SPECIFICATION

Electrical services engineering specification for:

Detail of works – Concrete Bridge Works
Project Number – PS2018-016

1.0 **Scope of Works**

Unless otherwise noted in this specification, the Contractor shall supply, deliver, off load, position, erect, test, commission and set to work all equipment necessary to complete the works detailed in the following sections of this specification.

Strip out

Skips where required shall be placed in locations agreed with the University. All skips located on site shall be lockable and secured when not in use.

Strip out all redundant services within the contract areas, extent to be agreed on site with the CA.

Offer to the University any items removed prior to disposal off site, in accordance with all current legislation.

All works to be carried out by a NICEIC or ECA registered contractor.

Provide copies to the CA of all electrical staff CSCS cards prior to any operative working on the electrical installation.

Lighting

New lighting is to be installed on the canal bridge as noted on the attached drawing.

Custom columns and bracketry are to be fabricated, as noted on the drawings. The fixings shall be suited to the wind load likely to be experienced at the base. All fixings in to the concrete structure (not the pavings) shall be by means of chemical resin fixing.

The additional steel support work shall be precision laser cut, de-burred and brush finished. All fixings to the existing hand rail shall be carried out to a high standard, as above de-burred and brush finished as required.

The columns shall be fabricated to marry the swan neck spigot of the lighting fitting.

The fittings shall be by DW Windsor lighting, fitting ref Swan Neck Iffley, with standard controls & performance COB LED light source.

Wiring to the fittings shall be installed using 25mm 316 stainless steel conduit and fixings, as manufactured by Electrix stainless steel solutions.

In general, all bends are to be formed on site and run parallel to their fixings, as noted on the drawing. Provide draw in boxes as required.

The FP200 enhanced cable is to be installed directly to the luminaire, and looped in /out. The cable shall be installed through the s/s conduit and connect to the columns by means of flexible conduit; water tight stainless steel. Final details to be agreed on site with University Electrical Engineer.

The supply for the installation shall be by means of 10A C RCBO in the existing DB located in the adjacent switch room.

All connections to live systems to be made under dead conditions as defined by HSG85.

The existing DB is a Square D QO DB.

Handover package

In addition to the O & M information defined in this document, at hand over the following information shall be provided. The certificates shall note full completion, with no faults.

Electrical Test certificates
Demonstration of system operation

The project will not be accepted without the attached.

Tender Drawings

The following drawings are issued with the tender and shall form part of the contract documents.

Number	Rev	Title	Scale	Size
1001	-	Electrical Services External Lighting	Noted	A1
1002	-	Electrical Services External Lighting	1:100	A1

Routine Maintenance

The Contractor shall include for all necessary routine maintenance required on the new systems from the date that equipment is first run to the handover date.

During this period, maintenance of all plant and equipment shall be carried out strictly in accordance with the

manufacturer's instructions. All costs incurred by the above shall be included in the tender.

Commissioning

Prior to running the installed systems the contractor shall commission all installed equipment as required by the equipment manufacturer. Load consuming devices shall have their running loads/ current measured and recorded in the record information.

Builders Work

The Contractor should note that all facilitating builders work for the works including making good to existing structures and finishes will be carried out by others at no additional cost to the contract

All fire stopping shall be carried out by the contractor, using proprietary materials, to ensure any fire rated structure breached is returned to the original standard.

Where the contractor requires holes up to 50mm diameter they shall be responsible for the formation of these holes. The contractor shall also be responsible for all fixings to the structure, where permitted. No fixing shall impair the structural properties of any building member.

2.0 **General Requirements**

Drawings

The following definitions shall be applied to drawings referred to and/or required by this Specification.

Tender Drawings

Drawings prepared by the Engineer in such detail as may be necessary to enable those tendering to interpret the design for the Works and to submit competitive tenders for the execution of the Works. These drawings will be re-issued to form the Contract Drawings for issue with the Contract Documents.

Co-ordination Drawings

Drawings showing the inter-relationship of two or more Engineering Services and their relation to the structural and architectural details. Such drawings where required shall be provided by the Contractor, in such detail with dimensions so as to demonstrate that the Engineering Services will be properly separated from one another and can be satisfactorily installed and maintained.

Builders Work Information

Drawings and/or schedules prepared by the Contractor to show requirements for architectural or structural provisions necessary to facilitate the execution of the Works and allow their integration into the Project. Such drawings shall include requirements for ducts, holes, chases, trenches, foundations, bases and supporting structures for plant or equipment and all related making good requirements.

Working Drawings

Drawings by the Contractor based on the Contract Drawings showing details of the proposals for the execution of the Works. The drawings shall be in such detail including dimensions so as to enable the Works to be installed.

Record Drawings

Drawings prepared by the Contractor in order to provide the Employer with a record of Works as installed.

The Contractor shall take, and be responsible for, all particulars and dimensions from site and details on any drawings prepared by him.

Drawings shall be prepared to a scale of 1:50 for all services and builders work in the buildings and 1:20 for all plant rooms, confined spaces and similar locations.

One copy of the Contractors drawings, including working drawings, shall be submitted to the Engineer for his appraisal, prior to the works commencing, and the Contractor shall allow in his programming for such submission and/or re-submission when required.

The drawings will be checked to ensure that they do not contradict the Design Intent and comment by the Engineer will be so limited. An allowance of 10 working days should be made for such appraisal.

The inspection of the Contractors drawings by the Engineer shall not alleviate the Contractor of his responsibility for ensuring their accuracy, nor from compliance with the requirements of the Specification.

Setting Out of the Works

The Contractor shall be responsible for the setting out of the Contract Works and for the correctness of the positions, levels and dimensions of the works. The Contractor shall supervise and be responsible for the accuracy of all information provided by him under the Contract.

If at any time during the progress of the Works any error shall appear or arise in the positions, levels or dimensions of the Works, the Contractor shall at his own expense remove and amend the work to the satisfaction of the Engineer and shall

become liable for any costs associated with such error including any delay caused to the Contract due to such error.

Making Good/Damage

Any and all damage to the building and its decorations that result from these works shall be made good without alteration of the contract value. Rooms where damage has occurred which is not due to the necessary process of the works will be required to be fully redecorated.

Documents and Drawings on Site

The Contractor shall ensure that one copy of the current Contract Documents prepared by the Engineer are kept on site at all times and that his staff and operatives are fully conversant with same.

The "marked up" set of Installation Drawings shall form the basis of the "Record Drawings" required upon completion of the works and shall also serve as a means of recording the progress of the works.

The drawings and documents on site shall be available for inspection by the Engineer at all times.

Person in Charge and Quality of Workmanship

The Contractor shall in the execution of the Contract Works employ such employees and workmen as are careful and skillful in their trades and callings. The person in charge shall be fully skilled in all relevant aspects of the work to be undertaken and shall hold relevant qualifications/registrations with a professional electrical body such as the JIB to the level of “approved electrician”, they shall also have had previous experience of the class of work involved. All other operatives shall be qualified to the level of work they are to undertake (levels of qualification and duties to be undertaken shall be as prescribed by the JIB grading scheme documentation).

The person in charge shall give his whole time and attention to the works for the full duration of the Contract and shall be responsible for no other contract or commitment.

The Contractor shall not be allowed to replace the Person in Charge without written confirmation from the Engineer.

Materials and Workmanship

The Contractor shall ensure that all materials, goods and workmanship used in the works shall be the best of their respective kinds and shall conform to the current British Standard Specifications and the recommendations of the respective current Codes of Practice including test pressures,

methods of testing etc.

Electrical installations shall be in accordance with the IET Regulations for Electrical Installations : Seventeenth Edition BS 7671, as amended to current date.

No materials brought to site for the incorporation into the works shall be used for scaffolding, any other temporary purpose or misused in any way.

All materials, goods or workmanship considered by the Engineer to be unsound, unacceptable and/or not in accordance with the Specification shall be immediately removed by the Contractor and properly replaced by the Contractor to the satisfaction of the Engineer at the Contractors own expense. Should the Contractor neglect or refuse to do this, the Engineer shall have the power to employ other monies that may then be or shall become due to the Contractor.

No deviation from specified equipment will be allowed. Where equipment is not specified, equipment and accessories shall be identical to those used on the existing installation.

Where manufactured items are not specified by name, the Contractor shall complete schedules of articles included in the Tender and submit these to the Engineer for comment before their use is permitted.

The work shall, unless otherwise stated, be carried out in strict accordance with the recommendations of the manufacturers of the materials, plant and equipment to be installed.

Cleaning of Materials and Works

The Contractor shall thoroughly clean out the interior of each item of the installation and plant immediately after the execution of any work on that item, to the satisfaction of the Engineer.

Immediately prior to Practical Completion of the Contract Works, the Contractor shall thoroughly clean down the works in an approved manner, and ensure the installation, including all plant, is free from dust, dirt, moisture and other foreign matter.

Carriage of Goods

The Contractor shall allow for the cost of all packing, carriage and delivery of goods, including off-loading, required upon the site to maintain the programme and shall include for the return of empty cases and the handling of materials not required on site. His Tender shall include for goods delivery by passenger train or other special transport as necessary to

carry out the work in the specified time. The Contractor shall advise with his Tender if the delivery programme cannot be met for any item involved.

Delivery to site shall be in accordance with the agreed programme and the Contractor shall give three weeks notice of the actual delivery to the Engineer.

Test Certificates

The Contractor shall in accordance with the testing and commissioning section of the Specification forward to the Engineer certified copies of results obtained from testing and commissioning on completion or on sectional completion as appropriate.

Use of Installation by Contractor

The Contractors shall be allowed to use the installation for testing, proving, and commissioning only, and when the following requirements have been fulfilled:-

The Contractor has given written advice of the date of testing, proving and commissioning etc., to the Engineer.

The Contractor has provided, at his own cost, unless stated to the contrary, all water, power, fuel, labour etc., necessary for the temporary operation of the plant including any temporary supplies for testing and commissioning.

The Contractor has undertaken full responsibility and arranged adequate insurance cover for the period of said operation.

All costs arising from the six items listed above shall be borne by the Contractor.

Under no circumstances shall the plant be used for any purpose other than those listed above.

Identification of Plant, Equipment & Cabling

The Contractor shall include for the complete identification of all plant and equipment etc., with white traffolyte labels having black lettering in general or red lettering where indicative of danger or risk, to a size, position and description as specified by the Engineer.

The labels shall be fixed by chrome plated round headed screws

The Contractor shall include for the provision of a cable

marking system, which shall be of the “Critchley” type to match the existing.

All switched fused spurs, double pole switch accessories and any other accessories which are required under this Specification, shall be engraved.

The accessory plate shall be engraved in either black or red, capital letters 5 mm high detailing the appliance or equipment being supplied by the accessory, e.g., 'EXTRACT FAN', 'FAN CONVECTOR', 'INCINERATOR', 'EXTERNAL LIGHTING' etc.

Record Documents

Two weeks prior to Practical Completion, in addition to the requirements of the Preliminaries Document, the Contractor shall provide to the Engineer for distribution four approved sets of the bound record documents comprising Record Drawings and Operating and Maintenance Manuals as described below, together with:-

Two sets of top quality paper prints of the Record Drawings.

In addition, at Practical Completion the Contractor shall provide:-

A complete set of drawings (in Autocad 2004 format) & the operation and maintenance manual (In Microsoft Word format).

The information shall be presented in Compact Disk, or DVD storage media.

The Record Documents shall comprise the following:-

Record Drawings

The Contractor shall provide a complete set of drawings based upon the installation drawings upon which must be clearly shown all details, sizes, types, locations, duties and descriptions of all plant, material, equipment and installations as installed, provided and executed under the Contract Works, including plant supplied as 'free issue' items to the Contractor.

Unless otherwise approved by the Engineer floor layouts shall be to a scale of not less than 1:50 and plant rooms, boiler rooms and equipment rooms shall be to a scale of not less than 1:20.

The drawings shall include symbols, plans, sections, elevations and isometric interpretations to provide a comprehensive record of the installations.

Electrical drawings shall be in accordance with IET Regulations and with this Specification.

Operating and Maintenance Instructions

The Contractor shall provide operating and maintenance instructions containing all information to enable the Purchaser to operate and maintain the installations and equipment, comprising fully detailed sections including the following.

Description of the system and equipment, including diagrammatic drawings of each system.

Setting to work and operating instructions of plant including safety precautions.

Schedules of routine and periodic maintenance.

Schedules of emergency measures and fault finding techniques.

Schedules of equipment with manufacturer's works/reference numbers, names, addresses and telephone numbers.

Manufacturers instruction leaflets and literature including lists of standard replacement parts.

Schedules of electrical circuits etc.

Set of paper prints of installation drawings to be replaced with prints of record drawings when completed in accordance with this Specification.

Description and schedule of control sequences together with wiring diagrams indicating plant and control interconnections and internal wiring of equipment.

All test results for all services installed, as described in this document.

The documents shall be bound in stiff-backed ring binders and shall be A4 size, with "pull open" two ring fitting at 80mm centres and of a capacity to suit the intended contents.

All the contents shall be mounted in clear PVC pockets sealed on three sides, open at the top and punched at 80mm centres.

The Contractor shall include for all costs and expenses in this context and shall indicate the item separately in his Tender Summary.

In the event of the Contractor failing to comply with this Clause in the stipulated time for production etc., the Engineer shall have the power to recommend the Contract Works as

being unacceptable to hand over due to insufficient information being available to enable the plant to be operated and maintained in accordance with the Health and Safety at Work Act, and furthermore shall have the power to instruct the work to be carried out by others and deduct the resultant costs from the Contractors Final Account.

Training of Purchasers Staff

The Contractor shall allow for the Person in Charge to fully instruct the Purchaser's staff in operating, maintaining and servicing the entire plant and systems. The training period shall be sufficient to adequately cover the subject matter and shall extend for a minimum period of two days. The Engineer will give seven days written notice of his requirements for this period of instruction to commence.

The Contractor shall allow for instructions on specialist equipment or systems to be given by the manufacturers/suppliers.

Visit to Site

The Tenderer shall, prior to submission of his tender, visit site in order to determine and confirm the details of the existing installations, site conditions, restrictions, obstructions and standard and condition of the existing installation.

No claim will be entertained with respect to lack of knowledge of the site and/or the existing installation.

Arrangements to visit site should be made by contacting

Mr P Heath
Electrical Services Engineer
University Of Huddersfield
Director Of Estates and Facilities
Property Services
Queensgate
Huddersfield

Tel 01484 472870

Year 2000 - Software Compatibility

All electronic or processor controlled devices shall be fully compliant with the year 2000 date change. This shall be demonstrated by the Contractor before orders are placed. No non-compliant systems or components shall be accepted unless it can be proven that there will be no effect to the operation of that system.

Ensure that all systems and components, including all embedded computer microchips, are fully compliant with the millennium date change to ensure

	no malfunction or resetting at the year 2000, or associated dates Ensure: No value for current date will cause any interruptions in operation. In all interfaces and data storage, the century in any date must be specified either explicitly or by unambiguous algorithms or inferencing. As defined by British Standards institution DISC PD2000-1 **E - Proms** The Contractor shall provide the Purchaser with a disk incorporating relevant software for any EPROMS incorporated within the Works.				

3.00	**SWITCHGEAR AND DISTRIBUTION** **Distribution Boards** **Miniature Circuit Breaker Distribution Boards** All locked distribution boards shall be operated by a master key and six such keys shall be supplied upon completion of the Contract to the Engineer. The neutral bars shall have one terminal for each SP way possible within the board, e.g. 8 way TP/N : 24 Terminals, and connection of conductors to the neutral bar shall be in the same order as the MCB ways. Earthing conductors shall be connected in the manner described for neutral conductors. Where the full capacity of a distribution board is not required, blanking plates shall be installed in the vacant MCB housings. **Fused Distribution Boards** All fuses shall be of the HRC type, ASTA certified, for compliance with BS 88 1975, Part 2, for Category of Duty 550, AC 80. Where the use of fuses of other makes or types than those specified would adversely affect the protection or discrimination provided, a permanent label shall be fixed to the distribution board giving details of the fuses to be used. **Fused-Switch Units, Switchfuses, Switches and Fuses** The above units shall comply with the current BS and shall be 500 volt type and installed where specified and as detailed on the Distribution Diagram. **Cartridge Fuses** All fuses installed within 13 amp plug tops, fused spurs, clock connections etc., shall be cartridge fuse links rated at 240 volts ASTA certified for compliance with BS 1362 "General purpose fuse links for domestic and similar purposes', or BS 646 'Cartridge fuse links (rated up to 5 ampere) for AC and DC service'. All equipment connected under this Contract which is locally fused shall have fitted fuses with characteristics which are recommended by the manufacturer of the equipment. If any appliance or equipment suffers due to incorrect fusing of the appliance, this shall be repaired or replaced at no extra cost to the Contract.			

Labelling and Engraving

Labelling

All fused-switch units, switchfuses, switches, bus-bar chambers, distribution boards etc., and all items of equipment on the main panel shall be identified and shall have securely bolted externally, a white 'Formica' or 'Traffolyte' label engraved with 10 mm black letters detailing the function of the equipment, any reference number and the size of incoming and outgoing cables and types.

Each distribution board shall be fitted internally with a TYPE WRITTEN list giving details of all MCB or fuse ratings, supply phase, equipment served and size and type of all circuit conductors. Each list shall be mounted in an envelope formed from 0.5 mm thick clear non-flammable material.

The envelope shall be open at one end and fitted to the inside of the distribution board with rivets passing through eyelets in the envelope.

An additional TYPED copy of each circuit card shall be incorporated in the maintenance manuals and handed to the Engineer.

Each TP or TP & N item of switchgear shall have fitted on the cover a white 'Formica' or 'Traffolyte' label having 'CAUTION - 415 VOLTS' engraved in 10 mm high red lettering.

No manufacturers or installers name plates whatsoever shall appear on the work unless written permission is obtained.

Engraving

The Contractor shall allow for engraving of all switched fused spurs, double pole switch accessories and any other accessories which are required under this Specification.

The accessory plate shall be engraved in either black or red, capital letters 5mm high detailing the appliance or equipment being supplied by the accessory, e.g. 'EXTRACT FAN', 'FAN CONVECTOR', 'INCINERATOR', 'EXTERNAL LIGHTING' etc.

4.00 **EARTHING**

The whole of the metallic portion of the installation other than current carrying parts, shall be electrically and mechanically bonded to the consumer's main earth terminal and also, if applicable, to the lightning protection system or other points specified.

The installation shall be effectively earthed in accordance with the following:-

.01 BS 7671, 17th Edition of the Regulations for Electrical Installations issued by the Institution of Electrical Engineers.

.02 Current Edition of the Regulations for Electrical Installations Guidance Notes Number 5.

.03 British Standard Code of Practice : Earthing.

.04 British Standard Code of Practice : The Protection of Structures against Lightning.

.05 Supply Authority requirements for compliance with the Protective Multiple Earthing regulations.

.06 Any other relevant, statutory or government authority.

In those circumstances where earth rods and/or earth leakage protection devices are to be used, these will be as detailed.

All protective conductor shall be enclosed within suitable containment as described in the drawings and small power wiring details.

Earth continuity between separate items of switchgear, distribution boards etc., mounted adjacent to one another shall be effected by means of high conductivity continuous copper tape, or PVC sheathed cable coloured green and yellow connecting all items to the earth terminal.

All items of switchgear, accessories, luminaires, conduits, and the outer sheaths of MICC cables, the armouring of all PVC/SWA/PVC cables, together with all other items of electrical plant and equipment, shall be effectively earthed by means of a suitably sized protective conductor.

At every terminal point on the fixed wiring system an integral earth terminal shall be provided, e.g., BESA boxes, plaster depth boxes, accessory boxes etc. A protective conductor shall be provided and installed between this terminal and the earth terminal on the associated switch, socket outlet, luminaire etc.

Each circuit protective conductor shall be connected to a multiway earth terminal provided and fixed within each distribution board. The earth terminal shall be provided with an adequate number of ways such that not more than one conductor per terminal shall be installed and the earthing conductors shall be connected in the same sequence as the current carrying conductors.

Connection to exposed metallic parts of the building shall generally be made where sections are bolted together in which case extended bolts capable of fulfilling their structural function and accommodating the connection shall be used, a locking nut shall secure the connection to the extended bolt. Welded stud connections will be permitted where welding does not adversely affect the quality of the structural steel and the written approval of the engineer has been obtained before starting work.

A permanent label, indelibly marked with the words 'SAFETY ELECTRICAL CONNECTION - DO NOT REMOVE' in legible type not less than 4.75 mm high, shall be permanently fixed at the points of connection.

Connection between each terminal and the consumer's main earthing terminal shall be made in PVC/PVC stranded copper cables. Each end shall be terminated in a sweated or crimped cable socket and connection to the pipe clamps and earthing terminal shall be made on to the studs or bolts using brass nuts, washers and locknuts.

Connections between dissimilar metals are to be avoided, if unavoidable they shall have the faces coated with petroleum jelly or similar neutral grease and in the event of copper being present it shall be tinned.

The protective conductors shall be fixed by means of PVC coated metal saddles.

Bonding connections to pipework shall be as unobtrusive as possible and where practicable shall be made in service ducts or accessible voids and shall be readily accessible and their positions shall be indicated on the Record Drawings.

The metal waste of all baths and showers shall be bonded to the hot and cold water pipes as shall all sinks and basins within the building. The cables shall be run so as to be as inconspicuous as possible.

All equipment located in kitchens, e.g. cookers, hotplates, etc., shall have an additional supplementary protective conductor interconnecting all pipework and the main earth terminal.

All earth bonding connections and safety earth labels shall be clearly visible at all times and shall not be covered by paint or lagging or otherwise obscured.

	Connections to lightning conductors shall be as detailed in the British standard. The provision of protective multiple earthing shall be in accordance with the Electricity Supply Authority and as detailed. All materials and sundry items shall be provided whether or not specifically mentioned, necessary to completely and effectively earth the installation. The installation shall be fully protected against dampness and corrosion and the effects of electrolytic action between dissimilar materials. A completely permanent installation shall be provided which shall be fully accessible for regular testing and inspection.				

5.00	**CONTAINMENT SYSTEMS** **Cable Trays** Cable trays shall be formed from perforated steel of not less than 1.5 mm thickness up to and including 300 mm width; and 2.00 mm thickness with return edge above 300 mm width. They shall be galvanised unless otherwise indicated. Tray shall be adequately sized to support the cables without bunching. Support shall be by means of steel brackets installed at intervals necessary to provide a rigid fixing and ensure that no undue deflection occurs in the complete installation. The brackets shall be galvanised prior to fixing. Dome headed bolts, nuts and washers of finish suitable to the tray shall be used between tray and brackets. Unless stated to the contrary on the drawings accompanying this Specification, tray shall be installed with a 100mm space between the structure and tray. Cable tray shall be installed using factory formed bends, elbows, tees, couplers and risers etc. Where cut sections are used for sets they shall be free from sharp edges and joined by means of fish plates bolted to each section. Site fabrication of elbows etc., will only be permitted with prior approval and where it is not possible to obtain the necessary factory made item. Where cuts have been made the tray shall be painted with zinc rich paint. Holes that have been cut to allow cables to pass through shall be suitably bushed. All routes must be chosen to allow ease of access to all cables when installed. All cables shall be securely fixed to traywork and the complete installations must be carried out in a neat and workmanlike manner without crossovers. A 25% reserve margin in size and weight shall be allowed for all cable trayworks. Cables of 30 mm diameter and above shall be fixed using the appropriate size cable cleat as supplied by BICC Ltd., or of approved equal type and manufacture. On multi light duty cable runs, proprietary fire rated (stainless steel) cable ties shall be used to secure cables. All ties used shall be fastened by using a suitable tool, which cuts the tie to length. Where the tie is cut any sharp edge shall not be accepted, and will require smoothing at no additional cost to			

the contract.

Cable Baskets

Cable baskets shall be formed from galvanised steel of not less than 3mm diameter up to and including 300 mm width

Basket shall be adequately sized to support the cables without bunching.

Support shall be by means of steel brackets installed at intervals necessary to provide a rigid fixing and ensure that no undue deflection occurs in the complete installation. The brackets shall be galvanised prior to fixing. Dome headed bolts, nuts and washers of finish suitable to the basket shall be used between basket and brackets.

Unless stated to the contrary on the drawings accompanying this Specification, basket shall be installed with a 100mm space between the structure and basket.

Cable basket shall be installed using factory formed bends, elbows, tees, couplers and risers etc. Where cut sections are used for sets they shall be free from sharp edges and joined by means of fish plates bolted to each section. Site fabrication of elbows etc., will only be permitted with prior approval and where it is not possible to obtain the necessary factory made item.

Where cuts have been made the basket shall be painted with zinc rich paint.

All routes must be chosen to allow ease of access to all cables when installed.

All cables shall be installed in a neat and workmanlike manner without crossovers. A 25% reserve margin in size and weight shall be allowed for all cable baskets.

On multi light duty cable runs, proprietary fire rated (stainless steel) cable ties shall be used to secure cables. All ties used shall be fastened by using a suitable tool, which cuts the tie to length. Where the tie is cut any sharp edge shall not be accepted, and will require smoothing at no additional cost to the contract.

Cable Trunking

Trunking shall only be installed in situations which will remain readily accessible throughout the life of the building. No cable trunking shall be installed behind a plastered ceiling or in other inaccessible situations.

Cable retaining strips shall be fitted at 1 metre intervals, unless trunking is installed with the cover on the top side.

Insulated cable support pins shall be fitted at intervals of 4 metres in vertical runs of trunking and at the top of the vertical trunking.

Sheet Steel Cable Trunking

Fixings shall be arranged in pairs across the back of the trunking at 1 metre intervals.

All lengths of trunking shall be connected together by internally fitted rectangular couplings of sufficient width to provide a minimum bearing face of 25 mm to which the lengths shall be bolted on site or welded at the factory.

Adequate provision shall be made to allow for expansion on all installed lengths of trunking.

All Tee pieces and bends shall be formed with similar means of connection and the inner radii area shall be such that cables will not be bent through a radius less than that prescribed in the IET Regulations. Only bends and tees of approved pattern will be accepted.

All fixing screws within the trunking shall be of the round head type. Self tapping screws shall not be used.

All necessary accessories including long sleeve couplings, end pieces, bends, sets, tees, reducer branches, fillets, pinracks, cable retainers etc., shall be purpose made units rather than being fabricated on site.

Where a change in direction of a trunking run occurs, the deviation should be effected by a purpose made unit manufactured on similar lines to the bends and tee pieces described above. Where this is not practical, changes in direction shall be fabricated in a neat and workmanlike manner. All joints shall fit closely and gaps will not be permitted.

All burrs and sharp edges shall be removed and no screw shall protrude into the trunking.

Trunking shall be firmly attached to its associated equipment either by bolted flanges or by male bushes and couplings.

Where trunking is connected to equipment by means of flange connectors the entry into the equipment shall be of the same cross-section as the trunking.

Where trunking does not terminate in equipment, the otherwise open end shall be capped with a cover suitably bolted in position.

Where conduits are taken off multi-compartment trunking they shall not pass through other compartments unless prior

permission is obtained in writing from the Engineer.

The entire trunking system shall be electrically and mechanically continuous throughout.

Trunking runs shall be so arranged that the lid or cover plate is always on the top or side and not underneath, unless this cannot be avoided in which case permission shall be obtained in writing from the Engineer.

Wherever trunking passes through walls, vertical partitions etc., a fixed piece of trunking lid shall be fitted to the trunking extending 25 mm either side of the wall or other barrier, to allow removal of the adjacent lid without disturbing the building fabric. Care shall be taken to see that no orifice is left between the trunking and the building structure through which fire might spread. All holes shall be filled with Rockwool or equivalent, fire barriers etc to maintain the fire integrity of the structure.

All trunking shall be fixed so as to drain off any condensed moisture.

Earth links of the appropriate size and type shall be installed outside the trunking at every jointing coupling, manufactured bend, tee, etc., throughout the entire trunking system.

In cases where sheet steel trunking is installed on wooden floor joists or similar applications, and there is a danger of movement, a flexible earth conductor shall be installed bonding all joints in the trunking. This shall be fitted in addition to the standard earth links.

Insulated Cable Trunking

Insulated trunking shall only be used where an insulated conduit system is being installed unless specifically stated otherwise. The trunking shall be fixed by means of round-headed screws at intervals not exceeding 1 metre. Fixing holes shall be slotted to allow for any subsequent expansion due to temperature variations. Insulated trunking shall not be installed where ambient temperatures are expected to exceed 60°C or fall below -5°C. Care shall be taken to ensure that the trunking is not deformed by fixings, particularly when trunking is fixed to an uneven surface. Packing pieces shall be introduced in order that the trunking shall be securely fixed, level and plumb without being deformed.

Insulated cable trunking shall be smooth inside and outside and free from imperfection.

Insulated cable trunking shall be of the high impact resisting heavy gauge type with well fitting lids of an approved type and size or as indicated in the Contract Documents.

Insulated trunking shall be fitted with manufacturer's standard tees, off-sets and other fittings where changes of direction occur.

Where trunking terminates, manufacturer's standard end plates and flares shall be fitted to connect to items of equipment.

Joints shall be effected using the manufacturer's standard internal connectors, and in accordance with the manufacturer's recommendations.

Separate protective conductors shall be installed in the trunking.

All joints, trunking and trunking covers shall fit closely and be free from gaps. Additional fixings shall be provided to the building structure 50 mm either side of the joint.

Joints in the lid and trunking must not be allowed to coincide.

The manufacturer's recommendations regarding the installation of insulated trunking must be adhered to at all times.

All conduit entries shall be made by means of purpose made bushes and couplings or adaptors.

Dado Trunking

Dado trunking shall be fixed by means of round-headed screws at intervals not exceeding 1 metre. Fixing holes shall be slotted to allow for any subsequent expansion due to temperature variations. Dado trunking shall not be installed where ambient temperatures are expected to exceed 60°C or fall below -5°C. Care shall be taken to ensure that the trunking is not deformed by fixings, particularly when trunking is fixed to an uneven surface. Packing pieces shall be introduced in order that the trunking shall be securely fixed, level and plumb without being deformed.

Dado cable trunking shall be smooth inside and outside and free from imperfection.

Dado cable trunking shall be of type specified in the appendix.

Insulated trunking shall be fitted with manufacturer's standard tees, off-sets and other fittings where changes of direction occur.

Where trunking terminates, manufacturer's standard end plates and flares shall be fitted to connect to items of equipment.

Joints shall be effected using the manufacturer's standard

internal connectors, and in accordance with the manufacturer's recommendations.

Separate protective conductors shall be installed in the trunking.

All joints, trunking and trunking covers shall fit closely and be free from gaps. Additional fixings shall be provided to the building structure 50 mm either side of the joint.

Joints in the lid and trunking must not be allowed to coincide.

The manufacturer's recommendations regarding the installation of dado trunking must be adhered to at all times.

All conduit entries shall be made by means of purpose made PVC bushes and couplings or adaptors.

Conduit and Conduit Facilities

No conduit smaller than 20 mm in diameter or larger than 32 mm diameter shall be used.

In no case will the use of proprietary bends, sets, elbows, inspection elbows or tees be permitted, unless permission has been allowed in writing from the Engineer to meet extraneous conditions.

From every distribution board a spare hole shall be provided (20 mm diameter conduit clearance) fitted with knock-out or plug. When trunking is employed to convey final sub-circuits from the distribution board, no spare entries are required.

All conduit boxes, couplings, draw-in boxes, etc., shall be of the same manufacture and quality as the conduit.

Mild Steel Conduit Systems

Conduits shall be finished with hot dipped galvanised conduit.

Conduits shall be stored in dry conditions prior to installation. The manufacturer's threads applied to each length of conduit shall be cleaned by means of conduit thread die before installation.

Fixing of Conduits

All conduits must be firmly and rigidly fixed to be entirely without whip or movement. Spacerbar saddles, or strap saddles, must be used on the timbers in roof spaces and will be allowed when conduits are run on the underside of exposed unsealed floor or ceiling joists. Pipe hooks or crampets will not be allowed except for securing conduits in chases, or screeds, when the top of the hook must be at least 10 mm below the finished surface of the walls, or 25 mm below the floor finish. Pipe hooks shall be galvanised.

The standard cast iron distance saddle, (single fixing base and two-screw fixing top) must be used for all conduits run on the surface of walls and ceilings etc., throughout the building, fixed at intervals of not more than 1.2 metres.

Where the conduit system is the sole support of the luminaires via conduit boxes, additional saddles disposed symmetrically about and near to the point of suspension must be introduced for security of fixing and all conduit boxes shall be separately fixed.

In service ducts and/or where conduits converge and run together, approaching distribution centres etc., made-up multi-saddle ensembles with common iron bar base, or plain flat saddles grouped onto neat hardwood strips, are acceptable alternatives, provided that 10 mm spacing from the wall surfaces is maintained.

The finish of the saddles must in all cases conform to the finish of the supported conduits. Galvanised, sherardised or cadmium plates or brass screws shall be used in all cases where galvanised conduit is installed.

When conduits are required to be run on shuttering, prior to the laying of concrete insitu, additional security must be provided near to every box and at intervals of not more than 1.2 metres by the introduction of short lengths of steel wire, of not less than 2 mm diameter twisted around the conduit and reinforcing steel. The conduits shall be adequately fixed to prevent excessive movement and damage during the pouring and settling of concrete and shall be protected from mechanical damage.

Conduit Runs and Concealment

The conduit installation routes shall be subject to approval from the Engineer prior to commencing the installation. Conduits shall be installed at least 150 mm from and preferably under hot water pipes and at least 50 mm from other service pipes and cables.

All conduits must be concealed, being run in roof spaces, behind suspended ceilings, under floors, in flooring and roofing screeds, on shuttering prior to the casting of concrete in situ, and in chases cut or cast into walls and/or concrete ceilings.

Earth continuity tests shall be applied to the system before plastering, screeding or casting of concrete is commenced. Surface work will be allowed where certain pre-fabricated methods of construction preclude the concealment of the runs, and on fair faced brickwork or blockwork or other unplastered walls.

Conduit runs shall be planned to obviate the need for draw in

boxes, but where the use of such boxes is unavoidable they shall be accessible at all times and be fitted with covers.

The installation of conduit boxes in floors shall generally be avoided but where it is essential and permission has been given in writing by the Engineer, the floor mounted boxes shall be fitted with brass covers recessed to accommodate the floor finish. The covers shall seal the box against the ingress of moisture.

When conduits are specified as being installed on the surface the runs must be arranged to render the whole system as neat and inconspicuous as possible, having regard to existing architectural features, all vertical and horizontal runs must be plumbed and levelled respectively. Particular care must be taken where conduits converge and run together near distribution centres to obtain a symmetrical layout. The distance between conduits shall be maintained through bends and sets and shall not noticeably vary.

All conduit runs must be designed to permit wiring to be readily installed after the complete erection of the conduits through the available draw-in, accessory and luminaire suspension boxes.

In all positions where the appearance of the conduit layout would be improved by the introduction of dummy lengths of conduit and in all cases where a more secure fixing for the suspension of fittings is considered necessary and would be obtained by continuing the conduits from their respective normal terminations, such dummy conduits and continuations must be included for and introduced.

Where surface mounted equipment (other than luminaires) is specified, all concealed conduits shall be terminated and an adaptable box installed recessed into the wall at every surface mounted equipment position. The recessed box shall in every case be completely covered by the surface mounted equipment. Provision shall be made in the back of the surface mounted equipment for the conveying of cables (including protective conductor) from the conduit system via a suitably bushed opening. Any opening between the recessed box and the surface mounted equipment shall be closed when the surface mounted equipment is fixed, to prevent the ingress of dirt etc.

Where surface mounted luminaires are to be fixed to a concealed conduit system, the boxes shall be circular. Screwed metal caps or plugs shall be used to protect the open ends of conduit and boxes. Special care shall be taken to prevent foreign matter entering the conduit. Cork plugs shall be used at conduit terminations to prevent the ingress of foreign matter.

Locking Bushing and Coupling

All conduit ends must be filed square and reamed before erection to ensure freedom from internal burrs and roughness.

All running couplings shall be secured by means of lock nuts or lock rings, and the exposed thread painted after installation. On galvanised steel conduit installations, galvanised internal thread malleable cast iron unions shall be used.

Every conduit connection to equipment, boxes, distribution boards, loop-in boxes, cable trunking etc., shall be made by means of a screwed coupling and male hexagonal headed smooth bore brass bush. The smooth bore bush shall be fitted to secure the conduit to the item connected via a purpose made clear hole only sufficiently large to permit the bush to be rotated, the hole to be closed by the bush and coupling where fitted. Paint must be removed from the surface of the item connected to allow it to be covered by the end of the coupling which shall be filed, clean and square, to ensure a good mechanical and electrical metal to metal joint.

Any exposed area of metal from which paint has been removed must be made good in a matching paint. Bushes shall be fitted and tightened by means of correctly fitting spanners. Mutilated bushes must not be fitted, and any bushes damaged whilst being fitted must be removed and replaced.

Conduits connecting to a coupling shall be connected by means of a 15 mm long threaded section and shall have a gap of approximately 2 mm between them. No threads shall be exposed except at running couplings.

Continuity and Earthing

The whole of the conduit installations shall be mechanically and electrically sound and continuous throughout their length in accordance with the IET Regulations.

Painting of Conduit

All exposed threads shall be painted and all conduit which has suffered minor damage to its paint shall be made good to prevent oxidation. Lubricant or cutting compound shall be removed from conduit prior to painting. Galvanised conduit which is slightly damaged shall be primed and painted with a metal based paint to match the colour finish of the conduit.

Insulated Conduit Systems

Insulated conduits shall be heavy gauge, high impact and manufactured to comply with BS non-metallic conduits and fittings for Electrical Installations.

During the course of the installation of the conduit system,

procedures for working and dressing the installation as recommended by the manufacturer shall be employed.

Conduit systems shall be protected during storage and during installation by means of wooden plugs, plastic plugs or plastic caps to prevent the entrance of plaster or foreign matter. Protection shall also be afforded against mechanical damage.

Surface conduits shall be supported by spacer bar saddles which shall be fixed at maximum intervals as stated in the IET Regulations except for bends where saddles shall be positioned 200 mm on either side of the bend. Conduit shall be free from slide within the saddles.

All saddles, tubes and boxes must be in perfect alignment to prevent warping when the installation is complete. Concealed conduits shall be fixed by galvanised crampets. The top of the crampets must be at least 10 mm below the finished surface in walls and 25 mm in floors.

Expansion couplings shall be installed where any length of conduit, inclusive of draw-in boxes etc., exceeds 5 metres in length.

Where luminaires or other items of equipment are required to be supported from an insulated conduit system the maximum weight supported shall be 3 kg, and the box or boxes shall be fitted with metal support lugs within each box.

Enclosed tungsten luminaires shall not be fixed directly beneath a conduit run but shall be mounted on a heat resistant box spurred off the main run.

The back plate of accessories shall be securely fixed and two saddles shall be fixed immediately adjacent on either side of the accessory.

Insulated conduit systems shall not be installed where the ambient local temperature is expected to exceed + 60°C or fall below -5°C. The manufacturer's recommendations must be adhered to with regard to jointing procedures. Where expansion joints occur these shall be made with the manufacturer's purpose made 'tacky' watertight expansion jointing cement to ensure adequate movement of the system during temperature changes. Throughout the entire system of an insulated conduit scheme, green and yellow coloured and insulated protective conductors shall be installed in accordance with IET Regulations.

Cable capacities of conduits in the IET Regulations shall include separate insulated earth wires.

Flexible Metallic Conduit

Flexible conduit shall comply with the BS. Flexible steel conduit and adaptors for the protection of electrical cable. It shall be used for the final connection from a rigid conduit installation to the terminal boxes of all equipment provided with a means of positional adjustment and/or where vibration may reasonably be expected to occur.

Flexible conduit shall be PVC sheathed.

Flexible conduit shall be terminated using approved glands.

Flexible conduit shall not be used external to a building, where it would be exposed to the weather or in any position where ingress of moisture may occur.

Under no circumstances will flexible conduit be accepted in lieu of sets and bends in rigid conduit installations.

In normal circumstances flexible conduit shall have a minimum length of 300 mm and a maximum unstretched length of 800 mm. It shall permit a full range of withdrawal, adjustment or movement of the equipment.

Painting of Supporting Steelwork Etc.

All supporting steelwork shall be free of rust and treated with an approved rust inhibiting compound prior to installation. The steelwork shall be painted with a minimum of two coats of zinc phosphate paint prior to installation and finally painted with the appropriate undercoat and topcoat to match the associated equipment after installation.

6.0	**PVC SINGLE CABLES** All cables shall be polyvinyl chloride (PVC) insulated to BS, PVC insulated cables (non-armoured) for electric power and lighting, 450/750 volt grade unless an alternative is specified. Prior to commencement of wiring the conduit system shall be swabbed to render it free from moisture and foreign matter. All cables installed in a conduit or trunking system shall be PVC single insulated stranded conductors. No conductor with cross-sectional area of less than 1.5 mm^2 shall be used. The conduit installation shall be completed before wiring is undertaken. No wiring shall be carried out before plastering or screeding is completed and has dried out, and in all cases permission must be obtained in writing before wiring is commenced. Final circuits shall be run in conduits separate from main or sub-main cables. All cables in a conduit shall be drawn in simultaneously. Where cables are installed in cable trunking they shall be installed in compliance with IET Regulations. The space factor shall be 40% to permit 5% to remain for future wiring after the completion of the installation. Cables shall be drawn into the conduit directly from reels, neatly without crossover. Care shall be taken to protect the cables from abrasion or other damage whilst being installed. All cables shall be drawn in without the use of excessive force or the use of lubricants and the wiring shall be installed in such a manner that it is easily withdrawable. Cables shall not pass through luminaires unless the luminaires are specifically designed with a wiring way protecting the cables from mechanical damage and/or heat. The wiring of the installation must be done in strict accordance with the drawings, cable sizes and circuit details given in the Specification and schedules or drawings issued for the particular project. All wiring of multi-point final circuits must be carried out in the loop-in system and no joints or connectors other than those required for the connection of luminaires and others that may be particularly mentioned in the Specification will be allowed. On all A.C. supplies, care must be taken to ensure that both phase and neutral are contained in the same conduit. The minimum length of spare cable generally to be left at each accessory shall be 150 mm per conductor, to enable terminations to be remade. Excessive cable length shall not be left at accessories.			

	Lids of all conduit and adaptable boxes and trunking shall not be fitted until the Engineer has inspected the wiring and given permission for them to be fitted. At least 48 hours notice, prior to the intention to wire the installation and to fix lids, shall be given to the Engineer . Cables installed in trunking shall be grouped in their respective circuits and taped together and identified at regular intervals not greater than 4.00 metres and at all junctions, conduit tap-offs etc.				

7.0	**ARMOURED CABLES** All cables shall be delivered to site on cable drums with the maker's identification labels attached and these shall be handed to the Engineer upon demand. Cables shall be manufactured by companies listed in the appendices. Cables shall only be handled when the temperature is above 0°C and in accordance with the manufacturer's recommendations. Unless permission is given in writing by the Engineer, no joints will be allowed. In the event of joints being unavoidable, they shall be made using plastic joint boxes of approved design filled with an approved cold pouring plastic or resin compound. The cable box shall incorporate suitable copper tapes and clamps to bond the armouring of the jointed cables. The conductors shall be joined with compression or soldered joints, and the conductors shall be wrapped with PVC tape to give a degree of insulation at least equal to that of the original insulation. Compression joints shall be made with the correct size tool and pressure for the ferrules used, or have soldered joints using solder grade 'M' or grade 'G' complying with the requirements of BS. The cables shall be terminated in the cable manufacturer's approved glands. The gland shall incorporate an armour clamping ring and earthing ring, and where used outdoors, a lead washer shall be used to ensure a watertight joint between the gland and the unit to which it is fitted. The earthing ring shall be rigidly fixed to the item of equipment and terminated using brass nuts, bolts and washers. All gland terminations shall be protected by a shroud which shall fit tightly over the cable. The shroud must be threaded over the cable before the gland is fitted. All cables shall have the cores connected to bolted connections in bus-bars etc., by means of compression type terminations, made off by means of hydraulic compression tools and suitable die to suit size of cable. Each terminal shall be fitted with a brass washer between the socket and securing nut or bolt to ensure good electrical contact. No claim, on the grounds of lack of knowledge, in determining the true nature and extent of cable routes, will be entertained. All cable routes shall be approved by the engineer prior to installation.			

After the cables have been installed and terminated, but prior to putting into service, they shall be subjected to an insulation test of twice the normal operating voltage and the results of these tests (recorded on test sheets) and forwarded to the engineer. The engineer shall witness the test and shall be given 48 hours notice to arrange for suitable representation.

Installation of Armoured Cables

The cables shall be installed from the top of the cable drum, correctly supported on cable jacks with brakes to prevent overrun. The cable shall be adequately supported during installation and rollers shall be used to ensure that the cable is installed over surfaces, through structures etc., without abrasion to the cable sheath.

Care shall be taken to ensure that the cable is installed without being twisted or kinked.

The cable shall be delivered to site with its ends effectively sealed and any cables cut on site shall have their ends immediately and effectively sealed with a cap which will permit movement of the cores during installation without impairing the seal. Paper insulated cables shall have their ends sealed by means of a plumbed-on cap.

Cables installed on building surfaces shall be secured by means of correctly sized silicone aluminum claw or clamp fixing cleats, claw cleats for smaller cables, clamp cleats for the larger cables. The cleats shall be secured to the structure by means of the maximum diameter cadmium plated galvanized, or sherardized screws permitted by the fixing holes in the cleats, adequately secured to the structure, and out of contact with other building services.
Where installed in escape routes all fixings shall be fire rated.

Multiple cable runs shall be planned and installed in such a way that cross overs are eliminated. The design of multi-way cable support racks shall be submitted for approval before manufacture.

All reasonable precautions shall be taken to ensure that the cables are not subjected to heating from adjacent service lines, heater units or plants operating at high temperatures. Where these conditions are likely to be severe and cannot be avoided, baffle plates of heat resistant material shall be interposed to suitably protect the cables.

When the routing of cables is not indicated on a drawing, the details of the proposed routing shall be submitted to the Engineer for approval prior to commencing the installation.

All steel and other support structures required for the support and effective installation of the cables shall be included and approval of the Engineer sought prior to manufacture.

Where more than three cables are surface fixed together

	along the same route, then they shall be installed on a return flange heavy gauge cable tray of the perforated type, fixed at regular intervals to ensure that no bending or buckling occurs. On no account shall cables be stacked, except where single core cables are specified as being in 'trefoil' formation. Cables supported on steelwork shall be fixed by approved steel straps. All cable bends shall be adequately supported. Special care shall be exercised in supporting cable at terminations to ensure that undue strain is not placed on any part of a cable termination or equipment. Cables shall be installed as neatly as possible and shall be protected from mechanical damage to a height of 2.0 metres above finished floor level by means of galvanised steel channel manufactured from steel of at least 2.0 mm thickness designed to span a cable or group of cables and fixings.				

8.0 **MINERAL INSULATED COPPER CABLES**

Cables

Where PVC sheathed MICC cables are used all other items shall be PVC served in the same colour, e.g. clips and saddles and PVC shrouds fitted at terminations etc.

The outer coating of the MICC cable shall be used to denote the use of the cable as follows:

Orange - General Low voltage wiring
White - Emergency Lighting
Red - Fire alarm wiring

Other colours may be used as detailed on the drawing or with written permission from the engineer.

Method of Installation

All workmen employed shall be fully conversant with and highly skilled in the installation of MICC cables, and they shall have received an approved course of instruction in the installation and termination of all types of MICC cables. Details of training given to each individual, when so requested, shall be submitted to the engineer for approval.

The manufacturer's recommended tools shall be used throughout the work.

MICC cables shall be installed in accordance with the IET Regulations and the manufacturer's recommendations.

Where four or more cables are installed together on the surface, they shall be installed on cable tray.

Where MICC cables are installed in stud partitions or brick/blockwork walls, all vertical drops shall have, in the suspended ceiling void, a loop of one complete turn allowed for the re-making off of the termination, should it be so required at a future date.

Where cables pass through holes in the building structure, short lengths of insulated conduit shall be threaded over the cables for protection against abrasion.

All holes shall be suitably plugged with flexible material or weak mortar mix, after the cables have been installed.

Where surface mounted cables pass through floors they shall be protected to a height of 2 metres by steel conduit fitted with coupling, bush and sealing compound through which the cable shall pass in order that moisture etc., is excluded.

All parallel cable runs shall be grouped in a neat and orderly

manner without crossovers, so that all cables may be easily identified and any cable easily removed at a later date.

Where MICC cables are installed in walls or partitions they shall be run square and vertical; cables run at an angle or in a zig-zag fashion will not be permitted.

Where a cable is required in excess of the manufacturer's maximum manufactured length the cable shall be extended by means of a factory made cable joint. The joint shall be readily accessible and marked on record drawings etc. Cables shall not otherwise be jointed. All adjacent cables shall be run in the same horizontal or vertical straight lines, diagonal runs are not permitted.

MICC cables shall be looped one complete turn where connections are made to motors, and other equipment where vibration or expansion is likely to occur. The manufacturer's recommendations shall be followed for the best method of expansion joint relating to the size of cable to be used.

Surge suppressors shall be fitted to the termination of MICC cables at contactors and 3 phase star connected motors in accordance with the manufacturers guidance.

Cable Terminations

Where PVC sheathed MICC cables are employed each gland shall be fitted with a PVC shroud, at all terminations, which must be threaded over the cable before the gland is fitted.

All conductors at terminations shall be insulated with continuous 'Neoprene' or heat resistant sleeving, they shall then be identified by coloured PVC insulated tape or by placing a 10 mm length of coloured PVC sleeving over the conductor insulation.

All terminations shall be performed using a pot tail earth lead seal.

All tails shall be of sufficient length to remake broken connections.

The system shall be wired on the loop-in principle, but where connections would assist to produce an economical installation, permission shall be obtained from the engineer. Any such connections shall be made in adaptable boxes fitted with "Klippon" type fixed base terminals and both ends of each cable connected into them shall be labelled and the references indicated on the Record Drawings.

Galvanised accessories such as conduit boxes etc., shall be used where PVC sheathed cables are employed.

All boxes shall be complete with earth terminal.

Circular conduit boxes complying with BS 4568 into which the cable terminations shall be screwed, shall be installed at lighting points except where the luminaires have conduit entries.

Testing MICC Cables

The cables which shall be delivered to site with the manufacturer's seals and identification labels intact shall be tested upon receipt. During the installation each individual cable or complete run shall be tested at least 24 hours after sealing with a 500 volt insulation tester capable of supplying 0.5 M Ohm load with 1mA. A report of these tests shall be submitted to the engineer for approval.

Nothing less than a reading of 200 Megohm must be obtained between the conductors or between any conductor and the cable sheath, all conductors being disconnected from any apparatus. Any re-sealing or replacement necessary shall be carried out without any additional expense to the Contract.

All cables which are to be covered by cement, plaster or are being buried shall be tested as detailed above for continuity and insulation resistance immediately after completion of work by other trades to ensure that no mechanical damage has occurred.

Nothing less than 200 Megohm insulation readings will be accepted in respect of tests on individual sections of cable.

9.0	**FLEXIBLE CORDS AND CABLES** All flexible cables and cords shall be of Butyl silicone rubber or equal to BS 'Insulated Flexible Cords', rated in accordance with the equipment they serve and shall be suitable for the operating temperature envisaged. In high temperature conditions flexible cables and cords shall be Elastomer to BS. They shall be multicore circular flexible cables or cords being insulated and sheathed. Where chain suspension is specified for luminaires the colour of the flexible cable used shall match the finish of the metalwork. All items which are suspended by flexible conductors shall have a straining cord to ensure that no weight or strain is carried by the conductors other than lighting pendants with plastic shades. All flexible cords and cables shall have a protective conductor of sufficient length to ensure that no undue stress is placed on the conductor.			

10.00 **INSTALLATION - GENERAL**

Routes of electrical services, cables, conduit, trunkings and cable trays etc., shall be so designed to avoid crossing building expansion joints if at all possible. Under no circumstances will conduits and cables encased in the building fabric or floor screeds etc., be allowed to cross a building expansion joint.

Where it is unavoidable for surface cables and support systems to cross an expansion joint the following precautions shall be taken.

.01 A sufficient loop of cable must be allowed between fixings on cables fixed directly to the building structure.

.02 All conduits in air must be joined by a 150 mm minimum length of flexible conduit, linking conduit and adaptable boxes and be suitably looped to accommodate the maximum variation in the building structure. A minimum protective conductor of 4.00 mm^2 shall link the conduit section.

.03 All cable trunking crossing an expansion joint shall be linked by flexible section being a minimum of 250 mm in length or greater to accept the maximum building variation. The two fixed sections of trunking shall be linked with a 25 mm x 3 mm flexible braided copper earth tape.

.04 Cable trays must be stopped at each side of the expansion joint, with a minimum gap of 150 mm. Sufficient lengths of cable shall be provided on all cables crossing this gap to allow for the maximum building movement. The cable tray sections shall be connected by two 25 mm x 3 mm flexible braided copper earth tapes.

Supports and Fixings

Fixings shall be made by one or more of the following methods detailed overleaf, according to the nature of the equipment to be fixed, the material in which the fixing is to be made and the local environment.

Holes for all fixings involving the use of plugs and inserts shall be drilled, the use of hammer-driven tools will not be permitted, except where written permission has been obtained.

In all cases, fixings in brickwork and masonry shall be made in the brick or masonry and not in the joint.

Fixings made by any method other than those detailed here

will not be permitted without the written approval of the Engineer.

Particular importance must be made to the type of supports and brackets for pipework and associated equipment. The materials, construction, method of fixing, practicability and appearance of the brackets must be carefully considered.

Full and proper care shall be exercised in the positioning and marking out of all brackets and supports. Brackets and supports shall be set out so that they do not obstruct the access to valves, flanges or fittings requiring maintenance.

The written approval of the engineer must be obtained to the type of brackets proposed, prior to commencing manufacture of any brackets.

All fastenings and fixings to the constructional and fabric elements of the building shall be included. All methods of fixing and fastening shall be approved by the engineer. Direct fixing, self-drilling and normal drilling methods of fixing to in-situ concrete slabs will be considered for approval.

No fixings whatsoever will be allowed into any external cladding panels or to the inside of any double skin roof decking. All supports in the latter instance shall be taken from the purlins.

On precast, prestressed and hollow floor constructions, metal plate and rod hanger supports with associated drilling of the structure and secondary spanning steelwork shall be employed subject to the written approval of the engineer.

Structural steelwork shall not be drilled either for the passage of containment systems or the attachment of brackets, nor shall steelwork be welded to, without written permission of the Engineer .

On hollow wall construction and light partitions, fixing of the spring clip or toggle type shall be used. On extremely light partitions, the conduits may be supported from the floor but approval must first be obtained from the Engineer.

Expanded bolt fixings used in concrete floors and blockwork walls shall be of a maximum diameter of 12mm and to a maximum depth of 100mm.

Expanded bolt fixings are not acceptable within the underground walkway duct and inserts will be provided in this area for all fixings.

Termination at Fixed Equipment

Apparatus Served from Surface Mounted Final Control Equipment

In a conduit installation where the final control equipment is remotely located from the electrical apparatus being served, a conduit link shall be installed from the control equipment to terminate to the apparatus in a fixed through conduit box complete with lid.

Flexible conduit shall connect the conduit box with the apparatus in accordance with Clause 4.03 with particular emphasis on the correct method of earthing as required by the IET Regulations.

Cables serving the electrical apparatus shall be continuous throughout their length, passing unbroken through the conduit box and flexible conduit. Connectors fitted inside the conduit box will not be permitted.

Every item of equipment shall be provided with terminals of adequate size to permit the connection of the conductors specified.

Apparatus Served from Flush Mounted Final Control Equipment

A conduit recessed into the building fabric shall link the final flush mounted control equipment to a conduit termination (end) box recessed adjacent the apparatus. An extension box with conduit spout outlet shall be fixed to the terminal box using the fixing lugs provided, a break joint ring being fitted between the two. The screws securing the extension box shall not form part of the earth path, a separate earth being obtained from the recessed conduit box.

Insulated and Sheathed Cable Installations

Where PVC insulated and sheathed multicore cables are used to serve an item of electrical apparatus they shall terminate adjacent to the apparatus in a suitable connection unit and/or isolating switch as specified.

Final connection shall be made using an insulated and sheathed multicore flexible cable or cord restrained at each end by either cord grips forming part of the connection unit and apparatus or approved packing glands correctly sized to the flexible cable or cord used and fixed to the connection unit and apparatus by a coupling smooth bore bush or entered directly into the apparatus by a tapped conduit entry if possible.

Final connection to an electric cooker shall be made using a proprietary cooker outlet connection unit.

Mounting Heights

The approximate position of main switchgear, control equipment, distribution boards, fittings and accessories shall

	be as indicated on the Drawings. Actual positions shall be determined and approved on site by the Engineer before the work commences. The right is reserved, prior to the work commencing, to make minor alterations to accessory positions of up to one metre in either direction, without incurring any cost variation to the Contract.				

Unless reference is given on Drawings or directed in writing by the Engineer, the following mounting heights to the centre of all accessories above finished floor level shall be adhered to:-

Wall Mounted Luminaires	2200 mm
Lighting and Override Switches	1200 mm
Fireman's Switch	2400 mm
Socket Outlets	450 mm, or 150 mm above worktops
Fused Connection Units	450 mm, or adjacent to appliance
Double Pole Indicator Switches	Adjacent to appliance
Shaver Outlet	1350 mm
Computer Equipment Trunking	550 mm
Cooker Control Unit	1525 mm
External Door Push	1350 mm
Fire Alarm Sounders	2200 mm
Fire Alarm Break Glass Contacts	1400 mm
Fire Alarm Control Panel	1350 mm
Fire Alarm Heat Detectors	Ceiling Mounted
Hand dryers	1150 to bottom
Telephone Outlets	450 mm
Clocks	2200 mm
Internal Alarm Indicator Panel	2200 mm
Warm Air Curtain - Control Unit	900 mm
Distribution Boards in Circulation Areas	1800 mm to lower edges
Thermostats	1650 mm

All groups of accessories shall be in line either vertically or horizontally or as detailed on the Drawings.
Where groups of distribution fuse gear, switches, contactors, etc., are to be installed in the same location, a detailed drawing of the proposed arrangements shall be submitted to the Engineer for approval prior to work commencing.

13.00 **APPENDIX 1 (SCHEDULE OF MANUFACTURERS)**

Item	Manufacturer	Type/ Range
Sub-Main distribution boards	Square D	-
Sub-mains cables	BICC, AEI, Pirelli	To have BASEC approval & to BS5467
Final circuit cables	BICC, AEI, Pirelli	To have BASEC approval & to BS6004 & BS6346
MICC Cable	BICC	To have BASEC approval & to BS6207
Cable Glands	BICC, AEI, Pirelli, CMP	To be acceptable to cable manufacturer
Flexible Cables	BICC, AEI, Pirelli	To have BASEC approval & to BS6007
Cable Trays	Swift, Salamander, Walsall Conduits	Medium or Heavy duty return flange (galvanised)
Cable Trunking	Salamadre, Walsall Conduits	Galvanised
Steel Conduit	Salamadre, Walsall Conduits	Galvanised
PVC Conduit & Containment systems	Ega,Mita, Centaur, Marshall Tuflex	High Impact
Fixings	Unistrut, Hiatt Ltd, Erico	Galvanised
Lighting	See separate schedule	
Small Power wiring accessories	MK	Logic Plus
Adaptable boxes	Appleby, Sarrel, Rittal, Eldon	IP45 In dry Conditions, IP68 In damp conditions
BMS Controls	Trend	-

Dado Trunking	Marshall Tuflex,	Sterling mono plus

15.0	**APPENDIX 2 (SUMMARY OF TENDER – ELECTRICAL)**			
	ITEM		**COST**	
	Strip out			
	Lighting			
	Small power			
	Containment systems			
	Fire alarm			
	Emergency lighting			
	Data installation			
	Access control			
	Provisional Sums (Contingency)		£2000.00	
	Total to carry forward		_____	