

**DIRECTORATE OF ESTATES**  
**PROCEDURE AND INFORMATION MANUAL**  
**EPM PM8 – Standard Electrical Specification**

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## **1.0 Purpose of the document**

- 1.1 This document sets out the Standards for all electrical installation work at the University of Manchester. It is intended to focus on standards not adequately covered in BS7671 and the associated guidance notes.

## **2.0 General Requirements**

- 2.1 The complete installation including all materials shall comply with all relevant and latest edition British Standards, British Standard Codes of Practice and, where indicated, with other Standards and Specifications, and all amendments thereto.
- 2.2 Equipment not manufactured in the United Kingdom shall be of a standard that ensures its compliance with all appropriate British and European Standards.
- 2.3 Each installation shall comply with all relevant statutory instruments and regulations.
- 2.4 If any discrepancy is found between this specification and other related documents, regulations or standards, the Project Design Engineer shall be informed during the tender period.
- 2.5 Electrical contractors and any associated sub-contractors shall be accredited to the NICEIC for a minimum of 2 years as an 'Approved Contractor'.
- 2.6 The lead electrician on any project work shall be a minimum of JIB graded Approved Electrician.
- 2.7 Any project involving work on the High Voltage distribution system shall be brought to the attention of and agreed with the University Electrical Engineer.
- 2.8 The installation shall be to the highest standard as expected of a fully experienced trade contractor. The installation shall be carried out in accordance with all manufacturers' recommendations and established methods and practices and to the entire satisfaction of the Project Design Engineer and the University Electrical Engineer. At the time of practical completion, the condition of the installation shall be as new including all lamps and consumables.
- 2.9 The Contractor shall be responsible for all site co-ordination with other trades, services and disciplines.
- 2.10 Manufacturer's and product types shall be agreed with the University Electrical Engineer prior to installation.
- 2.11 Drawings issued as part of tender documents are not installation or working drawings. The contractor shall allow for preparation of working drawings or such additional drawings to enable the works to be installed effectively.
- 2.12 Detailed manufacturers drawings of all items of equipment showing the constructional arrangements and wiring diagrams shall be submitted to the Project Design Engineer for comment / approval and sign off. No instruction shall be given to manufacture until comments have been received. Responsibility for any errors in any drawings prepared and issued shall remain with the issuing party irrespective of any comments passed by the Project Manager.
- 2.13 All equipment shall be installed to be accessible, without the need for access equipment.

### **3.0 Containment and Carrier systems**

#### **3.1 General Clauses**

- 3.1.1 All containment shall be installed neatly, unobtrusively and parallel to the general building line, and shall meet the aesthetic considerations of the building, as determined by the Project Engineer. Due consideration shall be given to future accessibility and maintenance. Where the Containment installation does not meet these criteria it shall be replaced, at no additional cost to the University.
- 3.1.2 Containment shall only be installed in horizontal or vertical runs.
- 3.1.3 Containment installed within ceilings, floors, ducts, risers etc shall be installed to the same standard as that of the surface installation.
- 3.1.4 All containment systems shall comply with the latest applicable British Standard, and shall be installed in strict accordance with manufacturer's instructions.
- 3.1.5 With the exception of conduit all containment shall be over - sized by 25% to allow for future projects, after all allowances have been made for Space Factors.
- 3.1.6 All metallic containment systems shall be electrically continuous and complete with appropriate bonding links across all joints.
- 3.1.7 All containment systems shall be offered for inspection to the Project Engineer / University Electrical team before cabling and concealment of any containment commences.
- 3.1.8 All metallic containment shall be tested for earth continuity before any cables installed on or in it are made live.
- 3.1.9 In instances where containment has to pass across building expansion joints if the installation method is not detailed in the Particular Specification, the Contractor shall agree it on site with the Project Engineer and the Building Surveyor.
- 3.1.10 The containment system selected shall be the same type, and grade throughout the entire installation, and shall be continuous utilising proprietary glands / couplers etc.
- 3.1.11 Separate containment, or proprietary brand spacers / dividers shall be installed to segregate the different categories of installation.
- 3.1.12 All metallic containment systems shall be electrically bonded where it terminates into electrical distribution equipment.
- 3.1.13 Where containment is installed on brackets, the bracket assembly and supporting steelwork shall be correctly sized for the application. If this assembly involves Unistrut, the Unistrut shall be neatly finished complete with end caps.
- 3.1.14 Where it is intended to use Adaptable boxes, they shall be of the same type and grade as the associated containment. They shall not be used as joint boxes unless it is a requirement of the Particular Specification and agreed with the University Electrical Engineer. If it is a requirement of the Particular Specification it shall be fitted with fixed din rail connectors, a circuit designation, and a warning 'voltage indication' sign fitted to the lid.
- 3.1.15 Where the bracket assembly involves screwed rod hangers the screwed rod shall be neatly finished with protective covers.
- 3.1.16 Fixings for screwed rod hangers shall be via adequately sized expansion plugs complete with locking nuts to secure the installation.

- 3.1.17 Containment installed externally to carry any cabling shall be fitted with protective lid.
- 3.1.18 Where containment interconnects through wall penetrations there shall be no reduction in cross sectional area of the containment.
- 3.1.19 Where different containment systems connect with each other they shall do so in accordance with the table below:

Containment	Approved connection
Steel trunking to Steel conduit	Steel Coupling / Male Brass Bush
Steel trunking to Flexible conduit	Proprietary gland / Locknut / Female Bush
Steel trunking to PVC Conduit	PVC Coupling and Bush
PVC trunking to Steel conduit	Not allowed
PVC trunking to PVC conduit	PVC Coupling and bush
PVC trunking to Flexible conduit	Not allowed
Basket tray to any conduit	Proprietary conduit connector bracket

### 3.2 Ladder Rack

- 3.2.1 All Ladder Rack shall be Hot-dipped Galvanised and the grade shall be selected to suit the application.
- 3.2.2 All Bends and sets shall be factory formed and be of the same grade and size as the Ladder Rack.
- 3.2.3 At each joint an earth continuity strap shall be fitted so as to ensure earth continuity. All straps shall be fitted on the external edge of the Ladder Rack so they are clearly visible.
- 3.2.4 All Cables installed on Ladder Rack shall be in accordance with Clause 4.4.10.
- 3.2.5 The Ladder Rack shall have all sharp edges removed and shall be painted with a zinc rich paint where cuts have been made.
- 3.2.6 The Ladder Rack shall be spaced from the building fabric by means of proprietary brand brackets, which shall be firmly fixed to the building structure. The brackets shall ensure the following minimum clearances:  
 Ceilings - Ensure 300mm between the Ladder Rack and the building structure.  
 Walls - Ensure 40mm between the Ladder Rack and the building structure.  
 Floors - Ensure 40mm between the Ladder Rack and the building structure.
- 3.2.7 Existing stock manufactured by Wiremold and Mita.

### 3.3 Cable Tray

- 3.3.1 Internal to a building Cable tray shall be Hot-dip galvanised.
- 3.3.2 External to a building Cable tray shall be either Hot-dip galvanised or plastic coated.

- 3.3.3 Cable tray shall be suitable for the application. The following table shall be used as a guide:

Gauge of Cable Tray	Application	Minimum Size
Light	MICC / FP cables	50mm
Medium Return Flange	MICC / FP / SWA cables	100mm
Heavy Duty Return Flange	SWA cables	150mm

- 3.3.4 The cable tray installation shall be a continuous installation comprising of bends, joints, sets as necessary.
- 3.3.5 All joints shall either overlap by a minimum of 50mm or be fitted with proprietary brand couplers. The joints shall be bolted so as to ensure a rigid and secure mechanical installation, by means of 6mm round head galvanised Roofing nuts and bolts. The bolts shall be installed with the bolt heads on the inside.
- 3.3.6 The tray shall be spaced from the building fabric by a minimum clearance of 40mm between the tray and the building structure, using proprietary brackets.
- 3.3.7 Brackets shall be fixed:-  
i) At the end of each cable tray,  
ii) At not more than 100mm from each bend or set,  
iii) At not more than 1M intervals along straight runs.
- 3.3.8 The cable tray shall have all sharp edges removed and shall be painted with a zinc rich paint where cuts have been made.
- 3.3.9 The cables shall be fixed at intervals as detailed in Clause 4.1.8, and installed in accordance with Clause 4.4.10.
- 3.3.10 A maximum number of 3 cables deep is allowable where it is necessary to stack cables.
- 3.3.11 Existing stock manufactured by Wiremold

#### **3.4 Basket Tray**

- 3.4.1 All Basket Tray shall be zinc plated steel to minimum Class 5.
- 3.4.2 Basket tray shall be suitable for the application, and shall be suitably sized for the anticipated load.
- 3.4.3 All Bends and sets shall be made in strict accordance with manufacturer's recommendations.
- 3.4.4 Basket Tray shall be mounted using the correct manufactured support system.
- 3.4.5 Basket Tray shall only be cut using the correct manufacturers cutting tool.
- 3.4.6 All Couplers to be of the correct type and grade for the Basket Tray.
- 3.4.7 Existing stock manufactured by Cablofil

### **3.5 Steel Trunking**

- 3.5.1 Steel Trunking and fittings shall be Class 3 Pre-galvanised steel.
- 3.5.2 Trunking dimensions shall not be less than 50mm x 50mm.
- 3.5.3 Trunking fittings shall be of the same finish and type as the associated trunking system.
- 3.5.4 Trunking shall be supplied and installed with close fitting lids which have a screw or catch type assembly.  
The exception to this is lighting trunking with PVC push fit lid – which may be used for lighting installations only.
- 3.5.5 Only standard manufactured bends, sets, end caps, flanges etc shall be used on the trunking system.
- 3.5.6 Trunking shall have all sharp edges, burrs and swarf removed internally and externally.
- 3.5.7 The trunking shall be butted solidly into all fittings so as to ensure a continuous mechanical and electrical installation.
- 3.5.8 At each joint a tinned copper link shall be fitted so as to ensure earth continuity. All links shall be fitted on the external edge of the trunking so they are visible.
- 3.5.9 The trunking shall be securely fixed to the fabric of the building at appropriate intervals not exceeding 1 Meter.
- 3.5.10 In instances where trunking is to be suspended it shall be firmly fixed to the fabric of the building by means of proprietary brand hangers and/or brackets, in accordance with manufacturer's recommendations and without undue deflection.
- 3.5.11 Where trunking passes through the general building structure, it shall be installed with a permanently fixed section of lid. Such fixed sections shall be restricted to the absolute minimum length necessary.
- 3.5.12 Where trunking pass through fire compartments (wall/floor etc) the trunking shall have fitted internally, a fire protective barrier equivalent to that of the (wall/floor). The method of achieving fire protection must be put forward for approval by the Project Design Engineer.
- 3.5.13 Insulated pin racks shall be installed in vertical runs of trunking exceeding 1M. All cables installed within these sections shall be fixed within the pin rack.
- 3.5.14 Multi compartment trunking shall be installed to ensure the integrity of all compartments.
- 3.5.15 Where trunking terminates into electrical distribution equipment the trunking shall be flanged to the inside of the equipment with protective grommet strip installed as required.
- 3.5.16 Existing stock manufactured by Wiremold, Legrand, and Trunk Line

### **3.6 PVC Trunking**

- 3.6.1 The grade of PVC trunking and fittings shall be Heavy Duty, Super High Impact, self extinguishing extruded and unplasticised PVC/LSF compound.
- 3.6.2 Trunking fittings shall be of the same grade, and finish as the associated trunking system.
- 3.6.3 Trunking dimensions shall not be less than 50mm x 50mm.
- 3.6.4 The trunking shall be supplied and installed with close fitting lids.

- 3.6.5 Multi compartment trunking shall be installed in a manner, which ensures the integrity of all compartments, and shall also have a separate lid for each of the compartments.
- 3.6.6 The trunking shall be installed complete with manufacturers bends, bridges etc.
- 3.6.7 Adhesive to be used shall be that recommended by the trunking manufacturer.
- 3.6.8 Where the trunking is extended into Ceiling voids for mains cabling the connection between 'other' containment shall be by means of an approved termination method as per clause 3.1.19.
- 3.6.9 Where the trunking is extended into Ceiling voids for non mains cabling the 'other' containment shall be within 200mm of the trunking.
- 3.6.10 Trunking shall be installed in strict accordance with the manufacturer's instructions.
- 3.6.11 The trunking shall be butted solidly and cemented (using the manufacturer's approved adhesive) into all fittings.
- 3.6.12 The trunking shall be securely fixed to the fabric of the building at appropriate intervals not exceeding 1 Meter.
- 3.6.13 In instances where trunking is to be suspended it shall be installed as follows:-  
i) A suitable sized metal tray shall be firmly fixed to the fabric of the building by means of proprietary brand hangers and brackets.  
ii) The trunking shall be firmly fixed to the tray/batten using pan head screws, nuts and washers.  
NOTE: The screw head shall be on the inside of the trunking.
- 3.6.14 Where trunking passes through the building structure, it shall be installed with a fixed section of lid. Such fixed sections shall be restricted to the absolute minimum length necessary.
- 3.6.15 Where trunking pass through fire compartments (wall/floor etc) the trunking shall have fitted internally, a fire protective barrier equivalent to that of the (wall/floor). The method of achieving fire protection must be put forward for approval by the Project Design Engineer, and offered for inspection on completion of the work.
- 3.6.16 Insulated pin racks shall be installed in vertical runs of trunking exceeding 1m. All cables installed within these sections shall be fixed within the pin rack.
- 3.6.17 PVC trunking shall only be used within areas where the ambient temperature is between - 5°C and 60°C.
- 3.6.18 Existing stock manufactured by Marshall Tufflex, Mita, Centaur, Caradon MK, Rehau and Legrand.

### **3.7 Steel Conduit**

- 3.7.1 All conduit shall be Hot Dipped Galvanised Class 4.
- 3.7.2 Conduit shall have a minimum diameter of 20mm.
- 3.7.3 Conduit fittings shall be of the same type as the associated conduit.
- 3.7.4 Conduit boxes shall be of the screwed circular pattern for sizes 20mm and 25mm.
- 3.7.5 Conduit shall be cleaned of all lubricant and swarf internally and externally.



- 3.7.6 All cut edges shall be reamed.
- 3.7.7 Conduit shall be free from all score marks.
- 3.7.8 Conduit shall be screwed and butted solidly into all fittings so as to ensure a continuous electrical and mechanical installation and terminated in to accessory boxes by means of a coupling and Male Brass Bush – not extended using flexible conduit.
- 3.7.9 Conduit shall be installed with the minimum number of running couplings.
- 3.7.10 Conduit shall have runs of no more than 6m for straight lengths or 3m for runs containing a bend or bends without the provision of a draw-in box.
- 3.7.11 Conduit shall have no more than two right angle bends without the provision of a draw-in box.
- 3.7.12 All exposed threads shall be painted using a zinc rich paint.
- 3.7.13 Conduit shall be bent, set, cut and threaded using a proprietary brand bending machine and pipe vice.
- 3.7.14 Where conduit is installed externally or in potentially damp locations, connections to accessory boxes shall be made with flanged couplings and long reach bushes, and all conduit boxes shall be fitted with gaskets.
- 3.7.15 Conduit shall be fixed at 250mm from each accessory box and in accordance with the following table:

Installation Type	Fixing Method	Max. fixing Distance
Surface	Distance Saddles	1.2M
Flush within fabric of building	Saddles	1.0M

- 3.7.16 Existing stock manufactured by Walsall

### **3.8 PVC Conduit**

- 3.8.1 All PVC Conduit shall be Super High Impact, Heavy Gauge, self- extinguishing, extruded and unplasticised PVC / LSF compound.
- 3.8.2 Shall be free from imperfections
- 3.8.3 Shall be suitable for jointing by adhesive solution and proprietary brand fittings
- 3.8.4 Shall have a minimum diameter of 20mm.
- 3.8.5 All fittings and boxes shall have brass inserts for the fixing of electrical accessories.
- 3.8.6 Where PVC Conduit terminates into a switchbox or accessory box of any kind, the termination shall be completed using a screwed bush and coupling.
- 3.8.7 If there is no provision on the actual accessory to terminate the CPC, it shall be connected in a brass terminal fitted to the accessory box.

- 3.8.8 Conduit shall only be used within areas where the ambient temperature is between -5°C and 60°C.
- 3.8.9 Conduit shall be cut with proprietary brand cutting tool only.
- 3.8.10 Conduits shall be cleaned of all debris and adhesive after fixing.
- 3.8.11 Conduit shall have no more than 2 right angle bends without the provision of a draw-in box. Conduit shall have runs of no more than 6m for straight lengths or 3m for runs containing a bend or bends without the provision of a draw-in box.
- 3.8.12 Conduit shall be securely fixed to the fabric of the building at each conduit box and shall be further fixed using proprietary brand spacer bar saddles. The maximum distance between saddles shall be 750mm and 250mm from any accessory box.
- 3.8.13 Expansion couplers shall be installed in straight runs of conduit in excess of 5M. The expansion couplers are to be installed in strict accordance with the manufacturer's instructions.
- 3.8.14 Conduit shall be bent and set with the use of a bending spring. The bending spring shall be of the same manufacturer as the conduit.
- 3.8.15 Light fittings shall not be fixed to, or supported from PVC conduit boxes.
- 3.8.16 PVC conduit shall be continuous through its installation and terminated in to accessory boxes by means of a coupling and Male Brass Bush – not extended using flexible conduit.
- 3.8.17 Existing stock manufactured by Marshall Tufflex, Mita, Caradon MK, and Centaur

### **3.9 Flexible Conduit**

- 3.9.1 All flexible conduit shall be PVC covered flexible steel.
- 3.9.2 The minimum size of flexible conduit shall be 20mm, and all fittings shall have a metric thread.
- 3.9.3 Only proprietary brand fittings shall be used.
- 3.9.4 Flexible conduit shall only be used within areas where the ambient temperature is between -5°C and 70°C.
- 3.9.5 The contractor shall install the correct type of flexible conduit for the application.
- 3.9.6 Flexible conduit shall be cut using the manufacturers approved cutting tool.
- 3.9.7 The maximum distance between supports shall be 0.5M
- 3.9.8 The maximum length of Flexible Conduit shall be kept to a minimum and not exceed 2 Meters.
- 3.9.9 Flexible conduit shall be installed neat and unobtrusively.
- 3.9.10 In all cases when terminating flexible conduit, the gland fitting shall be Type B Straight Fitting - Swivel External Thread.
- 3.9.11 Existing stock manufactured by Adaptaflex.

### **3.10 Busbar Trunking**

- 3.10.1 All Busbar trunking shall have equal sized phase neutral and earth conductors.
- 3.10.2 All Busbar trunking shall have copper conductors which shall be insulated and/or encapsulated.
- 3.10.3 All Busbar trunking systems shall be fixed in strict accordance with manufacturers instructions using proprietary brand brackets and/or hangars.
- 3.10.4 All Tap-In boxes shall be both switched, fused with mechanical interlock.  
If this is to be achieved by an MCCB this shall also comply with the requirements of Clause 5.2.7.
- 3.10.5 All Tap-In boxes shall have shrouded terminals on live connections.
- 3.10.6 Where Tap-In boxes supply local distribution equipment adjacent to the busbar the connection shall be completed by flexible conduit and tri-rated cables.
- 3.10.7 Tap off Units shall be labelled in accordance with the requirements of Section 5.4.
- 3.10.8 There shall be a minimum of 2 spare tap-offs supplied per busbar.
- 3.10.9 Where busbar is installed beneath the floor it shall be mounted on proprietary brackets and /or supported by a cable tray a minimum of 50mm from the floor slab and fixed throughout its length.
- 3.10.10 Existing stock manufactured by Eaton (MEM), Siemens, Schneider, and E&I Engineering, Electrak.

## 4.0 Cabling Systems

### 4.1 General Requirements

- 4.1.1 All cables shall be installed in strict accordance with the manufacturer's instructions and recommendations.
- 4.1.2 All surface run cables shall be installed neatly, unobtrusively, and parallel to the general building line, and shall meet the aesthetic considerations of the building. Cable runs that do not meet these criteria shall be replaced, at no cost to the University.
- 4.1.3 All surface run cable shall only be installed in horizontal or vertical runs.
- 4.1.4 All cables installed within ceilings, floors, ducts, risers etc, shall be installed to the same standard as that of the surface installation.
- 4.1.5 When installed all cables shall be free from all imperfections throughout their entire length.
- 4.1.6 The final layout of the installation (spacing of clips saddles etc) shall take into account the aesthetics of the building and the installation as a whole.
- 4.1.7 Standard minimum cable sizes on a general electrical installation comprising single insulated cables shall be: 1.5mm<sup>2</sup> for lighting circuits and 4.0mm<sup>2</sup> for power circuits.
- 4.1.8 Where cable is to be installed on cable or basket tray it shall be fixed using a proprietary brand plastic cable tie, cut to length. The Maximum distance between cable ties is 300mm. If the tray is run inverted / vertical / horizontal the cable tie is to be supplemented with saddles or band fixed securely every 2M.
- 4.1.9 There shall be no mixing of cable types and/or wiring methodologies on individual systems.
- 4.1.10 All terminations shall be readily accessible.
- 4.1.11 Where more than two cables run together they shall be installed on or in containment. I.e. Cable Tray, Cable Basket, or Trunking.
- 4.1.12 University preferred cabling systems are as detailed in the table below:

TYPE OF INSTALLATION	PREFERRED CABLING METHOD
Mains / Sub Mains Distribution	LSF/SWA/XLPE cables
Power / Lighting systems	Singles in conduit / trunking
Fire Alarms	Fire resisting – MICC / soft skinned
Emergency Lighting	Fire resisting – MICC / soft skinned

### 4.2 Non Armoured Cables

- 4.2.1 Cable shall be stranded copper conductors with LSF or LSOH insulation (Type 6491B) and shall be rated at 600/1000 Volts.
- 4.2.2 Cables shall be installed without joints, with all intermediate connections on the circuit to be made within the manufactured terminals, at luminaires, switches or other outlets etc.

- 4.2.3 Cables shall be laid into the trunking after the removal of all lids, and shall be held in place in the trunking by the trunking manufacturer's retaining clips, fitted at intervals as recommended by the manufacturer.
- 4.2.4 Where trunking passes through walls with short sections of permanently fixed lid the Contractor shall ensure that the cable is installed in a neat manner and free from damage to both new and existing cable.
- 4.2.5 Conductors shall be the correct colour for their purpose, in accordance with the harmonised standards i.e.
- Single Phase Supplies:
- |         |                  |
|---------|------------------|
| Live    | - Brown          |
| Neutral | - Blue           |
| Earth   | - Green / Yellow |
- Three Phase Supplies:
- |         |               |
|---------|---------------|
| L1      | - Brown       |
| L2      | - Black       |
| L3      | - Grey        |
| Neutral | - Blue        |
| Earth   | -Green/Yellow |
- 4.2.6 Where applicable all earth wires shall be sleeved throughout their length where exposed.
- 4.2.7 Where the installation involves modifying any existing circuit, the cable colours shall be the same throughout the circuit.
- 4.2.8 Where a Distribution Board is supplying circuits with different coloured cables, it shall be fitted with a Warning Sign detailing the danger.

### **4.3 Fire Resisting Cables (MICC / Soft Skinned)**

- 4.3.1 Single run cable shall be clipped using a proprietary brand two hole clip. Where two cables run together they shall be clipped using a proprietary brand saddle. All clips and saddles shall be fixed using brass round head screws.
- 4.3.2 On installations where LSF covered cable is specified the appropriate LSF covered clips and saddles shall be used.
- 4.3.3 Where cable passes through walls, it shall be protected by a high impact heavy duty PVC sleeve. The sleeve shall be finished to give a neat appearance.
- 4.3.4 Where cable passes through floors it shall be protected by a metallic covering to a height of 600mm above finished floor level. The metallic covering shall be cross bonded accordingly.
- 4.3.5 Cable shall be fixed at 110mm from each bend and or termination point. The cable shall be further fixed at intervals not exceeding 300mm.
- 4.3.6 Cable shall be securely fixed to the fabric of the building or to cable tray. The cable shall be fixed to cable tray using tyraps, supplemented with steel ties every 1 Meter.
- 4.3.7 Threaded rod is not an approved method of containment.
- 4.3.8 Cable shall have sufficient length to enable direct termination to the equipment to be made.

4.3.9 Cables shall be coloured in accordance with the following table:

Type of circuit	Sheath Colour
Fire Alarms	Red
Emergency Lighting	White
Mains	Orange

- 4.3.10 Where cables terminate into Conduit or adaptable boxes, all boxes shall be galvanised.
- 4.3.11 All cables shall be identified throughout the installation by use of either cable markers and/or coloured sleeving, as directed by the Project Design Engineer.
- 4.3.12 The University Electrical Engineer shall make the final decision on the type of cable to be installed.
- 4.3.13 Mineral insulated cables shall have copper conductors and sheath, and shall be of the correct duty and size to suit the application.  
Under normal circumstances for Fire Alarm and Emergency Lighting installations the MICC shall be light duty with a minimum size of 1.5 mm<sup>2</sup>.
- 4.3.14 All terminations shall be made with a universal brass compression gland, with the pot terminated at the same position.
- 4.3.15 Where MICC terminates into a switchbox or accessory box of any kind, the termination shall be completed using a screwed bush and coupling.
- 4.3.16 Screw-on pots complete with an earth tail shall be used throughout. Where the earth tail is of insufficient length it shall be extended to its point of connection via a 'thro-crimp' connection.
- 4.3.17 The cable shall be tested after the completion of each termination.  
In the event of test result being less than 200 M-ohm the termination shall be resealed and retested.
- 4.3.18 On installations where LSF covered cable is specified the appropriate LSF shroud shall be fitted at each termination.
- 4.3.19 All soft skinned cables shall have copper conductors and shall be Prysmian FP200 Gold or Draka Enhanced Firetuf Plus.
- 4.3.20 The soft skinned cable shall be installed in strict accordance with the manufacturer's instructions.
- 4.3.21 All terminations of soft skinned cable shall be made with a proprietary brand-stuffing gland.

#### **4.4 Armoured Cables**

- 4.4.1 All armoured cables shall have copper conductors.  
All armoured cables are to have XLPE insulation with an LSF oversheath.
- 4.4.2 All armoured cables shall be terminated with a shroud, brass compression gland, and earthing ring which is suitable for its application. The earthing ring shall be bonded by being directly bolted to the enclosure. From this bolted connection an appropriately sized earth

cable shall terminate for bonding purposes. All component parts of the bolted connection shall be of brass manufacture.

- 4.4.3 Where it is necessary to comply with the requirements of the IEE Regulations to install a separate CPC it shall be incorporated within the cable if at all possible.
- 4.4.4 All Armoured cables used in a distribution system shall be fitted with a Cable Tag reference number, using slide type identification numbers at each end of the cable. The Reference numbers shall be agreed by the Project Design Engineer, and a full schedule to be issued at both the beginning and completion of the project.
- 4.4.5 All glands and spreader boxes shall be installed in a manner, which ensures both mechanical and electrical continuity.
- 4.4.6 Cable shall be installed with no joints unless detailed as a specific requirement of the Particular Specification. Where joints are specified they shall be a proprietary brand cable joint.
- 4.4.7 Where cables are buried they shall meet the following criteria:
- (a) Soft Dig – Cable shall be installed to a minimum depth of 600mm.  
Cable shall be laid and covered in soft sand.  
Cable tiles / Polypropylene board installed at a depth of 400mm.  
Warning tape shall be installed at a depth of 150mm.  
Marker Posts shall be installed at strategic locations at intervals not exceeding 50M and all changes of direction.
  - (b) Pathways / Roads - Cable shall be installed to a minimum depth of 600mm.  
Cable shall be installed in a duct.(Minimum size 100mm)  
Warning tape shall be installed at a depth of 150mm.  
Marker Posts shall be installed at strategic locations at intervals not exceeding 50M and all changes of direction.

In both instances the excavation / proprietary work shall be offered to the Project Design Engineer for inspection before cables are installed.

The contractor shall submit dimensioned records to the University Electrical Engineer for updating of the Master Underground Services drawings.

- 4.4.8 Where cable enters a building it shall be installed within a suitably sized duct. The duct shall be sealed with a proprietary brand 'bung' so as to prevent the ingress of gas, flame, moisture and vermin.
- 4.4.9 Where the cable is running alone it may be fixed to the fabric of the building using a proprietary brand cleat. The cleat shall be of the correct size and specification for the cable, and shall be installed in the same orientation throughout its length.
- 4.4.10 Where cable is to be installed on Ladder Rack or Cable tray it shall meet the following criteria:

Cable Size (Outside diameter)	Fixing Method
Up to 32mm	Nylon Cable Tie
Between 32mm and 55mm	Plastic Cleats
Greater than 55mm	Metallic cleats

#### **4.5 Flexible Cables**

- 4.5.1 All flexible cables shall have stranded copper conductors with insulation rated at 600/1000 Volt grade.
- 4.5.2 Where a flexible cable is used to make a connection to electrical equipment without a specific flexible cable entry, the termination shall be made using a proprietary brand-PVC stuffing gland.
- 4.5.3 All flexible cables shall be terminated in a manner which ensures no undue stress is placed on any conductor.
- 4.5.4 Where flexible cables are connecting to high temperature equipment, 90°C rated cable shall be used.
- 4.5.5 Length of flexible cables shall be kept to an absolute minimum and shall not exceed 300mm for fixed equipment.
- 4.5.6 Under no circumstances shall any flexible cable pass through walls.

#### **4.6 Extra Low Voltage Cables**

- 4.6.1 Extra low voltage cables shall include Telecommunication, Data, BMS and Security systems cabling.
- 4.6.2 Cables shall be installed utilising Conduit, Trunking, Basket Tray and/or Cable tray, installed to the requirements of Section 2.
- 4.6.3 The method of installation shall be detailed in the Particular Specification.
- 4.6.4 The cables shall be fixed to the cable tray at intervals not exceeding 225mm
- 4.6.5 Where data cables are being installed on Cable Tray and/or Basket Tray they shall be installed in accordance with the requirements of the latest version of the Manchester Computing Structured Cabling Standard Specification.

#### **4.7 Unarmoured Multicore cables**

- 4.7.1 Use of unarmoured multi-core cables is not a preferred wiring methodology and shall not be considered in academic buildings. If they are to be considered for use in a residential installation the wiring methodology shall be agreed with the University Electrical Engineer.
- 4.7.2 Where unarmoured multi-core cables are used they shall be installed in strict accordance with manufacturer's recommendations and the General Cabling requirements detailed in Section 4.1.

#### **4.8 Final Circuit Wiring**

- 4.8.1 All general purpose 13 amp power outlets shall be wired in a radial circuit with the circuit protective circuit wired in a ring format. . The University standard circuit arrangement is to use 4mm<sup>2</sup> cables, and afford protection by a 20A, 30mA RCBO.  
The number of outlets connected onto each radial circuit shall consider the application but under normal circumstances shall not exceed 8No Twin Outlets.
- 4.8.2 All circuits including lighting serving an area containing a fixed bath or a shower shall be protected by a 30mA rated RCD.



## **5.0 Distribution Equipment**

### **5.1 General**

- 5.1.1 All switchgear shall be installed in strict accordance with the manufacturer's instructions and recommendations.
- 5.1.2 When installed all switchgear shall be free from all imperfections, dust, and debris.
- 5.1.3 All Switchgear and Distribution Boards shall be installed so they are easily accessible.
- 5.1.4 Where electrical distribution equipment is to be installed it shall be fitted with a facility to fit a padlock to prevent unauthorised access.
- 5.1.5 Switchgear and distribution boards shall be of the same manufacturer's type throughout each individual project, and building where applicable.
- 5.1.6 All Switchgear and distribution boards shall, in addition to the above, be subject to final approval by the Project Engineer.
- 5.1.7 The fixing method for individual items of equipment shall be determined on site between the Contractor and the Project Engineer.
- 5.1.8 All newly installed distribution equipment shall have a minimum of 25% spare capacity.
- 5.1.9 All newly installed distribution equipment shall be practically complete before being made live. This includes all dead test records, all panels / doors in place, all screws / fixings in place, labels, blanks etc. fitted. The University reserves the right to check / witness any equipment before it is made live.
- 5.1.10 All electrical installations associated with plant and equipment shall emanate from a Switchboard, Section Board, or final Distribution Board, NOT from a Central Control Panel.
- 5.1.11 All control gear associated with plant and equipment shall be mounted adjacent to the equipment and plant it serves. This control equipment shall incorporate full electrical isolation for maintenance purposes. The BMS shall form a separate installation and be interfaced locally.
- 5.1.12 Local isolation (within 1 metre) shall be installed to all plant.

### **5.2 Main Switchgear**

- 5.2.1 Main Switchgear shall be floor standing cubicle type, minimum standard of Form 4, Type 7 preferably with rear access external cable boxes. The switchgear shall have Withdrawable ACB incomers complete with Overcurrent and Earth Fault protection.
- 5.2.2 Main switchgear shall be of the 'plug – in' type for outgoing MCCB's / Fused switches.
- 5.2.3 The switchgear is to be adapted to allow for Thermal Imaging of all connections, and shall include provision for Power Factor Correction, transient over-voltage protection, and incorporate anti-condensation heaters.
- 5.2.4 All Main Switchboards shall have a plastic protective shield fitted between any removable panels and exposed live parts. The shield is to act as a defence for removal of the panels and shall be in the form of a 'perforated plastic' to enable thermal imaging to be carried out.

- 5.2.5 Main Switch boards shall include for Metering of incoming circuits in the form of an Instrument meter.
- 5.2.6 All incoming and outgoing supplies shall also be metered in accordance with the University Metering Specification. All tariff meters associated with the Main switchgear shall be housed in a separate panel; the final details shall be agreed with the University Electrical Engineer, and Energy Engineer.
- 5.2.7 Where Main Switchgear is made up of more than one incoming supply and the switching arrangement protected by Castell Interlocks, a spare Castell key shall be issued to the University Electrical Engineer on all occasions.
- 5.2.8 Before the installation of any MCCB's the settings shall be agreed with the University Electrical Engineer in the form of a completed discrimination study.  
The contractor shall include an inventory of devices and their settings at handover.
- 5.2.9 Sub distribution switchgear shall be a minimum standard of Form 3b, Type 2.
- 5.2.10 When Main Switchgear is being installed it is an absolute requirement of this specification that all connections are made using a Torque Wrench to ensure they are correctly tightened, in accordance with the manufacturer's recommendations. All connections to be marked and check marked.

### **5.3 Distribution Boards**

- 5.3.1 Distribution boards shall be fitted with integral isolators.
- 5.3.2 Distribution boards shall have fitted a locking mechanism which will facilitate a padlock and be fitted with dual earth bars.
- 5.3.3 All final circuit protective devices (MCB / RCBO) shall be fault rated to a minimum of 10kA.
- 5.3.4 Consultants and Contractors are to seek approval from the University Electrical Engineer before installing fuse-boards of any type for final distribution.  
Semi-Enclosed (BS 3036 –Rewirable) fuses shall not be used under any circumstances.
- 5.3.5 The Contractor shall ensure that all cables are clearly identified within each distribution board by means of Cable Markers.
- 5.3.6 The Contractor shall ensure that the identified phase, neutral and circuit protective conductor are connected in the same sequence within their respective protective device and terminal blocks.
- 5.3.7 Adjacent to each Distribution Board an MK Type K2977ALM single socket shall be installed.  
The socket shall be on a 20A radial circuit without RCD protection, and marked 'Test Socket'.
- 5.3.8 Where RCBO type devices are used for final distribution they shall be of the 'passive' type.  
(I.e. They do not trip with a loss of power, unless otherwise stated in the Particular Specification.)
- 5.3.9 Main supply cables supplying Panel Boards / Section Boards / Distribution Boards shall be installed bottom entry; final circuits in principal to be installed top entry so as not to impair or reduce the cabling capacities within the Boards.
- 5.3.10 Existing stock of switchgear and distribution boards are manufactured by ABB, Schneider, GEC, Eaton (MEM), E&I, Lostock, and Tyco (Dorman Smith)

## **5.4 Labelling**

- 5.4.1 A label, of acrylic engraving laminate (Traffolite) or flexible plastic shall be fixed using either bolts, or rivets to the outside of all switchgear and distribution equipment. The label shall have a minimum of 6mm black characters on white background and be fitted prior to the installation being used. The label shall contain the following information where applicable:

Outgoing (Supply End):

- Reference number of Supply point
- Where the supply goes to
- Location of what it supplies
- Switch Size / Fuse Size
- Cable Size / detail
- Cable Tag Reference

Incoming (Load End):

- Reference number of Distribution board / Switchgear
- Where the supply is fed from
- Location of where it is supplied from
- Cable Tag Reference

- 5.4.2 A circuit schedule shall be included within each distribution board. The schedule shall be typed and shall clearly indicate the following minimum information:-

- i) Specific circuit designation
- ii) Cable description.
- iii) Cable size.
- iv) Protective device rating and type.
- v) No. of points served by the circuit

- 5.4.3 A traffolite label shall be fitted identifying external equipment (isolators etc), this shall not compromise the IP Rating of any equipment and therefore may need to be fitted adjacent to the accessory.

- 5.4.4 Any amendment to a circuit schedule within a distribution will warrant compliance with Clause 5.4.2 above.

## **6.0 Final Equipment**

### **6.1 Accessories**

- 6.1.1 All accessories shall be installed in strict accordance with the manufacturer's instructions and recommendations.
- 6.1.2 When installed all accessories shall be free from all imperfections
- 6.1.3 The final layout of the installation (mounting of switches etc) shall take into account the aesthetics of the building and the installation as a whole.
- 6.1.4 Accessories shall comply with requirements of Equality Act in terms of colour contrasting. This may be achieved by using different colour accessories or by using colour fillets on dado trunking systems to ensure minimal LRV values are met.
- 6.1.5 Accessories shall be mounted only on the correct mounting boxes as recommended by the accessory manufacturer.
- 6.1.6 Socket outlets are to be double pole switched.
- 6.1.7 No accessory shall be used as a 'Through Box'.
- 6.1.8 At each accessory the contractor shall fit a thermally printed label, which details a riser number, distribution board and circuit reference number, if applicable.
- 6.1.9 Existing stock manufactured by MK.

### **6.2 Luminaires**

- 6.2.1 The contractor shall include for the supply and erection of all luminaires and lamps as detailed in the projects schedule of luminaires.
- 6.2.2 The Contractor shall consult the Project Engineer, together with the Building Officer/Project Surveyor, prior to installation of luminaires, to determine the method of fixing and termination to be employed, unless specified in the Particular Specification.
- 6.2.3 All luminaires shall be latest technology low energy with electronic control gear.
- 6.2.4 Lighting controls shall be installed on all projects / works.  
This shall include consideration for On/Off, Proximity, Night-time setback, and Daylight saving controls on each project. Further advice can be sought from the University Energy Engineer.
- 6.2.5 Approved methods of fixing luminaires are as follows:
  - By means of conduit boxes.(Not PVC)
  - By means of 'Caddy' clips.
  - Modular fittings laid into false ceiling
  - Fittings fixed to false ceiling tiles shall be supplemented by plywood pattress of the same dimensions as the ceiling tile.
  - Suspended by small link chrome chain / Piano Wire
  - Direct onto Trunking
  - Direct to ceiling / wallAs dictated by the ceiling / luminaire design.

- 6.2.6 Approved methods of connecting light fittings are as follows:-
- Terminated direct to luminaire.
  - Final connection via heat resistant flex and individual 'plug – in' ceiling rose Flex to any one luminaire shall not exceed 2M in length.
  - Final connection via heat resistant flex and 'plug – in' multi connection marshalling box incorporating lighting controls – Marshalling box to be mounted centrally to the area it serves and flex to any one luminaire shall not exceed 2M in length unsupported, or an absolute maximum length of 4M if installed and fixed on cable tray.
- 6.2.7 Under no circumstances shall any cable or flexible cable be allowed to pass or come into contact with the ballast and/or control gear of the luminaire.
- 6.2.8 Under no circumstances shall any luminaire be used as a 'Through' box.
- 6.2.9 Final connection to External luminaries shall be made using an IP56 Plug and Socket arrangement. The socket is to be fitted adjacent to the light fitting, unless otherwise specified in the Particular Specification.
- 6.2.10 Final connection to lighting columns shall be via a standard cut-out.
- 6.2.11 Existing stock of light fittings are manufactured by Crompton, Whitecroft, Thorn, Phillips, Haycel, Luxo, and Wirefield.
- 6.2.12 Existing stock of lighting controls are manufactured by Ex-Or Lighting controls.

## **7.0 Earthing**

### **7.1 General**

- 7.1.1 For all conduit and trunking systems (Metal and Plastic), a separate circuit protective conductor shall be installed to each point of termination. The cable shall have the same cross sectional area (CSA) as that of its associated circuit line conductors, unless detailed otherwise in the particular Specification.
- 7.1.2 The Contractor shall ensure that the whole area is bonded so as to create an equipotential zone.
- 7.1.3 All Main and Supplementary bonding conductors shall be LSF single cables coloured green / yellow.
- 7.1.4 All incoming piped services, Lightning Conductor, Structural steelwork, Lift structures etc with the exception of British Telecom Systems shall be connected to the Main Earthing Terminal by means of a main equipotential bonding conductor.  
This Main bonding conductor shall be installed in accordance with Chapter 54 of BS7671, and shall be fitted with a Cable Tag reference number, using slide type identification numbers, as agreed with the Project Design Engineer.
- 7.1.5 All extraneous metalwork (gas, water, steam, condensate, heating systems, ventilation systems, compressed air, ceiling grids and exposed metallic parts) shall be supplementary bonded to the electrical earth in accordance with Chapter 54 of BS7671.
- 7.1.6 At each point where the metalwork, pipes etc, are bonded to the electrical earth, a proprietary brand earth termination clamp complete with earth warning tag shall be fitted.
- 7.1.7 All power circuits shall be protected for earth leakage by means of an RCD, unless otherwise agreed with the University Electrical Engineer in writing.
- 7.1.8 All socket outlet circuits shall be wired in a form, which complies with the requirements of High Integrity Earthing, unless otherwise agreed with the University Electrical Engineer.
- 7.1.9 All metallic 'back boxes' shall be connected to earth via a cable connection.
- 7.1.10 Where any metallic containment is used in part lengths it shall always be bonded via a cable connection.

## **8.0 Emergency Systems**

### **8.1 Fire Alarm Systems**

- 8.1.1 Any work encroaching or involving Fire Alarm systems shall comply with the University Guidance Document EH&S 37 – The Management of Fire Alarm Systems. Copies of the document are available from the University Electrical Engineer.
- 8.1.2 In addition to complying with all statutory requirements the final design for a fire alarm system shall be approved by the University Fire Officer and the University ELV Supervisor prior to starting on site.
- 8.1.3 The cable type shall be as detailed in Section 4.3 – Fire Resisting Cables. The actual type shall be agreed with the University Electrical Engineer, and be specified in the Particular Specification.  
If the project is an extension of an existing system it shall be noted a mixture of cabling types is not permitted.
- 8.1.4 In instances where there is an existing fire alarm system, the Contractor shall ensure the existing fire installation shall remain fully operational until the new fire alarm system has been fully commissioned.
- 8.1.5 In the event that an existing installation needs to be disturbed in any way, in order to facilitate the new installation, the contractor shall inform and liaise with the University ELV Supervisor, who will advise and arrange the work accordingly.
- 8.1.6 The date of installation shall be clearly and permanently marked on the batteries.
- 8.1.7 The address information shall be fitted on the field equipment using a thermally printed label. The label detail shall be agreed with the Design Engineer.
- 8.1.8 Prior to programming all text information shall be approved by the University ELV Supervisor.
- 8.1.9 Prior to programming all general program information (cause and event etc.) shall be approved by the University ELV Supervisor
- 8.1.10 The fire alarm system shall be commissioned in strict accordance with all relevant British Standards and manufacturers' recommendations.
- 8.1.11 Fire Alarm points shall generally be mounted on conduit boxes. Where this arrangement is on a false ceiling the ceiling tile shall be supported by a plywood pattress of the same dimensions as the ceiling tile. The conduit box shall be fixed to the plywood pattress by means of banding.
- 8.1.12 Where the Fire Alarm system is to be interfaced to other systems (i.e. Aspirating systems, Plant Control systems, DDA Alert systems, Lifts etc) this shall be agreed with the University Electrical Engineer on an individual project basis.
- 8.1.13 Any project involving the replacement or a new fire alarm system consideration shall be given to the installation of a DDA Alert system in accordance with Equality Act.
- 8.1.14 Existing stock of fire alarms manufactured by Tyco (ADT), Cooper Menvier, and Chubb.  
Existing stock of DDA Alert system manufactured by Deaf Alerter.

## **8.2 Emergency Lighting**

- 8.2.1 In addition to complying with all statutory requirements the final design for an Emergency Lighting system shall be approved by the University Fire Officer and the University ELV Supervisor.
- 8.2.2 The Emergency Lighting shall be selected to be suitable for the application; normally this will be Central Battery or Static Inverter type systems, utilising 10-year life, Gas Recombination Cells supplying slave luminaires.
- 8.2.3 The date of installation shall be clearly and permanently marked on the batteries.
- 8.2.4 The Emergency lighting installation shall be in strict accordance with manufacturer's recommendations.
- 8.2.5 The cable type shall be as detailed in Section 4.3 – Fire Resisting Cables. The actual type shall be agreed with the University Electrical Engineer.
- 8.2.6 In instances where there is an existing emergency lighting system, the contractor shall ensure that all existing emergency lighting remains fully operational until the new system has been fully commissioned.
- 8.2.7 In the event that an existing installation needs to be disturbed in anyway, in order to facilitate the new installation, the contractor shall inform and liase with the University ELV Supervisor, who will advise and arrange the work accordingly.
- 8.2.8 When Self Contained type system is to be installed it shall meet the following criteria:
- Approval from the University Electrical Engineer
  - Self testing / addressable testing type
  - Recurrent costs identified
- 8.2.9 The Emergency Lighting system shall be commissioned in strict accordance with all relevant British Standards and manufacturers recommendations.
- 8.2.10 When complete O&M Manuals shall be handed over. As a minimum the O&M Manuals shall contain:-
- Copies of all relevant certification
  - Copies of any programming information
  - Recommended maintenance details
  - Manufacturers data
- 8.2.11 Existing stock manufactured by Emergency Power Systems, Cooper Menvier, and ADT (Emergilite).



## **9.0 Inspection and Testing**

### **9.1 Initial Requirements**

- 9.1.1 It is the Contractor's responsibility to ensure that the work is continuously checked throughout the whole of the installation period for quality and that all requirements of both this and the particular Specification are strictly adhered to.
- 9.1.2 Upon completion of the electrical installation, or any substantial section thereof, the installation shall be subjected to the Inspection and testing requirements as specified in BS7671, together with such other tests as may be specified in order to prove compliance with the design / specification. No sections of the installation shall be utilised until all testing and inspection procedures are complete and the test results accepted by the University or their appointed representative.  
Failure to provide the certification may result in postponement of practical completion.
- 9.1.3 The inspection element shall focus on the detailed lists as per a standard NICEIC Test Certificate. Particular attention shall also be given to ensure that all sections of both this and the particular Specification have been complied with.
- 9.1.4 All instruments required to carry out all testing procedures shall be provided by the contractor. Prior to any testing being carried out the contractor shall prove / demonstrate that all instruments are within calibration to the University or their nominated representative.
- 9.1.5 The minimum acceptable value of Insulation Resistance is 200 M.ohms on new installation work.
- 9.1.6 The contractor shall fill in NICEIC Test Certificates (or equivalent) in their entirety following the inspection and test in a neat and legible manner, and issue them to the Project Design Engineer when complete.
- 9.1.7 The contractor shall satisfy himself that all test results comply with the requirements of the IEE Regulations, this specification, and Manufacturers details as applicable
- 9.1.8 Throughout the testing process the University reserves the right for them or their appointed representative to witness the testing procedure on all or selected sections of the installation. If it becomes necessary for any remedial work to be completed during the testing or inspection procedure the whole of the installation shall be re-tested. The contractor shall produce a written report as to why the remedial work was necessary.

### **9.2 Final Commissioning**

- 9.2.1 Following the satisfactory conclusions of inspection and tests on completed sections of the works, the contractor shall commission each section of the electrical installation and leave it in full working order.
- 9.2.2 The term commissioning is deemed to include:-
- The energising of electrical distribution equipment , circuits and equipment which have been inspected, tested and found to be satisfactory and capable of being energised in complete safety
  - The setting of protective devices and systems where relevant
  - The energisation of all electrically powered plant and equipment, including that supplied and installed under other contracts

- The verification of performance of all such plant, systems and equipment by carrying out , where required, of further tests and making all necessary adjustments so as to obtain optimum performance.

9.2.3 No plant, equipment or installation shall be considered as complete until the prescribed commissioning procedures have been satisfactorily carried out and a reliability run has been completed without incident.

## **10.0 Other Requirements**

### **10.1 High Voltage – Typical components**

10.1.1 High Voltage switchgear shall generally be as follows:-

- SF6 (Typically Merlin Gerin Ringmaster range)
- Protection via a VIP electronic relay
- Earth Fault passage indication
- Be fitted with Shunt trip coils for remote tripping purposes
- Be fault rated at 250 MVA

10.1.2 Transformers shall be fluid filled - normally Midel.

10.1.3 HV cables shall be multi-core with copper conductors complying with IEC 502-1, with XLPE insulation, SWA and a red LSF over sheath. Cables shall be terminated with Heat Shrinkable termination kits.

### **10.2 Substation / Switchroom requirements**

10.2.1 Lighting shall be IP65 Fluorescent fittings, which are wall mounted and connected via a Plug in Ceiling Rose. All light fittings shall also be dual function normal / emergency lighting.

10.2.2 A minimum of 2 twin, 30mA Passive RCD protected sockets shall be installed within each Substation and Main Switchroom.

10.2.3 Substation / Switchrooms shall only be considered for handover when the following criteria are met:

- Clear of all builders debris
- Floors shall be painted
- Walls shall be painted
- Substation access doors are fitted with a ENW suited lock
- Switchroom access doors are fitted with University suited lock
- All relevant signs, labels, and safety notices are installed
- All High Voltage switchgear and Transformers to be fully labelled and clean
- All LV switchgear to be fully labelled and clean
- Rubber matting installed as required
- Heating of both shall be -Thermostatic controlled, Tubular oil filled radiators
- Distribution Schematic Drawings of size A) or A1 installed in a frame on the wall including Earthing arrangements and cable sizes.
- All protective devices set and commissioned.
- All pipe ducts sealed
- Test certification completed to the satisfaction of the University Electrical Engineer.

10.2.4 No new Substation shall be made live without the approval of The University Electrical Engineer.

10.2.5 Under no circumstances shall wet services be permitted to through or above HV / LV Switchrooms, Risers etc.

### **10.3 Stripping out of Redundant Installation**

10.3.1 All redundant installations shall be stripped out as far as practical. Where this exercise could lead to any future confusion labels shall be installed giving clear concise instructions.

- 10.3.2 Where the stripping out of redundant installation is specified, the work shall be carried out with the same care and attention as for a new installation, and the Contractor shall ensure that no damage to the building fabric or equipment ensues.
- 10.3.3 Under no circumstances shall the Contractor allow any of his own, or any other Contractor's or Sub-Contractors operatives to disconnect or cut a live cable, or cut conduit / trunking containing ANY cables.

#### **10.4 Handover**

- 10.4.1 Two copies of the manual shall be provided and shall contain complete operational and maintenance instructions for the various installations.
- 10.4.2 The manuals shall comply with The Building Research and Information Association (BSRIA) publication 'Operating and Maintenance Manuals for building services installations'. Unless otherwise stated the manuals shall be prepared to Class 'D'.
- 10.4.3 The manuals shall include:-
- Full set of 'As Fitted Record Drawings' in paper and Auto-Cad electronic format on a CD/ DVD.
  - Full description and commentary for each system
  - Schedule of all equipment including luminaires.
  - Maintenance schedules.
  - Recommended spares.
  - Commissioning test results including as a minimum
  - Cable Schedule
  - Breaker Setting schedule
  - Distribution Board Charts
  - Electrical certification
  - All relevant Fire alarm certification
  - Emergency lighting certification.
  - Lightning protection test results.
  - Specialist equipment certification.
  - Health & Safety File.
- 10.4.4 The manual shall be agreed in draft format and content with comments received prior to the final issue.
- 10.4.5 At handover all electrical keys shall be issued to the University of Manchester Electrical Engineer.

#### **10.5 Instructions to University Staff**

- 10.5.1 The Contractor shall include for instructing University staff in the operation and maintenance of the installations and where necessary specialist sub-contractors staff shall be made available to enable complete instructions to be given.

#### **10.6 Defects**

- 10.6.1 On completion of the works an inspection will be carried out by the University or their appointed representative, during this inspection a schedule of outstanding items or defects will be drawn up and subsequently issued to the contractor.  
All items included on this schedule shall be attended to by the contractor within fourteen days of the inspection.