPE LOUDSPEAKER

The cones should be "damp-proofed" and the air gaps well shielded to prevent the entrance of dust.

The diffusion type of loudspeaker should be designed on the assumption that it will normally be mounted above 8 feet and below 12 feet from platform level, depending on circumstances; spacing between loudspeakers being between 40 and 60 feet. The spacing of available mounting points should be taken into account when selecting the model of diffusion loudspeaker to be adopted for the particular station. It should be noted that some models offered by Contractors may not be suitable for 60 feet spacing.

Mounting arrangements will, of necessity, vary somewhat from station to station, but when loudspeakers are required on open platforms or on the open ends of platforms where use can be made of lamp posts of standard design, mounting shall be in accordance with the methods and details agreed as standard with the Railway Executive Architect and the dimensions and weight of the loudspeakers shall satisfy the agreed requirements.

10. MULTI-UNIT TYPE LOUDSPEAKER

The cones of multi-unit loudspeakers of the baffle type should be "damp-proofed" and the air gaps well shielded to prevent the entrance of dust.

11. PROJECTION TYPE LOUDSPEAKER

The projection type loudspeaker should be fitted with a narrow throated horn or be of the re-entrant type, the driving unit and associated line transformer being totally enclosed. The screw thread coupling the driving unit to the horn should be 18 threads per inch (Whitworth Form), having an external diameter of 1 inches.

An adjustable suspension bracket should, unless otherwise specified, be supplied with each loudspeaker to enable it to be suspended by means of a single bolt from a fitment which will be supplied by the Railway Executive. This bracket, which should be attached to the. loudspeaker at the point of balance, shall provide means of horizontal and vertical adjustment.

12. CABINET TYPE LOUDSPEAKER

The loudspeaker should be fitted in a wood or metal cabinet finished to harmonise with the general decorations and an internal tapped transformer should be incorporated.

The cone should be “damp-proofed” and the air gap well shielded to prevent the entrance of dust.

Loud speakers in refreshment rooms should be generally of the cabinet type designed, so far as practicable, to match the furnishing of the room, and they should be suitably located to obviate interference to staff serving at counters.

13. MICROPHONES

The microphones should normally be of the moving coil or ribbon type and be mounted on adjustable table stands of height suitable for operation in a sitting position. In some cases where plug-in points are used from platform positions, moving coil hand microphones may be required.

A microphone forming an integral part of the control cabinet may be considered, in which case the microphone unit should be readily detachable.

Post Office type 404 plugs and type 19 jacks are suitable for use with plug-in microphones.

The following information may be required from the Contractor before purchase :–

Type.
Directional properties-polar curves, if available.
Sensitivity at 800 cycles/sec. expressed as the open circuit voltage level below 1 volt per dyne per square centimetre.
Impedance. Transformer ratio.
Details of any capacitors fitted for tone correction.
Limits of stand adjustment expressed in microphone height above table level.
Weight and dimensions in the case of portable microphones.

14. CONTROL CABINET

The control cabinet should be suitable for standing on the Announcer’s table, and be fitted with a sloping front panel carrying the following equipment, as required :–

(a) Telephone lever type keys to select the required loudspeaker circuits.
(b) One speak key.
(c) Engaged indication lamps.
(d) Output level indicator.
(e) Telephone call lamps and keys.
(f) “Microphone on” lamp.
(g) Pilot lamp to indicate that equipment is switched on.
(h) Special lamps and keys, e.g., “Train ready to start” warning.

When there is more than one announcing point, consideration should be given to interlocking between circuits in addition to engaged indication lamps.

The cabinet should be made of hardwood suitably matt polished, pressed steel or cast light alloy. The excessive use of chromium plating should be avoided.

The circuit selecting keys should be of the locking lever type and be fitted with designation labels. The operation of a key in a downward direction should bring into use the appropriate loudspeaker circuit. The circuit selection keys should be fitted with contacts for controlling the high tension switching relays if required.

The cabinet should be fitted with a removable back and the sloping front panel hinged at the lower edge or at one end to allow easy access to the keys and wiring.

The wiring of the keys should be carried out in cable form with sufficient slack left in the cable to allow the keys to be removed from the front panel for inspection. The wiring should be taken to any spare loudspeaker circuit selecting keys that may be specified and suitable terminals provided for connection of the external wiring.

Details regarding the overall dimensions of the cabinet and the number and class (e.g., whether screened) of wires required between the amplifier and control cabinet should be provided by the Contractor prior to purchase.

Subsidiary control boxes required at points external to the Announcer's room for portable microphones should be reasonably weatherproof. Standard cast iron electrical junction boxes can be suitably adapted for use at external plug-in points.

Employing P.O. type 19 jacks, two contacts can be utilised for relay switching purposes by strapping together the two corresponding contacts on the type 404 plug. Selection of circuits from an external plug-in point can be catered for by providing one socket for each circuit or group of circuits, the selection being made by plugging into the appropriate socket, the desired switching conditions being set up automatically. A junction box having internal dimensions of 4 x 4 x 2 in. will house one type 19 jack and terminal strip, while five jacks can be fitted into a box having internal dimensions of 14 x 4¾ x 3½ in.

15. MAINS SUPPLY

The power consumption of the whole equipment, (a) under "stand-by" conditions, and (b) during periods of announcing, should be quoted by the Contractor.

In large installations a meter indicating the mains supply voltage should be provided on the amplifier rack.

16. TELEPHONE CIRCUITS

When separate Announcer's information telephone circuits are incorporated in the public address equipment, the circuit arrangements should be such that the Announcer is able to ring all points and vice versa. Inter-calling between the out station points will not be required. Code ringing to the out stations will be permitted, but on incoming calls, when the microphone switch is operated, the call must operate the lamp indicator on the Announcer's control panel and not give an audible signal. When the microphone switch is normal, an incoming call should operate a common bell or buzzer in addition to the lamp indication. Preference will be given to a circuit operating from the mains supply by means of a suitable power unit, both in respect of the Announcer's and out station telephones. Facilities should also be provided for terminating similarly a line from a C.B. or automatic telephone exchange but interconnection between this line and any other telephone circuits on the cabinet should not be possible.

Consideration should also be given to the provision of circuits enabling the station staff to signal to the Announcer when trains are ready to start.

The telephone circuits should conform to the requirements set out in the Appendix hereto, which consists of relevant extracts from Sub-Section 801 of the British Standard Code of Practice C.P.327.101 "Telephones and Telegraphs, Public Services."

17. SAFETY REQUIREMENTS

The equipment should be so constructed as to conform to Specification No. 415 of the British Standards Institution and reference should also be made to the Appendix hereto.

In general, the amplifier racks should be earthed to an earth plate provided for the purpose and should be bonded to the mains supply conduit.

18. DIAGRAMS

Full details of the proposed equipment, including drawings of the rack or racks, amplifiers and control cabinet, will be required with the tender.

Sufficient copies of all wiring diagrams and circuit theory diagrams, and of assembly drawings, should be supplied with the equipment. Alternatively, one set of linen tracings of all diagrams may be supplied.

The circuit diagrams should be marked with the normal voltages to be measured across the various resistances and with the component and terminal designations.

One copy of a circuit explanatory should be provided and the Contractor should quote the cost of additional copies when tendering.

B.S.I. symbols should be employed on the diagrams.

19. DEPARTURES FROM CODE OF PRACTICE

In the event of the Contractor being unable to comply completely with this Code of Practice, he should state, when tendering, all departures therefrom.

20. EXTERNAL WIRING

The circuits should be segregated in accordance with the Appendix hereto. The loudspeaker wiring should consist of any of the following types :

(a) P.B.J. insulated wire run on reel insulators attached to roof girders.
(b) 1/0.44-inch twin twisted lead covered cable V.I.R. insulated.
(c) 1/0.044-inch twin twisted tough rubber sheathed cable.
(d) 1/0.044-inch twin twisted plastic insulated and sheathed cable, in ducts or conduits if necessary.

Where vibration or movement of the loudspeakers is likely to cause wire breakage, plastic or tough rubber insulated flexible cable of suitable gauge should be used for the connection between line and loudspeaker. Care should be taken that loudspeakers are correctly phased.

For microphone wiring-apart from flexible leads – 1/0.044-inch T.T.L.C. cable or specially screened microphone cable should be employed, adequately separated from loudspeaker wiring.

In areas where the railway is electrified, lead sheathed cable should have a protective covering over the lead sheath in accordance with the Railway Signalling Cable Specification No. 4 (1947).

APPENDIX.

EXTRACTS FROM BRITISH STANDARD CODE OF PRACTICE CP 327.101

TELEPHONES AND TELEGRAPHS-PUBLIC SERVICES

801. SEGREGATION OF CIRCUITS

.1 INTRODUCTION.

This Appendix describes generally the conditions which should be observed for the purpose of reducing the probability of electrical interference between various classes of telecommunication circuit or between other circuits and telecommunication circuits, and of minimising the risk of dangerous voltages arising on telecommunication circuits. Sub-clause 801 .2 deals with interference and the remaining sub-clauses concern safety.

Code 413 contains recommendations with regard to the proximity of the various engineering services.

.2 ELECTRICAL INTERFERENCE.

.21 *Sensitivity to Interference.* According to their sensitivity to interference, telecommunication circuits may be divided into three categories :

(a) Circuits specially sensitive to interference from neighbouring circuits : these include audio-frequency-amplifier input circuits and radio-frequency distribution circuits.

(b) Circuits not specially sensitive to interference from neighbouring circuits and unlikely to cause interference except to circuits in category (a) : these include public and private telephone circuits.

(c) Circuits which are themselves not specially sensitive to interference but which, by reason of the relatively high level of the power carried, or the impulsive nature or relatively high frequency of the currents carried, are likely to cause interference in neighbouring circuits. This category includes telegraph, impulse clock, bell, alarm, signalling and audio-frequency-amplifier output circuits.

.22 *Reduction of Interference.* Interference can be reduced by the use of mechanically and electrically continuous metallic ducts or conduits, screened cable, or physical separation. Circuits of the. type referred to in (a) above should be run in screened cable, the screening being effectively earthed. The steps to be taken to avoid or reduce interference to or by other circuits will depend on the character and magnitude of the currents and lengths of run concerned in each installation.

.3 GENERAL SAFETY REQUIREMENTS.

.31 *Voltage limits.* Subject to the necessary precautions being taken to minimise electrical interference, telecommunication circuits may be run together in the same tube, groove or section, of a conduit, casing or duct system, provided that the voltage between any two conductors, or where a point in a circuit is connected to earth, between any of its conductors and earth, does not exceed : –

(a) for direct-current circuits, 150 volts (when measured under no-load conditions), or

(b) for circuits connected to a source of alternating current of unvarying maximum amplitude. 100 volts r.m.s. (when measured under no-load conditions), or

(c) for circuits connected to a source of alternating current of varying amplitude (e.g. audio-frequency distribution circuits) 175 volts peak (when the load is at the highest impedance to which it can be set by the user).

Such a telecommunication circuit may not, however, be run together with a telecommunication circuit operated at a higher voltage than the above, unless its wiring conforms to the requirements applicable to the wiring of the higher-voltage telecommunication circuit.

The wiring of any telecommunication circuit metallically connected to a public or private electricity supply system should conform to the recommendations of Code 321.

.32 *Separation.* As large a separating distance as is practicable should be provided between telecommunication cables and cables connected to a public or private electricity supply system. The minimum separations which should be allowed between telecommunication cables or conduit and electricity supply cables or conduit are as follows :-

.321 *High-voltage cables.* From single-core cables, at least 18 in. separation should be allowed and no exception to this requirement should be permitted. From twin and multicore cables (including concentric), there should be a normal minimum of 12 in., but this may be reduced in difficult circumstances, provided that, where the separation is not more than 6 in., a slab of concrete 2 in. thick is inserted between the two sets of cables. The slab of

concrete should be of such width and length that at every point the shortest path between the two sets of cable round the concrete is greater than 7 in.

.322 *Low- and medium-voltage cables for external distribution and leading into a building.* A normal minimum of 2 in., but where this is not possible a clearance of not less than 1 in., may be allowed, provided that wherever the separation does not exceed 2 in., a slab of concrete is inserted between the two sets of cable. This slab should be of such thickness as to fill the space between the two sets of cables where this does not exceed 2 in., and of such width and length that at every point the shortest path between the two sets of cables round the concrete is greater than 3 in.

.323 *Low- and medium-voltage cables for internal distribution.* The normal minimum separating distance between such cables and telecommunication cables is 2 in., and this distance should be maintained in all surface wiring except at crossings, where a bridge of suitable non-conducting material at least ¼ in. thick should be provided. Where a properly constructed duct or chase system of distribution is provided for both electricity supply and telecommunication cables, the minimum separating distance of 2 in. need not be. maintained, provided that separate ducts or chases are used for each service and that metallic ducts and chases are effectively earthed in accordance with the recommendations of Code 321.

.4 CIRCUITS ENERGISED FROM ELECTRICITY SUPPLY SYSTEMS.

A telecommunication circuit connected to apparatus energised by a low-voltage or medium-voltage electricity supply system may be regarded as operated within the voltage limits given above, provided the following requirements are observed :–

.41 No metallic connection is permissible between the supply system and the telecommunication circuit. Consequently, no circuit which is energised by a supply system through a series resistance or in which a potentiometer or floating battery arrangement is connected across a supply system can be regarded as operated within the voltage limits stated in Sub-clause .31.

.42 It is essential that any transformer used to isolate the telecommunication circuit from any circuit connected to the supply system should conform to the following requirements :–

.421 Unless the transformer will withstand a breakdown test at not less than 2000 volts r.m.s. at 50 c/s between the primary and secondary windings, these should be wound on separate limbs of the core, or be separated by a metal screen.

.422 The core and screen, if any, together with any metal parts not normally required to carry current should be connected to an earthed terminal, except that earthing is not required for metal parts which are so enclosed or shrouded by non-conducting material that they cannot be touched, and all metal parts on, or screws in (or through), non-conducting material and separated by such material from current-carrying parts and also separated by such material from earthed non-current-carrying parts in such a way that, in normal usage, they cannot become live or come into contact with earthed parts.

.423 The screen, if any, and any conductor used for connecting the screen or other metalwork to the earth terminal should be capable of carrying indefinitely, without appreciable temperature rise, a current of not less than twice the fusing current of the fuses in each non-earthed conductor connecting the transformer to the supply system.

.424 The insulation between each winding of the transformer and all other windings connected to the core and screen, if any, should withstand the tests specified for the insulation of isolating components in B.S. 415.

.43 The clearance and creepage distances between (a) the wiring and terminals on the supply side of any transformer and any associated apparatus and (b) the wiring and terminals on the telecommunication side thereof should be adequate to avoid failure under such conditions as may arise from the deposition of dust and moisture. The minimum distances are those specified for isolating components in B.S. 415. Terminals shrouded with insulating material are preferable.

.5 CIRCUITS ENERGISED FROM SECONDARY CELLS.

A telecommunication circuit deriving energy from a power system using duplicate secondary batteries charged alternately by means of a metallic connection to a low-voltage or medium-voltage supply system may be regarded as operated within the voltage limits defined above, provided that the following requirements are observed :-

.51 At no instant during the change-over operations should it be possible for either battery to be connected simultaneously to both the supply system and the telecommunication circuits.

52 The type and spacing of the components (terminals, switch-blades, etc.) should be such as to eliminate all possibility of accidental contact between the supply system and the telecommunication circuits.

.53 The insulation resistance between the supply system and the telecommunication circuits should not be less than 20 megohms when measured by the application of 500 volts D.C.

.6 CIRCUITS CONTROLLING OR CONTROLLED BY LOW-VOLTAGE OR MEDIUM-VOLTAGE SUPPLY SYSTEMS.

A telecommunication circuit controlling or controlled by apparatus energised from a low-voltage or medium-voltage supply system may be regarded as operated within the voltage limits defined in sub-clause .31 above, provided that the following requirements are observed :

.61 No metallic connection between the supply system and the telecommunication circuit is permissible.

.62 Any transformer used to isolate a circuit connected to the supply system from a telecommunication circuit together with its wiring should conform to the requirements of sub-clauses .422 and .423.

.63 In any relay, contactor or other device having coils connected to the telecommunication circuit, and contacts directly connected to a higher-voltage circuit or vice versa, adequate mechanical separation to minimise the risk of accidental contact should be provided between the parts connected to the telecommunication circuit and parts connected to the higher-voltage circuit. The insulation between parts connected to the telecommunication circuit and parts connected to higher-voltage circuits should be tested in accordance with specification R.C.S. 161.*

.7 CIRCUITS ASSOCIATED WITH HIGH-VOLTAGE SUPPLY SYSTEMS.

.71 Telecommunication circuits in any way related to or in close proximity to high-voltage equipment require special attention, and due consideration should be given in all cases.

.72 Where a telecommunication circuit is provided in a building where the neutral of a system of 33 kV or above is earthed, and the telecommunication circuit forms parts of, or is electrically connected to, a system outside the earth-electrode area † the following precautions should be taken to safeguard the circuit in the event of a fault on the power system causing a dangerous rise of station earth-electrode voltage :–

.721 As great a separation as possible should be provided between the telecommunication circuit‡ and the station earth-electrode system.†

.722 Where the separation described in Sub-clause .721 above is less than 20 ft., the terminal equipment should be insulated from the station earth-electrode system† by an insulating barrier capable of withstanding the application of 15 kV r.m.s. A.C. momentarily, and 5 kV r.m.s. A.C. for two minutes. Telecommunication underground cables should be lead-sheathed and have an insulating covering over the sheath capable of withstanding the same voltage. The position of the terminal equipment should be selected so that it is not possible for the user to make contact with any earthed metalwork.

.723 Any earth connection required by the telecommunication circuit should be made to the lead sheath(s) of the external lead-in cable(s) or, where an overhead lead-in is used, by means of a cable, insulated as described above, to an earth-electrode situated not less than 20 ft. from the station earth-electrode system.. †

.73 Similarly, where a private telecommunication system situated within such a building has subsidiary circuits outside the station earth-electrode area, the subsidiary circuits will need protection as follows :–

.731 External underground cable and lead-in should be lead-sheathed, and the sheath insulated as described in sub-clause .722 above and earthed more than 20 ft. from the station earth-electrode system.† Conductors of internal cable should be insulated from earth to withstand the voltage prescribed in sub-clause .722 above. An insulating barrier for the terminal equipment should be provided as in sub-clause .722 above. The position of the equipment should be selected as in sub-clause .722 above.

.732 Alternatively, an isolating transformer or barrier relay insulated to the voltages prescribed in sub-clause .722 above may be fitted in the line so that there is no metallic connection between the telecommunication system and the subsidiary circuits.

---

* Issued by the Radio Components Standardisation Committee, Thames House, Millbank, London, S.W.1.

† The earth-electrode system of a station includes all metalwork, such as cable sheaths, pipes and frameworks, situated within 100 yd. of the earth-electrodes and bonded to them, and the first three supports of any overhead line leaving the station.

The earth-electrode area includes all points within 20 ft. of the earth-electrode system defined above.

‡ The term " telecommunication circuit " includes external lead-in, internal wiring and all apparatus connected thereto.