

Lighting Refurbishment Works Sligo Training Centre

GENERAL ELECTRICAL SPECIFICATION MSLETB-STC-LED -GES-1

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GENERAL

The intention of this specification and the drawings issued is to describe and provide for a complete installation. The Contractor is advised that the work to be executed as described in these documents shall be complete in every detail, notwithstanding that every item involved may not be specifically mentioned or described. The Contractor shall be held to allow for all materials and labour necessary for an entire and complete installation and shall not avail of any unmentioned error or omission should such exist.

1.0 LOW VOLTAGE SWITCHGEAR

1.1 General requirements

Switchgear comprising switchboards and loose gear shall be provided as described herein, detailed in the schedules and/or as indicated on the drawings. Final configuration and equipment selection to be confirmed by contractor on site prior to manufacture.

All switchboards and as far as practical all items of loose gear shall be of the same manufacture but, in any case, all items of like kind shall be of the same manufacture and shall be interchangeable wherever possible.

1.2 Switchboard enclosures

Load centres shall be of sheet steel cubicle of modular design. They shall be constructed as factory built assemblies in accordance with IEC 439 and BS 5486.

Each switchboard shall provide a degree of protection against contact with live or moving parts, against the entry of foreign solid bodies and liquids, to the IP standard as specified in the schedules in accordance with the definitions contained in BS 5420 and BS 5490, but in any case shall not be less than IP43.

Cable terminations and space for terminations shall be suitable for the sizes of cable called for in the design and shall not be limited to mere compliance with BS 5486.

Circuit - breakers in switchboards shall comply with BS 4752: Part 1.

Fuse distribution boards shall comply with BS 5486: Part 11 and miniature circuit - breaker boards with BS 5486: Part 12.

Motor starters shall comply with the Specification section on Starters and Control Gear.

Fuse - switches and switch - fuses shall comply with BS 5419 and shall be fitted with bolted fuse - links of the appropriate class, rating, voltage and characteristics for the duty required.

Fuse links for fuse - switches, switch fuses and distribution boards shall be powder filled HRC cartridge type as specified in BS 88: Part 1. Detailed requirements for fuses are given elsewhere in this specification.

Moulded case circuit - breakers (MCCB's) shall comply with BS 4572: Part 1 and shall be of the current limiting type with inverse time delay, instantaneous short circuit, and earth leakage trips.

Disconnectors and switch - disconnectors shall be to BS 5419 and be of ratings suitable for the equipment served and with fault capacities compatible with the remainder of the equipment on the switchboard.

All main switchboards shall be self - contained, free standing, floor mounted, surface fronted, multi - cubicle Form 4 or multi - box type as called for in the schedules and shall be constructed in sections where necessary to facilitate transport and erection.

On - site fabrication of switchboards is not permitted and shall not be undertaken on this sub - contract.

The main earthing terminal shall consist of a copper earth bar sized in accordance with CP 1013 for the prospective short circuit current stated in the schedules. The earth bar shall be unjointed except between cubicle sections and shall extend through the length of the switchboard. The earth bar shall be connected to the earth conductor via an external test link. Earth bar sizes shall be the metric equivalents of the figures in CP 1013 and 25 mm x 5 mm is the smallest acceptable size. Each cubicle and all protective conductors shall be bonded to the earth bar.

All disconnectors, switch - disconnectors, switches and circuit - breakers shall be provided with the means to enable them to be locked in the 'off' position. When used as earthing switches they shall be capable of being locked 'on' when closed to the earth connection.

The busbars and the connections to them to the various items of switchgear shall be manufactured from tin plated hard drawn high conductivity copper, and the whole busbar assembly shall comply with BS 159.

Busbars shall be supported on non - hygroscopic, non - tracking insulators of sufficient strength to withstand, without damage, the forces set up, either by thermal effects during normal operation or by electromagnetic effects during short circuit fault conditions.

Busbars shall be housed in separate compartments, which shall not contain any wiring or apparatus other than that for connecting to the busbars.

Access to busbars and busbar connections shall be possible only after the removal of covers secured by bolts or studs. Such covers shall be identified externally by Formica engraving laminate labels bearing the inspection 'BUSBARS' in black lettering not less than 10mm high, on a white background.

1.3 Current Transformers for Metering

Where so specified on the schedules or the drawings, provision shall be made for metering current transformers to be installed by the Statutory Undertaking.

1.4 Instruments and Meters

Each switchboard shall be equipped with the instruments, meters, and the associated apparatus as detailed in the schedules or shown on the drawings.

When it is a requirement that space be allowed for the accommodation of the Statutory Undertakings' metering equipment, the Contractor shall be responsible for making contact

with the Statutory Undertaking, determining what the requirements are, and making the necessary provision in the switchboard.

All instruments, meters, and associated apparatus shall comply with the detailed requirements set out elsewhere in this specification under the heading 'Instruments and Metering'.

1.5 Indicator lights

Indicating lamps, including BS colour in accordance with BS 4099: Part 1.

1.6 Labeling and Marking

Each incoming and out going circuit on the switchboard shall be clearly identified on the front panel by means of an engraved label bearing, in black letters on a white background, the legend given the schedules.

The labels shall be of Formica engraving laminate with lettering not less than 5mm high and shall be secured to the panel front with instrument headed machine screws. Where rear access is available labels shall also be fixed to the rear panels.

All equipment and apparatus, both inside and outside the switchboard, including instruments, meters and relays, which is not clearly identified by integral labeling, shall be adequately labeled in the manner described above for front - of – panel circuit labels.

1.7 Standards

The British Standards and the ETCI rules applicable to this section of the Specification include, but are not restricted to, the following:

STANDARD DESCRIPTION

BS 88 Cartridge fuses for voltages up to and including 1000 V a.c. and 1500 d.c.

BS 142 Electrical protection relays

BS 159 Busbar and busbar connections

BS 3871 Specification for miniature and moulded case circuit -breakers.

BS 4099 Colours of indicator lights, push buttons, annunciators and digital read outs.

BS 4727 Glossary of electrotechnical, power, telecommunication, electronics, lighting and colour terms.

Part 2: Group 06: Switchgear and control gear terminology (including fuse terminology).

BS 4752 Specification for switchgear and control gear for voltage up to and including 1000 V a.c. and 1200 V d.c.

BS 5419 Specification for air - break switches, air break disconnectors, air break switch disconnectors and fuse combination units for voltages up to and including 1000 V a.c. and 1200 V d.c.

BS 5420 Specification for degrees of protection of enclosures of switchgear and control gear for voltages up to and including 1000 V a.c. and 1200 V d.c.

BS 5486 Low voltage switchgear and control gear assemblies.

BS 5490 Specification for classification of degrees of protection provided by enclosures.

BS 6121 Mechanical cable glands

BS 6231 Specification of PVC - insulated cables for switchgear and control gear wiring

CP 1013 Earthing.

BS 5992 Electrical relays

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Code of practice for the design, selection and erection of low voltage switchgear assemblies published by the Electro - Technical Council of Ireland.

2.0 CABLE INSTALLATION

2.1 General

All cables shall comply with British and IEC standards and all conductors shall be copper.

All cables shall be delivered to site with the manufacturers' seals, labels, or other proof of origin intact. Such labels and seals shall not be removed until the cable is required for use, and shall be retained for inspection.

2.2 Cable installation

All cables shall run directly from point to point without joints unless the length required is in excess of the length obtainable in one piece from the cable manufacturer, in which case all joints shall be shown on the installation drawings.

No other joints, whether straight through or tee, will be permitted unless specifically called for on the drawings or elsewhere on this Specification.

All cables shall be protected against mechanical damage. Non - sheathed cables shall be protected by enclosure in Trunking and/or conduit. Sheathed cables shall be run and clipped so as to obviate the risk of damage in normal operation.

PVC insulated cables shall not be installed in locations where the ambient temperature is 0 degrees C or lower or 65 degrees C and higher.

Cables shall not be buried in walls, floors or ceilings unless they are enclosed in conduit or trunking or are suitably protected against corrosion and mechanical damage. Buried cables shall always be run either horizontally or vertically.

Where cables run through floors, walls etc. the hole shall be made good with cement or other suitable fire resisting material.

Cables shall be handled, terminated and installed in accordance with the cable manufacturers' recommendations. The technical advice of the manufacturers' specialists shall be followed if any special conditions or unusual circumstances apply.

Where cable sizes are not indicated on the drawings or in the Cable Schedules, the Contractor shall be responsible for determining the correct size of each cable.

Cable sizes shall be determined on the basis of current rating and/or voltage drop and/or earth loop impedance, together with an allowance for grouping with other cables and the method of installation, whichever is relevant, after taking into account the type of cable, the ambient conditions, the method of installation and the disposition of each cable relative to other cables.

2.3 PVC sheathed - steel wire armoured PVC insulated cables

Main distribution cables shall be PVC sheathed steel wired armoured, PVC insulated with stranded copper conductors to BS 6346: 1969.

Spacing of cable supports shall be in accordance with the following table:

OVERALL DIAMETER (mm)	SUPPORT SPACING HORIZONTAL (mm)	SUPPORT SPACING VERTICAL (mm)
Up to 15	350	450
15 to 20	400	550
20 to 40	450	600
40 to 60	700	900
Over 60	1100	1300

Minimum internal radius of bend of cables shall be in accordance with IEE regulations Table B1.

Cables run on internal routes shall be spaced such that the clearance between cables is not less than eight times the overall diameter of an individual cable.

Cables shall be unjointed throughout their length. Parallel cables shall run along the same route.

Conductors shall terminate at equipment in soldered or crimped cable lugs of an approved type as recommended by the cable manufacturers.

Cables installed externally shall either be laid direct in trenches or drawn through duct as indicated on the drawings.

When cable trenches are opened, all cables shall be laid and the trenches shall be backfilled within 24 hours.

Cables shall be laid to a minimum depth of 600 mm in open ground and 750 mm under roadways.

2.4 PVC, Polythene, XPLE and EPR Insulated Cables

Cables shall be armoured and PVC sheathed. Multi - core cables shall be steel tape or single wired armoured and single core cables shall be aluminium armoured.

The insulation shall be coloured in accordance with ETCI Regulations.

2.5 Mineral insulated cables

Unless otherwise stated on the drawings or in the Cable Schedules, mineral insulated cables shall have conductors and sheath of high conductivity copper and insulation of compressed magnesium oxide or other approved mineral. They shall comply with BS 6207: Part 1.

Where an outer sheath is specified the material used shall be the non - halogenated, low smoke, reduced flame type such as CCM.

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All mineral insulated cables to be installed as mains cables shall be of the heavy duty (1000V) class, and shall be provided with a continuous extruded covering of orange CCM or similar non - halogenated thermoplastic elastomeric hybrid. Fire alarm cabling shall have red covering.

Cables shall be screw - on type capable of resisting a temperature of 135 degrees C.

Cable glands shall be stranded compression over which shall be drawn a PVC shroud.

Cables shall be fixed to the structure using spacer bar saddles. Spacing of saddles shall be according to the following table:

OVERALL CABLE DIAMETER (mm)	SUPPORT SPACING HORIZONTAL (mm)	SUPPORT SPACING VERTICAL (mm)
Up to 10	350	450
10 to 15	450	550
15 to 20	500	600

Minimum internal radius of bend of cable shall be not less than six times the overall diameter.

All cable terminations to motors shall be fitted with non - linear resistor type surge divertors supplied by the cable manufacturers and connected across each line.

Where cable passes through horizontal floors galvanized conduit cable sleeves shall be provided to a height of 200 mm above floor level.

2.6 Twin and multi - core Sheathed Cables

Twin and multi - core sheathed cables for installation on building surfaces or on cable tray shall be one of the following:

a) Unarmoured PVC insulated, PVC sheathed, 300/500-volt grade twin and multi - core non - flexible cables with stranded copper conductors complying with table 4a, 5a, and 6 of BS 6004, except that cables with conductors of 1.5mm sq. may be single strand.

b) Armoured PVC insulated, PVC sheathed, 600/1000-volt grade twin and multi - core cables with stranded copper conductors complying with BS 6346.

Unprotected PVC cables to BS 6004 shall not, under any circumstances, be installed externally, or be embedded in concrete.

Cables run along structural steelwork shall be secured with purpose - made girder clips not requiring drilling of the steelwork.

Cables shall not be embedded in the building fabric.

Cables shall not be connected to motors or other apparatus subject to vibration.

Cables shall be terminated in a BS conduit box or suitable adaptable box adjacent to the motor or apparatus and final connection shall be made with PVC single core cables in flexible conduit.

Cables fixed to the building structure or to cable tray shall have clips or saddles spaced at regular intervals according to the following table:

OVERALL DIAMETER OF CABLE (mm)	FIXING CENTRES HORIZONTAL (mm)	FIXING CENTRES VERTICAL (mm)
Up to 9 inclusive	250	400
Above 9 and up to 15 inclusive	300	400
Above 15 and up to 20 inclusive	350	400
Above 20 and up to 40 inclusive	450	550

Cable saddles and clips shall be fixed to the building fabric or to cable tray as follows:

- a) Building fabric - brass round head screws and fibrous or approved plastic plugs.
- b) Galvanized trays in wet conditions - zinc coated and round head screws, nuts and washers.
- c) All other cable trays, including plastic coated trays - brass round head screws, nuts and washers.

Cables shall be fixed 150mm on either side of a bend or set.

The minimum internal radius of bend shall be six times the overall diameter of the cable.

2.7 Fire Alarm Wiring

The wiring of the Fire Alarm Installation, which shall be carried out in a 2-core 1.5mm² loop "Prysmian FP Plus" Fire Alarm cable (rated @ 120 min in accordance with I.S. EN 50200 and BS 8434-2:2003 + A2: 2009) in an 25 mm dia continuous re-wireable dedicated steel conduit / trunking system,

3.0 INSTALLATION OF CONDUIT

Conduit shall comply with BS 4568: Part 1 and shall be galvanized screwed throughout. Conduit fixings and components shall comply with BS 4568: Part 2.

Conduit erection shall be completed before cables are drawn in. Adequate allowances shall be made for variations in building dimensions so that conduit or cables are not subjected to undue stress.

The internal surfaces of conduit installations shall have no sharp edges or protruding parts, which might damage the insulation of cables.

An inspection box of adequate size shall be provided at any point where a cable connection is made.

Conduit fittings without inspection facilities shall be used only in the following locations:

- a) The ends of conduits immediately behind a light fitting outlet box or inspection fittings.
- b) Elbows or tees located not more than 500mm from a readily accessible outlet box in a conduit run not exceeding 10m between two outlet points, provided that all other bends in that conduit run are not more than the equivalent of one right angle.

All unused conduit entries shall be sealed off and all removable covers firmly secured to complete the enclosure.

Suitable drainage outlets shall be provided at points where condensation is likely to collect. Adequate natural ventilation shall be ensured.

Conduit is considered to be an exposed conductive part, which shall be connected to the protective conductor in the installation. Flexible metal conduit shall not be used as the protective conductor, therefore a separate earth wire shall be provided inside the conduit binding the apparatus to the solid conduit system.

Conduit runs shall be determined on site by the Contractor and agreed with the Engineer before work commences. Conduit shall be run at least 150mm clear of plumbing and mechanical services.

Conduit run on the surface shall run through horizontal or vertical or parallel with the features of the building. Conduit buried in concrete shall have at least 35mm depth of cover over its entire length. Conduit buried in plaster shall have at least 5mm depth of cover over its entire length.

The length of thread in the ends of conduit shall suit the length of internal thread in the end of the fitting or accessory. Excess length of thread will not be permitted. All threads shall be painted with metallic paint before the next fitting is screwed on and shall be screwed up tight to make a good mechanical and electrical connection.

Conduit couplings. Standard conduit couplings shall be used to terminate conduits at adaptable boxes, distribution boards, switchgear, switch boxes etc. A male brass bush shall be screwed into the coupling from inside the box to make a good mechanical and electrical connection. All 'running couplings' must be securely locked with locking nuts.

Conduit shall be supported at regular intervals, not exceeding 1.2m on horizontal runs and 1.5m on vertical runs. Surface supports shall be spacer bar saddles with brass fixing screws. Conduits in chases shall be fixed by means of heavy gauge crampits at least 40mm long.

Conduits run on steel girders, purlins, etc. shall be securely fixed by means of proprietary clips. Under no circumstances will drilling of steelwork be allowed.

Where conduit is run on fair faced blockwork, accessories and saddles shall be fixed on the centre of the block, with vertical conduit drops run on the joint line of the blockwork. Conduit routes shall be agreed on site between the Engineer and the Contractor, as shall the position of draw - in boxes etc.

Where the conduit system serves vibrating or moveable machinery the final connection shall be made using PVC covered flexible steel conduit conforming to BS 731 (type Kopex or similar approved). Connection to rigid conduit system shall be by malleable iron conduit through box with earth stud or other accessory (e.g. isolator) as specified elsewhere. An earth wire minimum 2.5 sq. mm CSA shall be run in the flexible conduit connected between the conduit box/accessory and the item of equipment to be connected.

The number of cables drawn into any conduit shall be in accordance with the IEE Regulations (latest edition) or shall be such that a space factor of 40% is not exceeded.

4.0 INSTALLATION OF TRUNKING

4.1 General

Surface mounted trunking shall be run truly horizontal or vertical. Where these requirements cannot be met trunking shall run parallel to the building lines, and shall be installed in a neat and workmanlike manner. Manufacturers' standard fittings shall be used for all connections and changes of direction. Cutting and bending trunking to form flanges and attachments shall not be permitted. The standard length of trunking used shall not be less than 2m. Cable retaining straps shall be fitted at intervals not exceeding 1m. Trunking shall be properly aligned and securely fixed at regular intervals not exceeding 2m on straight runs. Where bends, angles or offsets occur, additional fixings shall be supplied at a distance not exceeding 150mm on each side of the accessory.

Where trunking passes through walls, floors and ceilings, non - combustible, non - metallic fire barriers shall be installed in the trunking. Similar barriers shall be installed in vertical trunking run in riser ducts, at intervals not exceeding 3m.

4.2 Metal trunking

Trunking and connectors shall be manufactured generally in accordance with BS 4678: Part 1.

Metal thicknesses for body and cover material may exceed those of Table 1 in BS 4678.

Metal thicknesses for all trunking and connectors having external dimensions in excess of 150mm x 150mm shall be shown on the Fabrication Drawings. In no circumstances shall the thickness be less than that specified for the largest trunking detailed in BS 4678: Part 1.

Trunking and connectors for internal use shall be finished with Class 3 protection in accordance with BS 4678: Part 1. When used externally protection shall be class 3.

All joints between trunking sections, between trunking and conduit, or trunking and switchgear shall be mechanically sound, and shall be such as to ensure that cables being drawn in shall not suffer any damage or abrasion.

Lengths of trunking shall be efficiently bonded to each other using strip copper links not less than 12mm wide x 1.5mm thick and fixed with brass nuts, bolts and serrated washers. A copper earth link mounted externally shall be provided between each length of trunking and fittings to give an efficient earth throughout the system. The earth continuity links across such joints shall be made of copper braided tape not less than 15mm wide x 2mm thick having a resistance from fixing to fixing equal to or less than the links used for the standard trunking joints.

The braid shall be long enough to allow for the maximum movement of the trunking. The braid ends shall be folded, and sweated solid.

Trunking shall be erected complete before the insertion of any cables and all entries to trunking shall be placed or so protected as to eliminate the possibility of water entering the trunking.

Vertical trunking shall be supplied with a cable support unit with insulated pins at intervals not exceeding 3m.

Horizontal trunking sizes exceeding 100mm x 50mm shall be supplied with cable separators with insulated pins at intervals not exceeding 2m.

Connections to conduit, multiple boxes, switchgear and distribution boards shall be made with flanged units.

Where trunking crosses settlement and expansion joints a trunking joint shall be made. The connector at this point shall be made with slotted fixing holes to permit a movement of 10mm in both the horizontal and vertical planes.

The number of wires drawn into trunking or under floor duct shall not exceed the number determined by means of the rules set out in the ETCI Wiring Regulations, and shall not occupy more than 40% of the cross sectional area of the trunking.

The number of cables to be installed in trunking shall be such as will permit easy drawing in without damage to the cables and shall in no circumstances be such that a space factor of 45% is exceeded. Cabling within any trunking shall not be grouped together with cable ties, insulation tape or any other similar product.

All trunking going through fire walls and ceilings shall be fire stopped using Intumescent fire blocks in and around the trunking in the approved manner. (The Contractor and his Electrical Contractor shall determine on site where these fire walls are actually located, and provide for all fire stopping of the new LV and ELV trunking system where they pass through the fire walls and ceilings as necessary).

5.0 INSTALLATION OF CABLE TRAY

Cable trays shall be perforated and manufactured from cold rolled mild steel in accordance with BS 1449: Part 1.

All accessories including bends (vertical and horizontal), intersections, tees, risers and reducing sections shall be purpose made by the tray manufacturer. Only the manufacturers' tray and accessories shall be used on the project.

The thickness of normal cable tray and accessories shall comply with the following table:

WIDTH OF TRAY ACCESSORY (mm)	MINIMUM THICKNESS (mm)
Up to and including 152	1.0
Above 152 and up to and including 254	1.2
Above 254 and up to and including 457	1.5
Above 457 and up to and including 914	2.0

Where heavy-duty cable tray is shown on the drawings or where the span between the supports and/or cable loading necessitates its use then the thickness of tray and accessories shall comply with the following table:

WIDTH OF TRAY ACCESSORY (mm)	MINIMUM THICKNESS (mm)
Up to and including 457	1.5
Above 457 and up to and including 914	2.0

Heavy-duty cable trays shall be manufactured with plain return flanges.

Except where specified or shown otherwise the Contractor shall be responsible for the selection of the correct grade of cable tray to meet the site conditions and the requirements of this Specification.

Where cable tray detailed on the drawings necessitates fabrication, full details shall be shown on the Fabrication Drawings.

Sections of cable tray and accessories shall be jointed in accordance with the recommendations of the manufacturer or alternatively by using mushroom - head roofing bolts, nuts and washers.

Cable tray and accessories shall be supplied with a hot dip galvanized finish to BS 729. Any damage caused to the tray, accessories and finish during cable installation and prior to Practical Completion shall be made good using either a zinc rich epoxy primer or similar approved with a generous overlap on the existing sound metal coating. The jointing screws, nuts and washers shall all be galvanized or sheradized steel, brass shall not be used.

Cable tray shall be supported at not greater than 1.5 metre centres, but in no case shall the deflection at mid span exceed 10 mm.

A separate earth bonding conductor of the appropriate size shall interconnect with the cable tray. A copper earth bonding strip shall be provided across all joints on the cable tray.

6.0 ACCESSORIES

6.1 General

Accessories shall comply fully with the relevant British Standards quoted in the later clauses referring to specific accessories.

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All accessories shall comply where applicable with the general requirements specified in BS 5733 and BS 6220.

Each type of accessory where applicable shall be of the same manufacture and where necessary be of the same makers catalogue number or description to provide consistent appearance and finish.

Flush mounting accessories shall be fitted into purpose made metal boxes only, and surface-mounting accessories shall be fitted onto metal or all insulated moulded boxes as shown on the drawings or in the schedules.

All boxes or sections of boxes for use with accessories must incorporate a suitably marked earth terminal. Accessory plates shall be secured to boxes by not less than two fixing screws. Where these fixing screws do not provide adequate earth continuity to metal plates or plates including parts to be earthed then a bonding connection shall be provided from the earth terminal to the plate or part.

The bonding shall be protected with a green/yellow-insulating sleeve. The above requirement shall not apply to the earth socket on a socket outlet when directly connected to a protective conductor.

Where more than one phase of a supply exists in a multigang box the following requirements shall apply:

A clearly visible label showing the maximum voltage present shall be arranged as a warning notice before access can be gained to live parts.

Wiring and accessories connected to each phase shall be separated from each other by fixed screens or barriers.

6.2 Socket outlet and plugs

In general, socket outlets for use at 220 V single phase shall be shuttered three - pin (two pole and earthing pin) to BS 1363 and corresponding plug tops shall be 3A or 13A fused to BS 1362.

Plugs and sockets for use at 380 V shall comply with BS 4343 and CEE 17.

Unless otherwise stated they shall be manufactured in high impact resistant plastic (polyamid 6) and be waterproofed to IP 55 (IECI 144). Voltage identification colour coding shall be as follows:

VOLTAGE COLOUR

20/25 V Violet

40/50 V White

300/440 V Red

110/130 V Yellow

500/750 V Black

220/240 V Blue

6.3 Lighting switches

Lighting switches for the control of lighting circuits shall be quick make, slow break type connected in the phase wire. Metal plate switches shall be earthed.

All switches shall comply with BS 76. Switches in out buildings shall be of weatherproof construction to protection level IP 54 of BS 5490.

6.4 Spare

6.5 Ceiling roses

Ceiling roses shall consist of a base and cover moulded in brown/white non – tracking insulating material to BS 1322 and complying with BS 67.

Ceiling roses shall be complete with brass terminals including earthing terminal, with break joint ring where installed in plastic ceilings.

6.6 Lamp holders

Lamp holders shall comply with the relevant British Standard and be provided for use with lamps as follows:

General lighting service lamps up to and including 150 watts - bayonet cap (BC) type to BS 5042: Part 1.

General lighting service tungsten lamps over 150 watts and up to and including 300 watts - Edison screw cap (ES) type to BS 5042: Part 2.

General lighting service tungsten lamps over 300 watts - Goliath Edison screw cap (GES) type to BS 5042: Part 2.

Fluorescent lamps from 15 to 125 watts - bi-pin cap (BP) type to BS 1875.

7.0 LUMINAIRES

7.1 General

Luminaires shall comply with the requirements of BS 4533.

Luminaires for exterior or damp locations, whether exposed to direct rain or not, shall be dust and water resistant to IP 65.

Diffusers shall be made from glass, acrylic, ultra violet stabilised polyethylene or other light stable material. Diffusers shall be moulded, extruded or otherwise manufactured in one piece.

Luminaires shall be rigidly constructed so as not to distort under normal conditions of service including lamp changing.

7.2 Emergency lighting

Emergency lighting shall be provided in all public areas and escape routes as indicated on the drawings.

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The emergency lighting consists of 3-hour non-maintained self – contained luminaires.

The supply and installation of the emergency lighting system shall meet the requirements of BS 5266: 1988 and the local fire authority.

The areas where the self - contained luminaires are installed, the emergency luminaire supplies shall be derived from the feeder terminals of the same MCB's supplying the normal lighting luminaires in that area. A separate neutral conductor shall be installed for each sensing circuit.

Self - contained emergency luminaires that incorporate inverter / battery packs shall be fitted with a red LED, fixed either to the body or the trim in such a way as to be visible at all normal times, and to indicate that the inverter supply is healthy.

The detailed specifications for integral batteries and charging equipment shall apply taking into account the particular requirements of this section. Batteries for emergency lighting units shall be sealed type cylindrical alkaline single cells, complying with BS 5932. They may be used singly or in groups, and shall be operated in conjunction with a charging circuit designed to the cell manufacturers specifications. Battery and charger performance shall be such that the lighting unit can satisfy the requirements of BS 5266.

7.3 Samples

The Contractor shall prior to placing order; provide manufacturers' samples of all the luminaires, fixings and accessories specified in the schedules. The samples will be returned to the Contractor.

7.4 External Site Lighting

The Contractor and their Electrical Contractor shall include for the supply, installation, erection and connection of the light standards, consisting of light fitting, and galvanised steel lighting column and provided for their erection and connection in the locations as indicated on the drawings.

The Contractor and their Electrical Contractor shall also include for wiring to the external light standards from the Electrical Distribution Centre as indicated on the tender drawings in 3 core PVC/SWA/XLPE (LSOF) Cable (to the sizes as indicated on the drawing) in a 100 mm dia PVC pipes in a 600 mm deep sanded trench as indicated on the drawings.

The 100 mm dia PVC pipes in the 600 mm deep sanded trenches shall be provided by the Main Contractor as part of the Main Contract, including the associated concrete bases for the light fittings.

8.0 EARTHING AND BONDING

8.1 LV Earthing

Provide a complete and effective system of earthing for the LV electrical installation.

The system of earthing shall comply with the ETCI Wiring Rules and the recommendations stated in CP 1013, except where detailed otherwise in this Specification and the drawings.

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Where the ETCI Wiring Rules and CP 1013 differ then the former shall take precedence.

Metallic services including gas mains, water mains, dry risers, etc., entering or leaving the building or structure shall be effectively bonded to the main earthing terminal at their point of entry or exit. Connections shall be made to the services with purpose-made earthing clamps to BS 951.

Where the building is comprised of steel framed structure or has metallic cladding then these shall be effectively bonded to the main earthing terminal.

The cross-sectional area of all earthing, bonding and protective conductors shall be as indicated on the drawings. Except where detailed otherwise in this Specification or on the drawings all conductors for earthing shall be copper, manufactured in accordance with BS 1432, for strip and BS 4109, for cables.

Single-core cables forming part of the earthing system shall be of stranded copper, insulated to 450/750V standards with green/yellow PVC. These cables shall comply with BS 6004, Table 1.

Bare protective conductors in twin and three core cables included in BS 6004, Table 5 will be acceptable.

8.2 Earth Electrodes

Earth electrodes shall consist of High Conductivity copper bonded earth steel rods of nominal 20mm diameter; minimum 1250 long with hardened steel driving tips and be of the extendible type.

Earth electrodes shall be driven vertically into the ground such that the top of the rod is below ground level.

The earth electrode shall be covered with a galvanized steel box with re-enforced lid engraved with 'earth electrode' with top of which shall align with the finished ground level.

Where more than one electrode is required to achieve the desired earth connection they shall be separated by a distance not less than the depth of the longest rod in the installation.

8.3 Earthing lead

The earthing lead shall connect between the main earthing electrode and the main earth bar of the main switchboard.

Unless specified otherwise this shall consist of a 70 sq. mm green/yellow PVC covered copper conductor which shall be terminated by means of non-ferrous high tensile clamp with appropriate nut bolts, spring washers, washers to a compression lugged cable end.

The earthing lead shall be provided with a factory made test clamp within easy access of the electrode. The earthing leads shall be labeled 'Safety Electrical Earth - Do Not Remove' with a metal engraved tab, lettering to be at least 4.5mm high. Exposed sections of the earthing lead shall be protected by galvanized steel conduit.

8.4 Equipotential Bonding

Main bonding conductors are required at the intake position of engineering services such as (gas pipes, water pipes, HVAC etc.). These shall be connected directly to the main earthing terminal.

Main bonding conductors shall consist of 10 sq. mm Green/Yellow PVC copper covered cables unless otherwise specified.

Local bonding conductors are required in bathrooms, at immersion groups and for water supplies to kitchens etc. These shall consist of 2.5 sq. mm green/yellow PVC covered copper conductors connected to the local circuit protective conductor.

9.0 TESTING AND CERTIFICATION

On completion of the installation, the Contractor shall be required to prove by satisfactory testing in the presence of the Engineer that the installation has been carried out correctly and is safe to be used by the Purchaser.

The tests shall be carried out in accordance with ETCI 'National Rules for Electrical Installations'.

The following tests shall be carried out:

- a) Visual inspection of the completed installation to verify compliance in the first instance with the Factories (Electricity) Regulations SI No. 3 (1972) and SI No. 124 (1979).
- b) Continuity test of circuit protective conductors and bonding conductors.
- c) Insulation resistance test.
- d) Earth line loop impedance test.
- e) Earth electrode resistance measurement.
- f) Polarity test.
- g) Continuity of ring circuit conductors.
- h) Functional test of apparatus.

Testing of switchboards

In addition to the above, all panels shall be subjected to the following factory tests.

- a) An insulation resistance test at 1000 volt D.C. between phases, phases to neutral and phases to enclosure.
- b) A high voltage 50 Hz test to 2000 volts for one minute between phases, phases to neutral and phases and neutral to enclosure.
- c) An impulse 1/50 microsecond test at 5000 volt between phases, phases to neutral and phases and neutral to enclosure.
- d) A continuity test designed to measure the conductivity of each circuit between incoming main and out-going terminals.
- e) Simulation tests to test selected circuits on overload and short circuit.

The values obtained from the above tests shall be recorded and a full copy in the form of a test record shall be supplied to the Architect before delivery is made.

After erection on site, all switchboards shall be subject to tests (a), (b) and (d) above in the presence of the Architect or their representative

Certifications

The Contractor shall on completion of testing of the installation furnish the E.S.B. and the Engineers with a duly written up and signed completion certificate of the type detailed in the ETCI National Rules for Electrical Installations Part 1.

