Facilities Management

Standard Specification for Electrical Installation Work
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STANDARD INSTALLATION SPECIFICATION

1.0. **Scope**

1.1. This Specification covers the type of materials, methods of use, fixing and location and is to be read in conjunction with the Conditions of Contract, the Specification of Work and the relevant drawings for each respective installation. The clauses contained therein are considered to be in addition to the 17th Edition of BS 7671, with amendments, and do not supersede the standard in any way.

1.2. The whole of the works shall be carried out in complete accordance with the 17th Edition of BS 7671 with amendments, the Supply Authority Regulations and the Electricity at Work Act 1989 and as currently amended.

1.3. The term “Engineer” shall mean the Director of Facilities Management or his appointed representative.

1.4. The term “Contractor” shall mean the company or firm engaged to carry out the electrical installation works.

1.5. The term “Tenderer” shall mean the company or firm tendering for the electrical installation works.

2.0. **Materials**

2.1. Materials used in the works shall comply with the Specification, be new and unused and shall be manufactured, wherever possible, in Britain.

2.2. Materials shall comply with the latest British Standard Specification, where stated, and where materials are offered as alternatives for which there is no British Standard Specification, then the materials must comply with an equivalent known standard and samples shall be submitted for the approval of the Engineer before orders are placed.

2.3. When a trade name, firm or supplier is stated in the Specification, this shall be taken as being indicative of the required standard of design, quality, service and/or material. Alternatives will not be accepted.

2.4. Where materials and/or services are described as “approved”, “equal and approved” or “selected” it shall mean that the Engineer’s approval shall be obtained in writing before ordering the materials and/or services and before proceeding with the work.

2.5. At the time of obtaining quotations from a supplier named in the Contract Documents or when placing the order with a Nominated Supplier or Nominated Sub-Contractor (on the instruction of the Engineer) it shall be deemed that the Contractor has specifically stated that the firm concerned will be able to supply the goods or service at the required time to suite the general programme for the Contract. This clause shall not apply in cases when no alternative service is allowable.

2.6. Should a Supplier, Nominated Supplier or Nominated Sub Contractor not be able to comply with the general programme dates allocated for his goods or service, the Contractor must, before confirming any order, notify the Engineer immediately in writing and no claim for additional costs or extension of time will be allowed for the period of delay resulting from failure to check dates and notify the Engineer. It is, therefore in the Contractor’s interest to place orders as soon as it is practical, after the signing of the Contract for Suppliers and as soon as instructed by the engineer for Nominated Suppliers and Nominated Sub-Contractors.

2.7. Where any propriety brand of material is identified, it shall be used or supplied strictly in accordance with the manufacturer’s specification or instructions.
2.8. The Tenderer shall include for taking down and removing from site all materials made redundant as a direct result of this Contract. The Engineer is to be offered the opportunity to retain, for further use, any serviceable items of redundant equipment.

3.0. **Installations - General**

3.1. Every installation shall be installed with the utmost care and attention given to neatness - in particular neatness of surface installations shall be of paramount importance. All installations and work shall be to the satisfaction of the Engineer, only the very best workmanship shall be accepted. **The Contractor shall include in his tender for providing such standards.**

3.2. The Contractor shall in all cases use figured dimensions on the drawings in preference to small scale.

3.3. The Contractor will be responsible for taking and checking all site dimensions and for setting out prior to fixing.

3.4. Where the position of existing services is shown on the drawings, these are to be regarded as approximate only and the Contractor shall, before commencing any work, satisfy himself as to the positions of such cables, conduits, pipes or fittings, and as to whether their depths below the surface shall interfere with the works. In which case he shall provide such slings, struts and other supports as are adequate to support and protect the cables etc (see Excavation and Earthworks).

3.5. Care shall be taken not to disturb or damage any cables, conduits, pipes or fittings belonging to any Statutory Undertaking, Local Authority or private parties, which may be laid on the site either before the work commences or during the period of the contract or period of maintenance. Any damage to such cables etc, shall be made good at the Contractor’s own expense.

3.6. The Tenderer shall include for supplying and installing all fixing brackets, standard or purpose made, necessary for the proper completion of the contract, including the supply and installation of any angle iron, framework, structures, or brackets necessary for fixing switchgear, bus bar chambers and tap off units etc. Brackets shall be steel - of dimensions to suit their purpose and loading, painted with a protective paint.

3.7. To avoid the possibility of inadvertently weakening load bearing structures, a schedule of holes through load bearing structures shall be prepared by the Contractor and approved by the engineer before commencement of work.

3.8. The drilling, welding to, or cutting of steel work (structural or otherwise) shall be avoided. If such drilling, welding or cutting appears essential the Electrical Contractor must first obtain the approval of the Engineer before any such work is undertaken. The general support for conduit, trunking, cable tray etc, shall be fixed by an approved clip or welded to steel work in a manner approved by the Engineer.

3.9. Where cable or conduits, trunking etc, pass through walls, floors, partitions or ceilings, the hole provided shall, after installation be made good with cement or similar incombustible material to the full thickness of the wall, floor, partition or ceiling. Instructions on priming and painting areas made good as part of this contract shall be given in the Specification of Work - where appropriate.

3.10. A competent site based foreman/supervisor must be constantly in charge during the installation and have in his possession full copies of the specifications, schedule of requirements and drawings which must be overmarked daily with any alterations.

3.11. The Contractor shall bring to the attention of the engineer any corrosive or other deleterious conditions revealed in the course of the work.
4.0. **Switchgear and Distribution Equipment**

4.1. All switchgear or distribution equipment used in main distribution systems or motive power installations shall be of the totally enclosed fully insulated interior metal clad (anti-rust finish) 500 volt pattern suitable for conduit or cable gland entry.

4.2. Switchgear shall have a fault rating compatible with the maximum prospective fault level attainable at each respective point of installation.

4.3. Switch panels shall be factory assembled and supplied complete with all necessary interconnection between bus bars and items of switchgear.

4.4. Before a switchpanel is ordered, the Contractor shall submit a manufacturer’s drawing fully dimensioned and detailed, and receive written approval from the engineer.

4.5. Bus-bar chambers shall be constructed of heavy gauge sheet metal and steel angle with solid copper bars on porcelain, acetate or other approved rigid supports and be marked in accordance with BS EN60439 with minimum current ratings in accordance with BS 159. The chamber shall be completely dust and vermin proof with gaskets between sections and the lids.

4.6. Bus bar chambers are to be constructed capable of being extended at both ends and the bars are to be ready to receive extension units.

4.7. Certain sub-main cables may be oversize in terms of current rating, being governed by voltage considerations, and attention is drawn to the necessity for ensuring the switchgear glands, terminals, etc, are of adequate size for the cable specified.

4.8. Switchgear shall be interlocked such that switches will not open whilst the switch handle is in the “ON” position.

4.9. It must not be possible for switch indicators to show an “OFF” position whilst switch contacts are closed.

4.10. Fuse carriers and bases shall be of the flameproof, high impact, moulded plastic type, incorporating HRC fuses.

4.11. Air circuit breakers shall be rated at not less than 600v, manufactured to BS EN60947-2 or BS 5311 as required, shall have a breaking capacity of not less than 25 MVA and be A.S.T.A. certified.

4.12. Particular attention is drawn to the method of any remote safety or interlocking control.

4.13. Contactors are to be rated in accordance with “uninterrupted duty” and “utilisation category ACI” unless otherwise specified, manufactured to BS 5424, complete with D.C. or rectified A.C. operating coils wound for 230 volts protected by a cartridge fuse link, installed within contractors or externally in the form of a fused connection unit.

4.14. Residual current devices shall be current operated rated at 500 volts designed to trip at 30mA unless otherwise specifically directed, and supplied complete with a test button with suitable warning label.

4.15. For smaller installations and with the permission of the Engineer, switchgear may be mounted on a steel angle framework or timber backed of adequate strength and proportion. Cadmium plated or sheradised steel set bolts, nuts and washers shall be used. Frameworks shall be painted with a protective paint. Where a timber backboard is employed it shall be non-hygrosopic. Timber backboards shall be spaced off walls in an approved manner. Generally, switchgear and fusegear shall be linked to other switch or fusegear via couplings and male brass bushes and steel trunking of adequate dimension.
4.16. MCCB panels shall be manufactured to EN 60947 as appropriate.

5.0. Rising and Overhead Bus-Bars

5.1. Rising and overhead bus-bars shall be manufactured to BS 159 of the appropriate size and rating as detailed in the Specification of Work and shall have each conductor enclosed in insulating material supported on high quality porcelain or other approved insulation, the whole being supported in a rigid rust-proofed steel framework with heavy gauge sheet steel covers. All junctions of steelwork shall be effectively bonded for earthing purposes. Bus-bars shall be best quality solid copper. Bus-bar trunking covers shall be removable only by the use of tools.

5.2. Plug in and/or clip on fuse boxes or enclosed fused tap off ways for conduit connection shall be arranged as detailed in the Specification of Work and shall be supplied complete with the necessary HRC fuses. A permanent label is to be pop-riveted or otherwise securely fixed to the lid of the tap off point.

5.3. Supports for rising or overhead bus-bars shall be as detailed on the drawings and the system is to be complete with all purpose made accessories i.e. Tees, bends, expansion joints, etc., and fire barriers are to be installed where the bus-bar passes through a floor or wall.

6.0. Distribution Boards

6.1. All distribution boards shall be rated at 500V manufactured to BS EN 60439 to details in the Specification of Work.

6.2. Enclosure shall be constructed of heavy gauge sheet steel and be fitted with an isolator switch.

6.3. Distribution boards are to be mounted at a height of 2 metres to the top edge, above finished floor level or as otherwise directed.

6.4. Miniature circuit breaker distribution boards may be used complying with BS EN60439 and having a category of duty M6 minimum or as detailed in the Specification of Work. MCB types i.e. A,B,C or D shall be as detailed in the Specification of Work.

6.5. Spare ways for MCB boards are to be blanked off with factory made blank units and insulating bus-bar boots, and for fuse boards they are to be complete with fuse carriers to the maximum size of the spare way but no fuse cartridges are to be fitted.

6.6. All neutral and earth bars fitted in distribution boards shall include a way for each circuit contained in the board. Where TP & N fuse boards are utilised as SP & N the neutral bar is to include for a neutral way for each fuse way of the board (i.e. an 8 way TP & N distribution board used as a SP & N board is to have a 24 way neutral block).

6.7. All distribution boards shall have provision for padlocking off the complete front cover to prevent unauthorised access to MCBs or fuses i.e. a pillar to take 6mm shank padlock.

7.0. Fuses

7.1. All fuses in switchgear and distribution equipment are to be HRC manufactured in accordance with BS88 or BS1361. Cartridge fuses complying with BS88 shall have a category of duty A046 and a fusing factor as for Class Q1 fuses or as detailed in the Specification of Work.

8.0. Marking

8.1. All switchgear and distribution equipment is to be complete with Traffolyt or similar approved labels, attached by small brass screw and nuts indicating in 10mm block lettering on white background, the duty, reference number, phase (1ph equipment), origin of supply, and also for isolators/switches/switch fuses and fused tap-off boxes, their rating and fuse size installed.
8.2. All polyphase equipment is to be complete with Traffolyte or similar approved labels attached by small brass screws and nuts or otherwise securely fixed indicating in 12mm red lettering on white ground “DANGER 415 VOLTS”

8.3. All distribution boards and consumer service units are to be complete with a typed circuit schedule on thick white paper. The schedule shall clearly detail circuit designation, description, location, cable size, CPD rating and type and be enclosed in a heavy duty plastic envelope fixed to the inner face of the lid.

NOTE: It shall be possible to gain access to the “envelope” without removing fixing rivets, set screws, etc.

A further copy of the Schedule is to be issued to the Engineer.

9.0. Wiring

9.1. The system of wiring shall be as indicated on the Specification of Work or on the working drawings and may be any of the following:

   a) LSF cable in conduit or trunking (6491B)
   b) MICC cable (LSF sheathed, unless otherwise specified)
   c) Armoured, double PVC insulated cable
   d) XLPE, SWA, PVCS or XLPE, SWA, LSF cables
   e) Double LSF insulated cable (T+E), with stranded conductors and equal sized CPC!

9.2. All cables are to conform to the type and BS Specification quoted in Chapter 52 of the I.E.E. Wiring Regulations and shall be of an approved manufacture, copper cored. Each cable reel shall bear the manufacturer’s name and the date of manufacture. Cables shall not be more than 12 months old at the date of installation.

9.3. The “loop-in” system of wiring is to be used on final sub-circuits. No joints are to be made in the run of the cable and ringing of cable sheaths shall not be allowed. Generally, lighting feeds shall be taken to and from switches and not jointed through fitting etc.

9.4. The circuits are to be capable of carrying the connected load with a volt drop in accordance with The Wiring Regulations.

9.5. Identification of wiring shall be in accordance with Appendix 7 of BS7671, “Cable Harmonisation” as follows:

   Colour codes
   Single phase live conductors shall be Brown
   Live 1 of a 3 phase circuit shall be Brown
   Live 2 of a 3 phase circuit shall be Black
   Live 3 of a 3 phase circuit shall be Grey
   Neutral conductors shall be Blue
   Protective conductors shall be Green / Yellow
**Mixed circuits**
Where old and new cables are present in the same circuit, i.e., an alteration or addition to a circuit, conductors shall be identified by proprietary cable markers at joint boxes and accessory joints:

- **Phase 1 (red or brown)** Identified as L1
- **Phase 2 (yellow or black)** Identified as L2
- **Phase 3 (blue or grey)** Identified as L3
- **Neutral (black or blue)** Identified as N

Protective conductors shall be green and yellow.

9.6. Duplicate supplies shall not be run within the same cable, conduit, trunking or duct. Category 3 cables shall not be run within the same cable, conduit, trunking or duct as category 1 or 2 cables. Category 2 cables shall not run within the same cable, conduit, trunking or duct as Category 1 cables. Category 3 cables forming fire alarm or emergency lighting systems shall be self-contained for each function in respect of cables, trunking, conduit and ducts.

*Note:* In dado trunking applications, segregation of categories must be strictly adhered to all necessary barriers etc., to be installed.

### 10.0. Underground Cabling and Handling

10.1. The Contractor shall provide all equipment required for installing the cable including cable jacks, cable rollers, cable stockings, hauling tackle, and the like and shall be responsible for ensuring that these are used and maintained in a safe and serviceable condition.

10.2. Cable drums shall be handled, moved and stored in a manner so as to prevent any likelihood of damage to the cable. The Contractor shall take all necessary precautions to ensure that no loss or damage occurs to the cable supplied by the University.

10.3. Where mechanical means are approved to pull cables, the pull shall be applied using a cable stocking or pulling eye sweated to the conductors and sheath, and measures shall be taken to avoid excessive strain on the cable.

10.4. The cable shall only be laid when it is at a temperature of above 0°C and has been above this temperature for the previous 24 hours.

10.5. The Contractor shall bring to the immediate attention of the Director of Facilities Management any corrosive or other deleterious conditions revealed in the course of the work.

### 11.0. Excavation of Reinstatement

11.1. Before excavation is commenced, the marked out area on site shall be approved by the Engineer.

11.2. Trenches shall be kept as straight as possible, bottom of each trench shall be firm and of smooth contour.

11.3. In order to prevent damage to cables and accessories, the Contractor shall take adequate measures to ensure that water is not allowed to accumulate in cable trenches.

11.4. The depth of cable trenches shall in general be not less than 450m (18") and the distance between cables shall be 150mm (6") between centres.
11.5. When the course of excavation, obstructions are encountered which require deviation from the marked route, the new route shall be approved by the Engineer before further excavation commences.

11.6. Damage or suspected damage to other services found during or caused by the excavation and installation of cables, shall be reported by the Contractor to the Engineer.

11.7. Material excavated shall be so placed as to prevent unnecessary nuisance or damage. Top soil shall be placed separately and re-used to form the top layer when reinstatement is made. Large pieces of rock, concrete or metal etc. removed during excavation shall not be replaced when back filling, but shall be removed and disposed of by the Contractor.

11.8. Back filling shall be made in even layers, the earth of each layer being well consolidated by light ramming and sufficient allowance made in the final layer to allow for settlement.

11.9. Where back filling is carried out by a Sub-Contractor, the Contractor shall provide supervision to prevent damage to cable.

11.10. Each and every cable shall be protected by cable tiles centred 75mm above the top of the cable. All cable tiles whether for straight runs or bends shall be of the apex interlocking pattern with the words – DANGER ELECTRICITY - impressed on every tile. Tiles shall conform to BS 2484 and shall be earthenware 225mm long by 150mm wide.

12.0. Cables in Ducts

12.1. Cables shall be drawn through ducts when crossing under roads, buildings, structures, paved areas and where shown on drawings.

12.2. Earthenware ducts shall be used unless otherwise stated, they shall be of the Stamford type, and conforming to BS 65 in all respects. During laying, care shall be taken to remove all extraneous material from the sockets, and the ducts shall be laid on a base of 75mm concrete also a launching of 75mm concrete shall be provided around the ducts. Effective measures shall be taken to prevent concrete entering the bores of ducts.

12.3. Prior to the installation of cables, all ducts are to be cleared by drawing through a mandrel of suitable dimensions, this shall be followed by a pull through to clear any accumulated dirt, after which the ducts will be plugged until cables are laid. After cables are laid, the void formed between the cable and the duct shall be sealed using bituminous compound hessian to prevent ingress of dirt and water.

12.4. Ducts shall extend for a minimum distance of 300mm beyond the limits of the features being crossed.

12.5. All ducts shall be 100mm internal diameter unless otherwise stated.

12.6. Not more than one cable shall occupy any one way in a duct unless otherwise approved.

13.0. Jointing and Terminations

13.1. The filling of cable boxes with compound shall proceed without break, the box having been preheated to the pouring temperature of the compound. Compound shall be poured at a steady rate at the correct temperature to ensure that voids are not formed. Joint compounds shall be in accordance with the cable manufacturer’s recommendations.

13.2. The armouring of cables shall be securely terminated at glands by means of armour clamps in such a manner that the lay of the wires is undistorted and all wires are firmly gripped.

13.3. Through joints in cables will not be permitted in approved areas.
13.4. The cores of all power cables shall be phased out and the core ends identified in accordance with BS 7671

14.0. Markers

14.1. On all cables of 11KV and above, identification labels shall be securely fixed by non-corroding ties to the ends of all cables. The cable labels shall give the cable size and destination. All labels shall be of brass contraction.

15.0. Site Testing

15.1. All cables of 11KV and above shall be tested by an approved high voltage testing, specialist contractor.

16.0. Cables

16.1. Where more than two circuits are run in one trunking the cables in each circuit are to be laced together with cable ties or cord and identified.

16.2. All cables shall be kept 150mm clear of steam and hot water pipes and other services.

16.3. Where unprotected cables are laid on the soffit of the ceiling, and only single battens are used for ceiling support, these battens are to be cut to allow the cables to pass through. The Electrical Contractor is to include in his tender for the supply and fixing and act as protection for the cables from ceiling fixing nails/screws.

16.4. LSF cables shall not terminate in lampholders or lighting fittings or pass through lighting fittings where temperatures significantly above the ambient are present.

16.5. Final connections to such lighting fittings shall be made in heat resistant silicone rubber insulated flexible cable. Connections between flexible cables and sub-circuit wiring shall be made via cable connectors housed in the conduit boxes supporting respective fittings. Where this is impractical, an approved conduit box shall be sited adjacent to each respective fitting. Where this is impractical, an approved conduit box shall be sited adjacent to each respective fitting and connector shall be housed within the conduit box.

17.0. Mineral Insulated Copper Clad Cables

17.1. Mineral insulated cables shall be sheathed with copper, incorporating high conducting copper conductors embedded in compressed magnetism oxide, heavy duty grade for all systems as manufactured to B.A.S.E.C approvals, and delivered to site bearing the manufacturer’s identification labels.

17.2. Mineral insulated cables shall be fitted with screw-on pot scale, filled with plastic compound, and incorporating protective conductors on pots, or an approved heat shrink seal incorporating protective conductor with green/yellow sheath. Phase conductors shall be identified using coloured tapes.

17.3. Where possible, unless directed to the contrary, MICC cable shall terminate at equipment, fittings or accessories via a gland, conduit coupling and male brass bush.

17.4. MICC cable shall be LSF sheathed installed using LSF boots and shrouds (unless otherwise specified).

17.5. MICS cable shall be installed in accordance with the manufacturer’s instructions by tradesmen who are expert in the handling and jointing of the cable. Bending, stripping and sealing tools shall be employed as recommended by the manufacturers.
17.6. MICC cable shall be installed in horizontal and vertical runs-diagonal runs will not be permitted. Minimum bending radii of MICC cable shall be in accordance with chapter 52 of the Wiring Regulations. Where MICC cables are surface routed, they shall be run in a neat and workmanlike manner to conform with the architectural features of a room—even if this entails longer routes of cables. Where MICS cables are buried in wall fabric or floor screeds, they are to be adequately protected from mechanical damage—particularly before floor screeding.

17.7. Where MICC cables pass through floors they shall be protected by steel conduit to a minimum height of 300mm. Protective conduits shall be fitted at each end with a female brass bush. Where MICC cables are routed through other areas where mechanical damage is likely to occur, they shall be protected by steel troughing. Protective conduits or roughings shall be sealed against the ingress of dust or litter using quick setting mastic after the installation of MICS cables.

17.8. Where it is proposed to use MICC wiring units on an installation, these will only be acceptable when obtained from the manufacturers direct.

17.9. Each circuit wired in MICC cable shall leave switchgear or distribution boards as separate.

17.10. Special scale (1350°C) are to be used on mineral insulated cable for all boiler plant wiring, where run within heating ducts, final connections to electric fires, fan convectors, unit heaters, enclosed close to ceiling lighting fittings or where high ambient temperatures can be anticipated.

17.11. Where mineral insulated cables are used on fire alarm system, the cables are to be LSF sheathed and the sheathing is to be coloured red to identify its duty.

17.12. MICC cables shall be fixed by means of LSF sheathed copper clips (one cable) and saddles (more than one cable) where cables are buried in the building fabric. Clips and saddles shall not be secured to the joints of surface brickwork or blockwork.

17.13. Where three or more MICC cables are run together in plantrooms, roof and floor spaces, ducts, etc., they shall be run on galvanised tray.

17.14. Fixings on galvanised tray shall be made with round head brass set screws, nuts and washers.

17.15. Fixings for MICC cables recessed into floor screeds or walls shall be made with galvanised nails secured into purpose made plugs.

17.16. Fixings for MICC cables surface routed shall be by roundhead brass wood screws into purpose made plastic plugs.

17.17. Plastic cable straps shall not be used.

17.18. MICS cables shall be tested as soon as possible after receipt on site, before and after installation within the building fabric (i.e. Walls and floor screeds) at handover and during the guarantee period. MICS cables shall be tested with a 500 volt Insulation Tester. Should any test not produce an infinity reading the Contractor shall investigate and make good the fault at his own expense.

18.0. **Steel Conduit Work**

18.1. All steel conduits and conduit accessories used in the execution of the Contract shall comply with the following requirements:
18.2. Solid conduits shall be of heavy gauge steel, welded, with screw threads for jointing length to length and for the attachment of accessories. Generally, conduits shall be galvanised inside and outside. They shall be manufactured to the requirements of BS No. 4568 for Class B materials and none of size less than 20mm external diameter shall be used unless specially called for to the contrary elsewhere in this specification.

18.3. Flexible conduits shall be of heavy WATERTIGHT pattern finished galvanised and none of size less than 20mm external diameter shall be used unless specially called for to the contrary in this specification. Flexible conduits to be used for fixed wire installation work within building fabric shall be manufactured from low-smoke halogen free materials throughout.

18.4. Conduit accessories shall be of malleable grey cast iron BS 4568 and shall generally be galvanised inside and outside. They shall be of BESA pattern with long spouts threaded for the reception of conduits except in the case of such loop-in and adaptable type boxes. Covers for draw-in junction etc. boxes shall be of heavy malleable grey cast iron, generally without gaskets but, when definitely called for, in external situations or in damp atmospheres or locations, suitable approved gaskets shall be fitted. Special waterproof or watertight pattern accessories shall only be used if definitely so specified.

18.5. Bushes, glands, plugs, etc., used in conjunction with conduits and conduit accessories shall be of brass. All male bushes shall be of long thread pattern.

18.6. Saddles used for fixing conduits, which are to be buried in floor or roof screeds, shall be of clip type finished galvanised. Those used in fixing conduits to surface walls, ceilings, steelwork, etc., shall be of spacer bar type, galvanised. Crampets used for fixing conduits which are to be buried in wall plaster, shall be of steel, finished galvanised.

18.7. All conduits and conduit accessories used in the execution of the Contract shall be installed to comply with the following requirements.

18.8. Conduit and accessories damaged by weather or other hazards shall not be installed. Previously used conduit shall not be installed.

18.9. Cutting, screwing and setting shall be carefully carried out, and all ends shall be cut square. After cutting and screwing, ends shall be reamered to remove all sharp edges and burrs. Setting shall be affected without distortion of diameter and by means of an efficient setting machine. Screwing shall be by means of good quality dies in good condition and poor or damaged threads shall be rejected.

18.10. After jointing either length to length or to accessories, the exterior of the conduits, couplings or accessories spouts in the vicinity of the joint shall be particularly observed in the case of work to be buried or concealed and the Contractor shall take care to see that all joints are so painted before being buried or concealed.

19.0. **Conduit Installations**

19.1. Draw-in boxes or trough shall be inserted at intervals of not more than 10m in straight runs of conduit and, a draw-in box or trough shall be inserted after not more than two such bends or changes in direction.

19.2. Conduits shall be surface installed or buried in building structures in accordance with definite requirements of the other sections of this specification.
19.3. Surface installed conduits shall, in all cases, be run parallel to the building lines and shall be fixed in position at intervals of not more than 1.23m (4') by means of spacer bar type saddles and these saddles shall be fixed by the following methods as appropriate:

a) To brickwork, concrete or the like, by 25mm (1") x no. 8 brass woodscrews and plastic raw plugs.

b) To woodwork by means of 25mm (1") x no. 8 brass woodscrews.

c) To steel structure by means of cadmium plated 2 B.A. mild steel machine screws and nuts or by means of similar mild steel self-tapping screws.

Conduits run in roof spaces, accessible trenches and such like shall be considered to be surface installed.

Draw-in inspection and junction boxes, and troughs, other than “adaptable” type boxes installed in conduit runs whether on the surface or buried, need not be separately fixed to building structures, but shall rely on the efficient saddling of conduits for their support. Saddles shall be fixed to the conduit runs immediately adjacent to the boxes or troughs. “Adaptable” type boxes of whatever size shall always be fixed separately to building structures by means of at least two fixings of nature similar to the fixings specified for saddles in sub-clause “1” above.

19.4. Conduit attachment to sheet steel cable trunking and fluorescent fittings channelling and such like and to all sheet steel or cast equipment boxes with untapped conduit entries, whether surface installed or concealed, with the exception only of loop-in type conduit boxes and other instances where space limitation prohibits shall be effected by means of flanged coupling, a long thread male brass bush and heavy pattern brass compression washer. The coupling shall be fitted outside the equipment and the male bush and compression washer inside the equipment with the flanged part of the washer bearing against the head of the bush.

19.5. Conduit attachment to loop-in type conduit boxes and to sheet steel or cast cases of other equipment where space installed or concealed, shall be effected by means of a standard conduit coupling, a long thread male brass bush and a heavy pattern brass compression washer. The coupling shall be fitted outside the equipment and the male bush and compression washer inside the equipment with the flanged part of the washer bearing against the head of the bush.

19.6. Attachments other than as detailed in the foregoing sub-clauses 10 and 11 will not be accepted unless the prior approval of the Engineer has been obtained.

19.7. Where attachment is to equipment such as cable trunking, fluorescent fittings, channelling, etc., which is painted or enameled, the paint or enamel shall be carefully removed from the area of coupling, bush or washer contact and after attachment any exposed area from which paint or enamel has been removed shall be carefully touched up to match the original.

19.8. Attachment of flexible conduits to solid conduit, conduit accessories, equipment cases or motor terminal chambers shall be effected without exception by means of brass adapters to which the flexible conduit shall be effectively brazed or soldered. The brass adapters shall then be fixed to solid conduit, conduit accessories, equipment cases or motor terminal chambers in a sound manner, bearing in mind the need for the maintenance of efficient earth continuity. Earth continuity across all flexible conduits shall be affected by the installation within the conduit of a 2.5mm green/yellow sheathed earth wire, which shall be efficiently connected to the brass adapters by soldering or other approved method.

19.9. The Contractor shall ensure that conduits are free from dampness and moisture before any wiring is installed therein and shall swab them dry if there is any doubt or if such should prove necessary.
19.10. Throughout the course of the Contract, all conduits and accessories shall be effectively protected against the ingress of plaster and other building materials.

19.11. Wiring shall not be drawn into any conduit system until the system is complete.

19.12. In the case of buried or concealed conduit work, draw-in, inspection and similar boxes, the covers of which must be flush with the finished surface of walls or ceilings, shall have covers of a special overlapping type or shall have fitted between a standard cover, and the box a white bakelite breakjoint ring.

19.13. The use of running couplings shall not be allowed within the works carried out under this contract. Conduit union will be used instead.

19.14. All conduit systems shall be complete before the installation of cables.

19.15. All surface conduits shall be in vertical and horizontal routes. Conduits in loft areas and ceiling spaces shall be installed in vertical horizontal routes. Conduit routes shall be determined on site where not clearly defined on the contract drawings. All main or conduit routes shall be approved by the Engineer before installation.

19.16. Conduits recessed into or installed within walls shall be installed in vertical and horizontal routes. Horizontal routes shall be restricted to high level positions wherever possible.

19.17. Conduits cast into floors may be routed in diagonal routes.

19.18. All conduits must be installed in a neat and symmetrical pattern and should, where possible, follow the same route even if this entails using longer conduit runs and if during the course of construction it is found this is not being carried out in the manner specified, then the Contractor will be instructed to dismantle and re-install the conduits in the manner specified and the cost of any additional conduit and labour required will be borne by the Contractor.

19.19. All conduit routes shall incorporate an adequate number of draw-in boxes in agreed positions. Draw-in boxes shall be of correct type to suit purpose of use i.e. correct number and position of outlet points. Draw-in boxes shall be securely fixed in position using steel wood screws or toggle bolts, as appropriate, and shall be provided at each outlet position. All conduits to be "cast" into building fabrics shall be positioned clear of and above first reinforcement material. No more than two right angle bends shall be incorporated in any conduit run.

19.20. Generally, conduit fixings shall be installed at spacings within manufacturer's recommendations. Fixing saddles shall be positioned at a maximum of 1.2m apart or 0.3m from conduit outlet boxes or changes in direction.

19.21. Surface conduits including conduits routed through loft areas shall be secured using distance saddles to give not less than 2mm clearance between conduit and wall.

19.22. Flush conduits shall be secured using crampits or spring saddles as directed by the Engineer.

19.23. Where conduits are run adjacent to steam or hot water pipes, they are to be placed below these wherever possible and in any case are to be not less than 150mm there from.

19.24. The conduit and accessories are to be electrically and mechanically continuous throughout.

19.25. Conduits shall be protected by Denso tape wrapping where passing through floor slabs.

19.26. Where conduits are to be installed externally or in other potentially damp situations, spout outlet boxes or internally threaded cast boxes shall be used. Special measures to ensure water tightness shall be taken including provision of rubber gaskets.

20.0. **Plastic Conduit and Conduit Fittings**

20.1. Plastic conduits shall be rigid PVC heavy gauge, white, black high impact, or LSF flexible conduit as specified.
20.2. Conduits shall generally be installed in accordance with manufacturer’s instructions, with particular reference to expansion joints.

20.3. All changes in direction of conduit shall be carried out via purpose made accessories.

20.4. Conduits shall terminate at accessory boxes using a plastic flange coupling and plastic male bush. Conduits shall butt solidly into all conduit fittings.

20.5. All plastic “slip on” connections shall be cemented using manufacturer’s approved cement.

20.6. Plastic conduits SHALL NOT be installed in locations suffering temperatures (high or low) likely to cause damage to the same.

20.7. All plastic conduits shall incorporate protective conductors.

20.8. Plastic conduits boxes shall be made of high impact material supplied complete with box lid and where installed at lighting point positions, shall be the type with external fixing feet.

20.9. Plastic conduits shall be fixed rigidly to the building fabric in accordance with Clause 2.22.3 above.

Plastic conduit boxes used to support light fittings shall be either reinforced pattern to carry 10KG load or be substituted with Galvanised boxes.

21.0. Polyethylene Conduits

21.1. Polyethylene shall not be used.

22.0. Cable Trunking – Steel

22.1. All cable trunking and accessories used in the execution of the Contract shall comply with the following requirements.

22.2. It shall be constructed of sheet steel of not less than 1.5mm for sizes up to 100mm x 100mm or equivalent and not less than 1.75mm for sizes above 100mm x 100mm or equivalent and standard sections shall not be less than 2m in length and shall be manufactured to BS EN10142.

22.3. It shall be free from all rough edges, burrs and rust, and shall be thoroughly rust-proofed and finished inside and out in a galvanised finish.

22.4. Sizes and types of trunking shall be as called for in the various sections of this Specification or on the drawings, or shall in any case by sufficient size to accommodate the wiring required whilst still ensuring the appropriate space factor.

22.5. All standard rectangular section trunking shall be of the lipped type i.e. the sides shall be flanged over or lipped along the opening over which the cover or lid shall fit. Any skirting, trunking, multi-section trunking or trunking of special nature for installation in floors shall, if called for in any of the various sections of this Specification, be as definitely specified therein.

22.6. Lids or cover plates for standard rectangular section trunking shall be of similar gauge and finished as the trunking, shall have their edges flanged over to overlap the sides of the trunking and shall be provided with substantial means of attachment to the trunking. Fixing by means of self-tapping screws will not be acceptable. Lids or cover plates for skirting or other special trunking, shall if such trunking is called for in any of the various sections of this Specification, be as definitely specified therein.
22.7. Bend, tees, jointing pieces and plates, flanges and other accessories shall, unless special permission is otherwise given by the Engineer, be ex-works by the manufacturers of the trunking and suitable in all respects for use in conjunction with the trunking. All shall be of gauge of steel not less than that of the trunking and preferably at least one gauge heavier. All shall be rust proofed and finished similar to the trunking.

22.8. Trunking of greater length than 3m, installed vertically, shall be fitted with stout metal pegs at 1000mm intervals so that cables can be laced in and out between them and thus be held firmly in position, and the trunking size shall be increased to maintain the same space factor present for the horizontal.

22.9. Where trunking is required to pass through floors from one floor of the building to another, it shall be fitted with suitable and approved flame proof fire barriers.

22.10. All trunking and trunking accessories used in the execution of the Contract shall, unless called for otherwise in any of the various sections of this Specification, be installed to comply with the following requirements.

22.11. It shall be fitted with lid or cover plate facing outwards or uppermost.

22.12. Trunking may be fixed direct to brickwork, plasterwork, steelwork, etc., as may be necessary or indirectly to such structures by means of brackets. The Contractor, however, shall be guided in this matter by the requirements of any of the various sections of this Specification or where no definite requirements are given, but consultation with the engineer. Where steelwork etc., is permissible, the methods of fixing shall be as for surface installed conduit saddles, as specified in Clause 4.12, Paragraph 8 herein before. Where fixing shall be by means of brackets, the trunking shall be secured to brackets by means of cadmium plated mild steel bolts, nuts and lockwashers. Bolts shall be round head pattern and heads shall be fitted within trunking.

22.13. Brackets for supporting trunking from roof or other steelwork shall preferably be arranged to hook or clip onto the steelwork in order that drilling of steelwork may be avoided. In such cases, use may be made of such patent fixings as “lindapter” or similar. In the event of hook or clip or similar type bracket proving unsuitable or unfeasible, the permission of the Engineer shall be sought to drill steelwork, but such drilling shall not be carried out prior to the engineer’s approval being given in writing.

22.14. Brackets for fixing trunking to walls shall be arranged by fixing to the walls by means of woodscrews and plastic plugs.

22.15. All trunking shall be of standard finish and size, as called for on drawings.

22.16. Trunking systems shall be re-wirable and shall be complete before the installation of cables.

22.17. Trunkings shall be run in vertical and horizontal routes, in a neat and symmetrical pattern. Routes shall be determined on site unless detailed on the contract drawings. All main routes of trunkings shall be approved by the engineer before installation.

22.18. Trunkings shall be sized to provide at least 50% spare capacity after the installation of all cables provided at original installation stage.

22.19. Trunkings shall be kept 300mm minimum clear of steam or hot water pipes.

22.20. Expansion couplings shall be provided where trunkings cross an expansion joint within the building fabric. Floor routed trunkings shall not be employed without prior approval of the Engineer.
22.21. Trunking covers through walls, floors or ceilings shall be solidly fixed. The solidly fixed portions shall project 50mm on either side of walls and 150mm on either side of floors or ceilings. No trunking apart from ceiling trunking shall be installed with the cover on the underside. Where trunking is secured to switchgear, fuseboards, etc., flanged type couplings shall be used. Particular attention is to be given to corners at tees and bends and to the fitting of screws to avoid possible damage to cables.

22.22. Trunkings shall be wrapped with “Denso” tape where passing through concrete floors.

22.23. Flush ceiling trunking shall not be less than 2.0mm gauge galvanised flo-coat after manufacture and free from distortion.

Lids are to be flush with ceiling, secured to the body by means of mushroom headed steel screws at intervals not exceeding 400mm and suitably reinforced to prevent sagging.

Fire barriers shall be fixed to the lid.

22.24. Where lighting fittings or pull cord switches are fixed to trunkings, trunking lids shall be cut and arranged to allow lids in the vicinity of fittings or switches to remain secured after the removal of other sections of lid.

23.0. Plastic Cable Trunking

23.1. Plastic trunking shall be rigid PVC heavy gauge, white, high impact complete with lid, full length back tray and manufactured fittings.

23.2. Plastic trunking shall be installed in accordance with manufacturer’s recommendations.

23.3. Plastic trunkings shall be secured rigidly to building fabrics using round headed steel wood screws in manufactured plugs with oversize washers to prevent screw heads pulling through holes in trunking.

23.4. All plastic trunkings shall incorporate protective conductors.

23.5. All changes in direction of plastic trunking shall be carried out via purpose made accessories.

23.6. Plastic trunking shall be cut to length and access holes for conduit entry etc. shall be cut using only the manufacturer’s special tools.

23.7. Surface fixed plastic trunking shall be routed as unobtrusively as possible following the architectural features of the room even if this entails longer runs of trunking. Trunking shall be run along full wall lengths and must not terminate part way along a wall, unless specified to the contrary.

23.8. Plastic trunking shall not be routed through areas suffering high or low temperatures.

24.0. Cables Tray and Basket

24.1. All cable tray and accessories used in the execution of the Contract shall comply with the following requirements.

24.2. It shall be constructed of perforated sheet steel as particularly called for in any section of the Specification, shall be of the particular widths and depths specified or, when not specified, of dimensions sufficient to accommodate all the cables to be routed on it without bunching, unless specifically approved by the Engineer. It shall be provided in standard sections of not less than 2m in length.

24.3. All cable trays shall be heavily galvanised throughout and shall be free from all rough edges and burrs. The quality and type, unless otherwise specified, shall be heavy duty galvanised medium return flange.
24.4. All bends, sets, tees, jointing pieces and other accessories shall, unless special permission is otherwise given by the Engineer, be ex-works by the manufacturer of the cable tray and suitable in all respects for use in conjunction with the tray. All fittings shall be of gauge of steel not less than that of the tray and of the appropriate dimensions and shall be of galvanised finish. Fixings to tray sections shall be as specified for cable trunking.

24.5. All cable tray and accessories used in the execution of the contract shall, unless called for otherwise in any of the various sections of this Specification, be installed to comply with the following requirements.

24.6. Where intended to carry heavy power cables, it shall be installed, when horizontal, to enable the cables to be laid inside and not suspended below, unless particularly called for.

24.7. It shall always be installed whether horizontal or vertical, to allow space behind for securing cable straps.

24.8. Cable tray shall generally be carried on suitable steel brackets, securely fixed to the building structure work, as particularly called for in the various sections of this Specification and generally specified for the cable trunking above.

25.0. **Wires, Cables and Flexible Cords**

25.1. All wires and cables installed under this contract shall conform with the relevant and applicable requirements appropriate up-to-date British Standards as follows:

25.2. PVC LSF XLPE sheathed and armoured cables and insulated to BS 6346; BS 6724; BS 5467 and BS 7211 as appropriate, all holding BASEC approval.

25.3. Polyvinyl-chloride-insulated (PVC insulated) cables and flexible cords.


25.5. Mineral-insulated metal-sheathed cables must be the product of an approved manufacturer and compliant with the relevant B.S.

25.6. Polyvinyl-chloride-insulated (PVC insulated) cables and flexible cords, vulcanised-rubber-insulated cables and flexible cords, paper-insulted cables, butyl-rubber insulated cables and all others shall be the product of an approved manufacturer compliant with the relevant B.S. 6004.

25.7. In so far as identification of single core cables, wire and flexible cords and the cores of multi-core cables, wires and flexible cords is concerned, the requirements of I.E.E. Regulations must be rigidly adhered to.

25.8. All wires, cables and flexible cords shall be delivered to site with the maker’s labels, seals and other proofs of origin, intact.

25.9. The sizes of all LSF and similar wiring, shall be strictly in accordance with the requirements of the various sections of the Specification and with the details shown on the drawings.

25.10. LSF and similar wiring, shall only be installed within conduit or trunking systems within enclosed equipment or apparatus, unless specific direction is given otherwise.

25.11. Wiring shall not be installed within any conduit or trunking system until that system is complete.

25.12. Jointing of wiring shall not be permitted other than at equipment terminals or within suitable and approved joint boxes containing suitable terminals.
25.13. In so far as termination, bonding, protection against damage by heat, fire, explosion or by corrosion is concerned, special attention shall be paid to the applicable requirements of I.E.E. regulations.

25.14. The number of cables which shall be installed in any one conduit shall not exceed the number permitted by I.E.E. Regulations.

25.15. All wiring installed in cable trunking, ducting, channelling, and such like, shall be bound together in single or three phase circuit groups at 2m intervals and shall, at intervals by typed label marked in permanent fashion to indicate the circuit.

25.16. Where installed within switches, distribution boards, control panels and such like, wiring shall be neatly and carefully bunched, secured together by means of whipcord binding and adequately supported and held in position by means of supports or brackets of insulating material.

25.17. Wiring of not more than one phase shall be installed in an outlet box, switch box etc., other than one designed for multi-phase use.

25.18. The sized of all M.I.C.C. wiring shall be strictly in accordance with the requirements of the various sections of this specification and with the details as shown on the drawings.

25.19. All accessories used in conjunction with the termination, sealing, jointing, etc., of the cable, shall be the product of the cable manufacturers and of the correct size of the product of the cable manufacturers and of the correct size and type for the purpose. Where SF sheathed cable is used, LSF shrouds shall be fitted over the final few inches of cable and over cable gland at all terminations. Also all jointing, sealing and termination work shall be carried out strictly in accordance with the manufacturer’s recommendations and only by tradesmen qualified to do so.

25.20. In so far as termination, jointing, bending, protection against mechanical damage, damage by fire, explosion or corrosion is concerned, special attention shall be paid to the applicable requirements of the I.E.E. Regulations in addition to any requirements of this clause.

25.21. Except in cases of runs not exceeding 2m in length, M.I.C.C. wiring shall not be buried in building structure in such a way that it is accessible only by breaking in to the structure, unless prior permission is obtained from the Engineer in writing.

25.22. In the case of wiring or cabling by means of other than LSF or mineral insulated cables being called for in the Specification, methods of installation shall be as called for in the section of the Specification under which the work is to be carried out.

25.23. Where the use of flexible cords is called for, no cord of size less than 0.75mm² shall be used and, unless specified to the contrary, they shall be of PVC coloured white, to BS6500 and be rated at 85°C.

In all usage of flexible cords, arrangements must be made to ensure that cords are so clamped or fixed that weight of fittings or such like is not taken by terminals.

25.24. Where LSF, LSF double insulated cables are used within the building structure, the following conditions shall apply:

25.25. The cable shall be run at a minimum depth of 75mm below the underside of all floor boards, joists shall be drilled, not slotted, to accommodate transverse runs. Where cable is run parallel with the joists, it shall be affixed to the joist at intervals not exceeding 300mm using moulded PVC clips of appropriate size to the cable.

25.26. Where LSF, LSF double insulated cable is run within walls, it shall be enclosed in steel conduit in accordance with the Specification, or be RCD protected. The foregoing conduit shall extend from the accessories being wired to 50mm beyond the point of entry of the cable into the floor or ceiling void.
25.27. Where new cabling is to be installed on existing cable tray, the cabling shall be independently fixed to the cable tray and **not** tied wrapped to existing cables.

25.28. Where traditional telephone wiring is installed, all telephone cabling from floor distribution points to line jack units shall be carried out in CW 1308 B white coloured sheathed cabling.

25.29. All data and structured cabling from data cabinets to data outlet positions shall be carried out in U.T.P. Cat 5E or Cat 6 sheathed cabling according to the specification.

26.0. **Lighting Switches**

26.1. Lighting switch assemblies shall comply with BS 3676 either surface or flush and are to be 10A rated grids with rocker type in metal boxes and complete with cover plates detailed in the Specification.

26.2. Insulated plate switches may be used where detailed in the Specification. These are to comply with BS EN60669 rocker type screwed to a metal box where flush or to moulded PVC boxes where surface.

26.3. Where more than one phase of the supply is brought to a single switching position, purpose made switch units with fixed phase barriers shall be employed incorporating danger notices below the switch plate.

26.4. All grid type switches are to incorporate a protective conductor terminal on the grid plate into which the circuit protective conductor shall terminate. In the case of a steel conduit system a protective conductor shall be provided between each grid switch plate and its respective metal housing i.e. switch box.

27.0. **Switched Socket Outlets**

27.1. All socket outlets shall comply with BS 1363 either surface or flush and are to be 13A shockproof three pin shuttered and switched type complete with metal plates mounted in a metal box or as detailed in the Specification of Work.

27.2. Insulated plate socket outlets may be used where detailed in the Specification of Work. These are to comply with BS 1363 to match the insulated plate switches and screwed to metal boxes where flush or to moulded PVC boxes where surface.

27.3. Surface mounted metal socket boxes are to have no unused knockouts left when the installation is complete, all socket boxes must accept only the installed conduit.

27.4. A protective conductor shall be provided between the protective conductor terminal on each socket outlet and its respective metal housing i.e. Socket box.

28.0. **Lighting Fittings**

28.1. All lighting fittings detailed in the Specification of Work or on the drawings are to be supplied complete with lamps or the detailed wattage and colour.

28.2. Where hook and chain suspension is specified a protective conductor terminal shall be fitted in the conduit box and three core flexible cable is to be cable tied to, not threaded, down the chain.

28.3. Where the conduit suspension is specified, a ball and socket type dome lid with flexible copper bend between the fixed and moving part is to be mounted on the conduit box with a conduit drop and oversize double lock nuts and bush are to be installed on the fitting.
28.4. Unless directed to the contrary, where a lighting fitting is recessed into a ceiling, the wiring system is to terminate in a plug-in ceiling rose or three pin plug and socket sited on the soffit and a short length of 3 core white circular silicone rubber flexible cable is to be taken into the fitting via a suitability grommetted opening.

28.5. All diffusers shall be manufactured in light stabilised plastic such as polycarbonate.

28.6. All control gear for luminaries shall be either electronic ballast or high frequency unless otherwise specified.

28.7. Any existing luminaries to be re-utilised within an installation shall be cleaned, overhauled and relamped.

29.0. **Mounting Heights of Equipment**

29.1. Mounting heights of all equipment are important and the Contractor shall take considerable care in this respect. The following schedule of heights shall normally apply, but where it is desired shall differ from these, special instructions will be as contained in the various sections of the specification or on the drawings.

29.2. In the following schedule, the heights given are from finished floor level to bottom of the equipment:

   a) Wall mounted switch and distribution equipment and the like – 1600mm to 1900mm.
   b) Wall mounted control equipment – 1300mm to 1900mm.
   c) Lighting switches, control switches, indicator switches and the like – 1400mm.
   d) Socket outlets in labs and offices – 850mm or 200mm above bench height.
   e) Socket outlets in corridors – 450mm.
   f) Clock points at 2500mm.

30.0. **Circuit Protective Devices**

30.1. Fusing shall be of the cartridge type of size called for in the various sections of the Specification and on the drawings. No departure from Specification or drawing requirements shall be made without the approval of the engineer.

30.2. All circuits of 32A or less shall be controlled by miniature circuit breakers and the Contractor attention is drawn to the necessity of maintaining correct discrimination with the fuse feeding the M.C.B.’s.

30.3. R.C.D.s and R.C.B.O.s shall be used in accordance to BS 7671 and in accordance with the specification.

30.4. All cartridge fuses shall be of H.B.C., A.S.T.A. tested indicating pattern of approved manufacture.

30.5. On completion of the works, spares for all switch and distribution equipment, including switchboards, shall be handed to the engineer.

31.0. **Earthing**

31.1. Main earth electrodes shall be supplied in the form of copper, steel tipped earth rod (s) of Messrs Furse manufacture or equal and approved, where supply authority earthing points are not provided.
31.2. Where a point of distribution external to the main switchroom is served by conduit and/or trunking, a protective conductor shall be supplied and installed within the conduit and/or trunking and shall serve as the main protective conductor for the said point of external distribution, and the conduit or trunking serving the point of external distribution shall not be relied upon as part of the conductive path.

31.3. An equipotential bonding cable shall be provided between the main earthing connection point and the incoming water supply pipe, generally at its point of entry into the building.

31.4. An equipotential bonding cable shall be provided between the main earthing connection point and the incoming gas supply pipe, generally at its point of entry into the building.

31.5. An equipotential bonding cable shall be provided between the earthing connection point and accessible structural steelwork and lightning conductor system.

31.6. Maker tiles and earth rod chambers shall be supplied and installed indicating the position of earth main electrode.

31.7. Supply authority earthing blocks fitted as part of this contract shall be bonded to main earthing connection points.

31.8. On all sites where Protective Multiple Earthing (PME) is provided by the supply authority, the earthing conductor shall be connected to the consumer’s earthing terminal together with the neutral conductor of the consumer’s installation.

31.9. All items of electrical distribution equipment within switchrooms shall be bonded to the main earthing connection point.

31.10. Where MICC cables are used as sub-mains i.e., feeding a point of distribution external to main switchrooms, the outer copper sheath may be employed as an earthing conductor but shall be bonded direct to the main earthing connection point (switchroom) and the main earth connection on the distribution equipment and cable glands.

32.0. Labels and Circuit Lists

32.1. Labels – labels engraved to indicate the function or usage of equipment shall be supplied and fitted as called for in the various sections of the Specification.

32.2. Labels shall be polished brass, brass finished matt chromium plated, traffolyte or plastic as definitely specified. Lettering shall be coloured black unless specially called for the contrary, although all labels bearing wording of a warning or “Beware of Danger” nature, shall be coloured red.

32.3. Circuit lists shall be fitted in all distribution boards or equipment from which more than one circuit emanates.

32.4. Generally, circuit lists shall take the form of a sheet with circuit details typed or printed thereon in a clearly legible manner, the sheet enclosed within a cellophane envelope and the envelope attached to the inside of lid, door or cover of the distribution equipment. The size of each list shall be commensurate with the size of lid, door or cover and with the information which it must contain.

32.5. A further copy of the distribution board schedule is to be handed to the Engineer.

33.0. Painting

33.1. Generally, any necessary painting of work carried out under this Contract will be the responsibility of the building Contractor, but the following are exceptions where painting shall be carried out by the electrical Contractor.

33.2. Of any work or items where particularly called for in other sections of this Specification.
33.3. Of any manufacturer’s paint finish of equipment which has been marked or damaged, in which case painting required shall be in the nature of touching up and shall match the original in every respect.

33.4. Of all brackets, fixings, supports etc., in which case anti-rust painting and undercoating is required by means of zinc chromate or other anti-corrosive paint and an undercoating of light grew colour and all to be carried out before erection.

33.5. Of any externally installed metal equipment, in which case treatment after installation, shall be aluminium primer or other anti-corrosive paint, one undercoat shall be agreed on site during the course of the Contract.

34.0. Tests on Site

34.1. During and on completion, the installation shall be tested by the Contractor. Tests shall be carried out in accordance with the I.E.E. Wiring Regulations. In addition, the Engineer or his representative may carry out or request to be carried out further tests to satisfy himself or any special aspect of the installation.

34.2. Tests shall include resistance of earth electrodes to the general mass of earth, earth continuity of the complete installation, and insulation resistance of all circuits. In addition, tests of protective conductors shall be carried out on all enclosed work before being closed.

34.3. The Contractor shall provide a sufficient type and quantity of all measuring equipment and labour for tests which may be required to be carried out concurrently at various points on the site. Contractor shall take every precaution to ensure the safety of his own, other contractor’s personnel during periods of testing.

34.4. On completion of the test, an Inspection Certificate based upon the current I.E.E. Wiring Regulations, shall be completed by the Contractor and handed to the Engineer with two copies for the test results upon which the completion is based.

34.5. The Engineer may, at his discretion, instruct his representative to duplicate any tests and/or completion inspection with a reasonable period after the receipt of the Contractor’s Inspection Certificate, in order to assess, independently, the results declared thereon.

34.6. All costs incurred because of the necessity to conduct a second test and/or inspection of incorporated or deficient work (and, if required, any and all further tests and/or inspections as may prove necessary in this respect) shall be carried by the contractor.